Content and Language Integrated Learning (CLIL) in a Swiss context

The linguistic challenges and implications of teaching biology in English (CLIL) and German (non-CLIL) analyzed through the lens of translanguaging and technicality

Aline S. Bieri

NIHIN studies
New Ideas in Human Interaction

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1 Introduction

This first chapter introduces the rationale, the aim and scope of the current study[1] as well as the structure of the book itself. More specifically, Section 1.1 outlines the research niches relevant for the current study: CLIL in the Swiss context, comparative process-oriented studies and the theoretical concepts of translanguaging and technicality. In Section 1.2, the main objective and the three research foci including the corresponding research questions are introduced. Lastly, Section 1.3 gives an overview of the structure of this book.

1.1 Rationale

Due to globalization and internationalization, English has become the main global language (Crystal, 2010, 2018) and the primary lingua franca for international communication (Jenkins, 2009, 2012). This development has not taken place without generating implications for language education: the idea that traditional language lessons are not enough to efficiently learn foreign languages, and English in particular, gained increasing support and finally gave way to new innovative teaching models such as Content and Language Integrated Learning (CLIL). CLIL is a dual-focused educational approach whereby a content subject such as history or biology is taught in a second or foreign language with the aim of improving both the content knowledge as well as the language proficiency of that second or foreign language. Influenced by the positive experiences from French immersion programs in Canada (see e.g. Cummins, 1978), CLIL was introduced in Europe in 1994 (Coyle, Hood, & Marsh, 2010; Marsh, Maljers, & Hartiala, 2001). Since then, CLIL has become a firm component of the bilingual education landscape in Europe and elsewhere.

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[1] Present study and current study are used interchangeably to refer to the research conducted as part of the PhD thesis, which is the basis of this book.

The present study is a comparative process-oriented case study focusing on the use of multilingual and multimodal resources (translanguaging) and the use of technical terms (technicality) in CLIL (English) and non-CLIL (German) biology lessons, conducted at a Swiss upper-secondary school. The relevant research niches and thus the rationale for why such a study is needed are explained in the following paragraphs.

The first research niche concerns CLIL research in Switzerland. Switzerland offers a particularly interesting context for the study of CLIL due to its multilingual situation and its decentralized education system. Since there is no national curriculum, language education can vary considerably among regions. There are, for instance, no exhaustive CLIL programs in compulsory education. Those schools that employ CLIL in compulsory education do so mostly based on individual initiatives. The only form of CLIL implemented nationwide is the bilingual baccalaureate offered at some upper-secondary schools. In 2012, more than 70% of upper-secondary schools offered the bilingual baccalaureate (SKBF, 2014, p. 150), a number that has increased ever since (SKBF, 2018a, p. 147). Research on CLIL in the Swiss context is ongoing (see Gajo, Steffen, Vuksanović, & Freytag Lauer, 2020), but because Switzerland offers such a diverse context with regard to the languages, subject, grade or format of the respective CLIL programs, more research is needed on all fronts. For instance, only few studies actually deal with English as the medium of instruction, which is interesting considering the fact that the most common form of the bilingual baccalaureate is with Standard German as mainstream language (ML) and English as the target language (TL).[2] The present case study investigates such a CLIL program with the TL English and

[2] The term mainstream language (ML) is used here to refer to the default language of instruction in school whereas target language (TL) refers to the language of instruction in CLIL lessons. In many cases, the ML is the students' first language (L1), but not always. For instance, in the present context, the ML (Standard German) is different from the L1 (Swiss German) of most teachers and students.

ML Standard German, and thus adds to current CLIL research set in a Swiss context.

The second research niche concerns the lack of comparative process-oriented studies in CLIL and non-CLIL contexts. Much of the earlier research on CLIL has focused on trying to answer the question of what effect CLIL has on language proficiency. This was often done by means of macro-studies investigating the implementation of a CLIL program, or product-oriented studies[3] evaluating language performance in the TL. Many of these studies on linguistic outcomes are comparative in nature. This is due to the fact that the researcher intends to investigate the variable of CLIL and thus needs a control group as a reference, which usually consists of students in regular classes with no type of CLIL instruction. While many of these early studies confirmed the beneficial effect of CLIL instruction, recent comparative outcome studies such as those of Rumlich (2016, 2020) cast doubt on whether the improved language proficiency of CLIL students is due to CLIL instruction alone, citing elitism and selection processes as relevant impact factors.

A second wave of CLIL research focused more on interaction in the CLIL classroom (see Nikula, Dalton-Puffer, & Llinares, 2013 for an overview). These so-called process-oriented studies investigated the role language plays when content subjects are taught in an additional language (Llinares, Morton, & Whittaker, 2012) in order to shed light on potential challenges as well as effective teaching strategies particular to the CLIL classroom. Such classroom-based process-oriented CLIL studies were often also conducted in a comparative setting. However, most of the studies compared CLIL lessons with traditional foreign language (FL) classes, effectively comparing two different subjects

[3] Product-oriented CLIL studies (so-called outcome studies) focus on language proficiencies and learning outcomes, whereas process-oriented CLIL studies are interested in the processes that lead to these outcomes (see Dalton-Puffer, Nikula, & Smit, 2010a, p. 10; Dalton-Puffer & Smit, 2007a, p. 14)

with each other[4]. Consequently, one cannot conclusively say whether the observed differences between CLIL and FL classrooms are due to linguistic difficulties in the TL or simply stem from different pedagogical approaches to the teaching of the respective subject. Comparative process-oriented studies comparing CLIL and non-CLIL classrooms, on the other hand, can shed light on whether communicative difficulties arise from the particular content subject or whether they are specific to CLIL instruction in this subject. Therefore, such studies are immensely important to gain more insight into the role of language from a different comparative perspective. However, to this date comparative process-oriented classroom studies are scarce. By comparing language use in CLIL and non-CLIL biology lessons, the current study attempts to fill this gap.

A third research niche concerns a topic that has received much attention lately with regard to CLIL: translanguaging. In short, translanguaging describes a speaker's full use of multilingual and -modal resources to communicate effectively. Studies on translanguaging and CLIL have so far mainly focused on the (potential) use of the L1 or ML for the teaching of content in the TL. Some of these studies have looked at the teachers' attitudes to and self-reported use of the L1/ML (see e.g. Gierlinger, 2015) while others focus on CLIL classroom data (see e.g. Nikula & Moore, 2019). Nevertheless, in their investigation of translanguaging practices in the CLIL context, these studies all follow the paradigm of bilingualism by focusing on practices primarily concerned with the use of the L1/ML as a potential resource in CLIL lessons. Understanding translanguaging as the use of a speaker's entire repertoire of resources to transmit any kind of information, it follows that one should also investigate the use and purpose of translanguaging practices in CLIL not restricted to the L1/ML but incorporate all facets of the multilingual (and -modal)

[4] E.g. the subject of history taught in a TL (CLIL) compared to the subject of English (FL).

repertoires students and teachers bring with them. This is especially important in a context like Switzerland, where multiple languages are at play simultaneously. The current study therefore investigates translanguaging practices that go beyond the use of L1/ML in CLIL and non-CLIL lessons, showcasing and comparing potential functions of such translanguaging practices that have not yet been examined before.

The last research niche the present study wants to tackle concerns science and technicality, in particular the challenges encountered in the CLIL science classroom. Science subjects are often marked by a high density of technical terms, which is one of the reasons some teachers can be reluctant to teach it in a CLIL program (Langer & Neumann, 2012, p. 93). Nevertheless, research on the role of these technical terms and how they exactly affect communication in the CLIL classroom has not yet progressed much. Technicality, according to Wignell, Martin and Eggins (1993), encompasses everything that makes language in science technical, or specific to a particular scientific field. This involves the very creation or etymology of technical terms but also the function and use of technical language in science discourse in general. In other words, technical terms in science are not just specific vocabulary but encode a different understanding of the world compared to common-sense views. This becomes particularly relevant in CLIL lessons where technicality is not necessarily encoded the same way in the L1/ML and the TL. For example, some languages have borrowed a large number of terms, whereas other languages allow for more internal word-formation processes, and others again have a higher density of vernacular terms becoming technicalized. Hence, there are different ways in which technicality is constructed or encoded in a particular language. The current study looks at the use of technical terms in CLIL (English) and non-CLIL (German) biology lessons and compares and illustrates how technicality affects both classrooms.

1.2 Aim and Scope

Based on the rationale presented in the previous section, this section outlines the overall objective and the scope of the investigation in the present study. The overall objective of this project is to gain a better understanding of the role(s) of language(s) in CLIL (English) and non-CLIL (German) biology classrooms. This is done, on the one hand, through the lens of translanguaging, and on the other, through the lens of technicality in an extensive case study. The data consists of the EG_BIO corpus (**E**nglish and **G**erman **Bio**logy lessons) which I collected myself at a Swiss upper-secondary school (*Gymnasium*) over a consecutive period of one month in 2015. The corpus consists of 31 video-recorded biology lessons taught by two teachers teaching in both English (CLIL) and in Standard German (non-CLIL). In the present study, the two theoretical lenses—translanguaging and technicality—are used to investigate the EG_BIO corpus in three particular research foci: Research Focus 1 focuses on translanguaging, Research Focus 2 on technicality, and Research Focus 3 on translanguaging in the negotiation of technicality. The following section provides a brief summary of these aspects and presents their corresponding research questions.

The first research focus of the current study looks at translanguaging. The objective is to get an overview of and compare translanguaging practices in CLIL (English) and non-CLIL (German) biology lessons, thereby incorporating all facets of the multilingual repertoires of students and teachers. This is especially relevant considering the data at hand, since there are multiple languages on various levels simultaneously at work: the individual linguistic repertoires of students and teachers (Swiss German or other L1s), the languages of instruction (Standard German or English), the source languages of the subject-specific terminology (Greek, Latin and others) as well as any other linguistic influences that might occur. Thus, the first two research questions the present study seek to answer are the following:

1. What translanguaging practices are present in the EG_BIO corpus?
2. How are these translanguaging practices distributed within the EG_BIO corpus?

This way, a fuller, more nuanced picture emerges of how translanguaging practices in CLIL and non-CLIL biology lessons are used and distributed.

The second research focus of the current study concerns technicality. Here the objective is to get a better understanding of the complicated relationship between technical terms used in English and those used in German in the subject of biology. In an earlier study (Bieri, 2015) on the above-mentioned corpus, it was found that the amount of technical terms and the fact that the technical terms in English did not always coincide with the technical terms in German, was often problematic in the CLIL lessons. Therefore, in order to get a quantitative overview of technical terms, the second research focus looks first at the nature and density of technical terms in CLIL and non-CLIL biology classroom as well as in the corresponding teaching materials:

3. What technical terms can be identified in the EG_BIO corpus and how are they distributed?
4. How does technical density and relative frequency of technical terms in teacher-led whole class interaction compare to a subsample of written text in the teaching materials?

The second part of Research Focus 2 deals with the introduction of new technical terms. In the science classroom, with its high frequency of technical terms, it is crucial that new technical terms are properly introduced. Therefore, the qualitative analysis of technicality seeks answers to the following to questions:

5. How are new technical terms introduced in written vs. spoken mode?
6. Are there any similarities and differences regarding the variables of lesson type (CLIL vs. non-CLIL and Teacher 1 [T1] vs. Teacher 2 [T2])?

Research Focus 2 on technicality thus offers a quantitative overview of how technical terms are distributed in CLIL and non-CLIL biology lessons as well as a qualitative analysis of how new technical terms are introduced in said corpus.

The third research focus then zooms in on the interconnectedness of translanguaging and technicality. Bieri (2018b) not only showed that non-CLIL biology lessons also contain translanguaging, but also demonstrated that teachers as well as students employ a variety of multilingual resources—translanguaging practices—to deal with technical terms. Particularly striking was the finding that translanguaging involving the source languages (etymological roots such as Latin or Greek) of the technical vocabulary seems to be a useful tool for the negotiation of meaning of technical terms. Subsequently, the third objective of this project is to better understand how translanguaging practices are used in the negotiation of technical terms by answering the following research question:

7. What is the role of translanguaging (including different linguistic, non-verbal semiotic and multimodal resources) in the negotiation of technical terms?

This way I am able to illustrate in detail the role of translanguaging practices in the negotiation of meaning of technical terms in CLIL and non-CLIL biology lessons. Overall, by answering research questions one to seven, the present study empirically documents the use of multilingual and multimodal resources (translanguaging) and the use of technical terms (technicality) in CLIL (English) and non-CLIL (German) biology lessons at a Swiss upper-secondary school to ultimately describe language use that is particular to either CLIL instruction in biology or the teaching of biology in general (independent of type of instruction).

1.3 Structure of the Book

The book is organized in four main parts: *Context, Theoretical Background, Research Design* and *Analysis,* followed by a conclusion. Part I (*Context,* Chapters 2 and 3) provides a literature review on Content and Language Integrated Learning (CLIL) and discusses the geographical and educational context of the current study. More specifically, Chapter 2 introduces CLIL, defining it as both a type of program as well as a methodological approach to the integration of content and language. Current literature on CLIL is reviewed and contextualized within the scope of the current study. Chapter 3 then focuses on the specific context of Switzerland, a multilingual country with a decentralized education system, both of which are crucial factors in the implementation of CLIL programs. CLIL research in the Swiss context is examined and compared with the broader CLIL literature discussed in Chapter 2.

Part II (*Theoretical Background*, Chapters 4 and 5) addresses the theoretical frameworks central to the project. Chapter 4, explores the concept of translanguaging, tracing its development from a pedagogical practice to a theory of language, and its application in the present study. The chapter also discusses two key debates: translanguaging's relationship with CLIL and its connection to code-switching. Chapter 5 focuses on the concept of technicality and its definition of a technical term. Semantic profiles—an analytical tool used in Research

Focus 3—are also introduced. The chapter concludes with a discussion of challenges particular to the CLIL science classroom.

Part III (*Research Design,* Chapters 6 and 7*)* outlines the data and the general methodology. Chapter 6 details the various processes of data collection, selection and preparation processes, alongside ethical considerations such as access and consent. The chapter provides an overview of the data used to compile the EG_BIO corpus, as well as follow-up data such as teacher interviews occasionally referred to in the analyses. Chapter 7 presents the mixed-methods design employed in this project, describing key variables such as lesson type (CLIL vs. non-CLIL; T1 vs. T2, grade 10 vs. grade 11), speaker and classroom register, which are essential for the quantitative analyses of translanguaging and technicality.

Part IV (*Analysis,* Chapters 8, 9 and 10) presents the findings of the study. More specifically, Chapter 8 focuses on the analysis of translanguaging practices in the EG_BIO corpus (Research Focus 1). The chapter introduces the specific research questions, outlines two pilot studies and revisits the concept of translanguaging from Chapter 4. The unit of analysis—the translanguaging instance—is defined, and the detailed codebook used to analyze these instances is presented. This is followed by a detailed examination of the use and distribution of translanguaging practices in the EG_BIO corpus across the variables of lesson type, speaker and classroom register. The chapter ends with a critical discussion of the findings.

Chapter 9 shifts focus to technicality (Research Focus 2), beginning with the research questions, which address both the quantitative overview of technical terms in the EG_BIO corpus and the qualitative analysis of how new technical terms are introduced. The concept of technicality is revisited to define the unit of analysis—the technical term— used in the identification and quantitative analysis of technical vocabulary. The various findings on the distribution of technical terms in the EG_BIO corpus in relation to lesson type, speaker and classroom registers are discussed, followed by a qualitative comparison of the introduction of technical terms in classroom discourse with written teaching materials. The chapter concludes with a summary, highlighting the added value of this combined approach to technicality.

Chapter 10 investigates the role of translanguaging in the negotiation of technicality (Research Focus 3). The research questions and respective methodology are introduced, with the methodology involving the application the semantic profiles from Chapter 5 to selected classroom episodes. For each of the selected episodes, a semantic profile is created, allowing for an analysis of the functions of translanguaging practices in the negotiations of technical terms. The chapter ends with a critical discussion of the findings, highlighting the role of translanguaging practices in the negotiation of the meaning of technical terms.

The conclusion (Chapter 11) summarizes the main findings of the present study and explores its pedagogical implications. Methodological challenges encountered during the diverse analyses are discussed, along with potential avenues for future research.

1.4 Summary of Chapter

This introductory chapter has introduced the study and the topic at hand, providing an overview of the rationales for the current study as well as outlining its scope and its specific research foci. It shows that the present study is in tune with the times, touching on various research niches when it comes to CLIL: by being conducted in the context of Switzerland, it can add to much needed Swiss CLIL research; by being comparative and process-oriented, it can help fill the need for such studies in CLIL research; by focusing on translanguaging beyond the use of L1/ML, it illustrates and compares potential functions of such translanguaging practices that have not yet been investigated before in CLIL and non-CLIL lessons; and lastly, by looking at technicality it contributes to much needed research on the role of these technical terms and how exactly they affect communication in the CLIL and non-CLIL classroom. Using translanguaging and technicality as theoretical lenses, the present study investigates three research foci. Research Focus 1 looks at translanguaging and aims to provide a quantitative overview of translanguaging practices found in CLIL and non-CLIL biology lessons. Research Focus 2 addresses technicality, and focuses on a quantitative overview of technical terms and a qualitative analysis of the introduction of new technical terms in-CLIL and non-CLIL lessons. Research Focus 3 directs attention to the role of translanguaging practices in the negotiation of technicality and analyzes the function of these in a few selected episodes. This way, a better understanding of the role(s) of language(s) in CLIL (English) and non-CLIL (German) biology lessons in Swiss upper-secondary schools can be gained.

Part I: CONTEXT

2 Content and Language Integrated Learning (CLIL)

This chapter provides an overview of Content and Integrated Learning (CLIL) and its relevant literature. As there are competing definitions of the term CLIL in the literature, Section 2.1 first reviews CLIL as a denominator for a specific type of bilingual program, which includes its associations to other related terms such as immersion, Content-Based Instruction (CBI) or English as a Medium of Instruction (EMI) (Section 2.1.1). This is followed by another definition of CLIL as a methodological approach to the teaching of language and content in integration (Section 2.1.2). The definition of CLIL employed in the current study is presented at the end of the section. Due to the breadth of ongoing CLIL research, a comprehensive review of all current topics falls outside the scope of this chapter. Instead, Section 2.2 revisits the history of CLIL research and focuses on the topics most relevant to the present study, specifically the integration of language and content, and CLIL subject literacy. Section 2.3 then positions the present study within current CLIL research. Additional topics pertinent to the present study are further explored in subsequent chapters, such as CLIL research specific to Switzerland (Chapter 3), CLIL and its connection to translanguaging (Chapter 4) and CLIL and technicality (Chapter 5).

2.1 Defining CLIL

Content and Language Integrated Learning (CLIL) is an educational approach, whereby content is taught in an additional or foreign language to efficiently improve both the content knowledge of that particular subject as well as the corresponding language proficiency of the TL. This means that students in a CLIL program will have some subjects taught in an additional language (predominantly English), while other subjects are still taught regularly in the L1 or ML of students. The term CLIL itself was established in the 1990s to refer to this particular form of bilingual education in the European context

(Coyle et al., 2010; Marsh, 2002; Marsh et al., 2001). Since then, CLIL has become a firm component—although in many different forms depending on context—of the bilingual education landscape in Europe. To list a few examples, the CLIL approach has become part of mainstream education in many places in Spain (Lasagabaster & Ruiz de Zarobe, 2010); in Italy, CLIL is compulsory in the final year of upper-secondary school since 2013 (Cinganotto, 2016; Grandinetti, Langellotti, & Ting, 2013); and in the Netherlands, CLIL has become a highly institutionalized matter (van Kampen, Admiraal, & Berry, 2018). CLIL is also firmly anchored in upper-secondary school education in Switzerland (Gajo, Lauer Freytag, Steffen, & Vuksanović, 2018; SKBF, 2014; 2018a, see Chapter 3 for further details). CLIL has further become an important part of education also in places outside Europe, for example in the US (see e.g. Tedick & Cammarata, 2012), Latin America (see e.g. Banegas, Poole, & Corrales, 2020), Asia (see e.g. Lin, 2016), Australia (see e.g. Turner, 2013) the Middle East (see e.g. K. Gallagher, 2011) or Africa (see e.g. Mathole, 2016).

While CLIL was indeed established as a particular type of program used for bilingual education in the European context, its rapid spread and diverse implementation have made it difficult to define what type of bilingual program exactly qualifies as CLIL. For instance, Tedick and Cammarata (2012) also use the terms CBI (Content-Based Instruction) and CBLT (Content-Based Language Teaching), suggesting an implied difference of these programs with CLIL. Similarly, Lin (2016) refers to bilingual programs in the Asian context as CLIL and LAC (Language Across the Curriculum). Another example of terminological conflation is the Swiss context, where apart from CLIL the terms immersion and bilingual teaching are predominantly used to discuss this type of education (EDK, 2021b; Gajo et al., 2018).

Meanwhile, another definition of CLIL not as a type of program, but as a methodological approach to the teaching and learning of content and language in integration (a so-called CLIL pedagogy), has gained ground in recent years. This is the definition of CLIL that is used in the present study. However, in order to understand CLIL as a methodological and pedagogical approach to the integration of content and language, one first needs an understanding of what CLIL as a type of program refers to. Therefore, in the following sections, the definition of CLIL as a type of program is reviewed, followed by an exploration of CLIL as an approach to integration.

2.1.1 CLIL as a Type of Program

CLIL was established in the 1990s to describe a specific European approach to bilingual education. Based on the findings in Baetens Beardsmore's edited book *European Models of Bilingual Education* (1993), a group of experts of the European Commission (EC) launched the term Content and Language Integrated Learning (CLIL) to "create a label for different European approaches to bilingual education" (Ruiz de Zarobe & Jiménez Catalán, 2009, p. xi). Powered by the European Union's push of "2+1", a policy according to which European citizens should gain proficiency in three community languages, the EC suggested, among other measures, that "[i]t could even be argued that secondary school pupils should study certain subjects in the first foreign language learned, as is the case in the European schools" (European Commission, 1995, p. 44). In the same year, the Council of the European Union (1995, p. 3) stated that one of the innovative teaching methods applied to enhance language learning is "the teaching of classes in a foreign language for disciplines other than languages, providing bilingual teaching".

As a result, CLIL became the label for a European innovative approach to language teaching where so-called non-linguistic subjects are taught in an additional or foreign language. Since its introduction in the 1990s, the implementation of CLIL programs has spread consistently and rapidly in Europe and beyond. Dalton-Puffer and Smit

(2007a, p. 8) list three main reasons responsible for the rapid spread of CLIL programs in the bilingual education landscape: naturalistic learning environment, meaningful communication, and efficiency.

First, CLIL is supposed to create a more naturalistic learning environment compared to traditional second or foreign language teaching. Often referred to as a "language bath" in which students, simply through more varied exposure to and input from the TL, can absorb more knowledge. This is connected to the second aspect, meaningful communication. By having the focus of the lesson not on learning the language itself, but on communicating meaningful content in subjects such as geography or history, using the TL acquires "a purpose over and beyond learning of the language itself" (Dalton-Puffer & Smit, 2007a, p. 8), which can, in turn, enhance student motivation (Bieri, 2015). The third argument is an economic one and concerns efficiency. By combining content and language teaching, two subjects can seemingly be taught and learned at the same time—a fiscally viable way for schools to foster foreign language learning as the curriculum can usually stay the same, and no additional lessons or teachers are needed. As will be discussed later, these three arguments for CLIL do not hold up to the same extent in light of current CLIL research. However, these arguments in favor of CLIL fueled the implementation of CLIL in and beyond Europe. As a result of such a rapid spread, CLIL implementation varied greatly in different contexts, to the point where it became difficult to define CLIL as one particular type of program.

As an example, in 2006, Eurydice, the European Education Information Network, described CLIL as follows:

> [CLIL is] the use of at least two languages to teach various subjects in the curriculum, one of which is the language used in mainstream education (generally the official state language), and the other a target language (which may be a foreign language, a regional or minority language, or another official state language), independently of language lessons in

> their own right (the aim of which is not content and language integrated learning. (Eurydice, 2006, p. 61)

Following Eurydice's definition, a CLIL program can be any school program where a TL other than the ML is used as a medium of instruction to teach not only language lessons but content subjects such as biology or history. Throughout its report, Eurydice (2006) refers to schools employing such a type of bilingual education as schools with a "CLIL type provision".

While Eurydice's definition leaves open what TL might be taught in a CLIL program (as long as it is not the ML), other popular definitions such as Coyle et al. (2010, p. 1) clearly state that it needs to be an additional language:

> Content and Language Integrated Learning (CLIL) is a dual-focused educational approach in which an **additional language** is used for the learning and teaching of both content and language. (Coyle et al., 2010, p. 1, emphasis in original)

This would imply the use of a foreign language as opposed to a second language, in the same vein as Dalton-Puffer et al. (2010a, p. 1) claim "CLIL is about a foreign language, not a second language". However, Coyle et al. (2010, p. 1) specify that an additional language can refer to a foreign language, but also to "a second language or some form of heritage or community language". I have previously discussed and criticized the varying definitions of CLIL regarding the TL (Bieri, 2015, p. 11). However, even today, regardless of context or definitions of the TL, CLIL programs remain popular

> not only because it is perceived as a new, additional and financially viable way of language learning, but also because the language that is learnt this way is English—the global, international language that is seen as a necessary precondition for socio-economic success (Smit, 2010b, p. 44).

This is why Dalton-Puffer et al. (2010b, pp. 286–288) have suggested that based on its implementation, CLIL would more accurately be called CEIL (Content and English Integrated Learning). The central role of English within CLIL is visible not only in its implementation, but also in CLIL research, since a majority of studies in the first but also the second wave focus on programs involving English as TL (see Section 2.2.1). Although this issue is not further discussed in this literature review, it is important to highlight the relevance of CLIL research focused on minority or heritage language learning due to its potential for language revitalization or maintenance, warranting greater attention in the field (Lyster, 2017, p. 29; see also Anderson, 2009, or Charalampidi, Hammond, Hadjipavlou, & Lophitis, 2017).

Connected to the discussion of which TLs can and should be learned in a CLIL program is the notion that CLIL as a program specifically reflects a European approach to bilingual education and can, therefore, be distinguished from other approaches to bilingual education developed elsewhere. For example, putting Dalton-Puffer et al.'s (2010a, p. 1) previous quote into more context, they explicitly note that "CLIL is about a foreign language, not a second language," highlighting this as a distinguishing feature of European CLIL. They mention other features of European CLIL, for instance that CLIL teachers are mostly non-native speakers of the TL and not language but content experts (Dalton-Puffer et al., 2010a, p. 1). While Dalton-Puffer et al. (2010a) compare the perceived joint features of European CLIL with any other forms of bilingual education, other scholars are more explicit in differentiating bilingual programs from each other.

In an influential paper published in 2010, Lasagabaster and Sierra compare commonalities and differences between immersion education and CLIL in Europe. They identify differences between these two approaches in terms of the nature of TL (second vs. foreign language), amount of exposure to TL (classroom and community vs. only classroom) teachers (native vs. non-native), starting age (early vs. late), teaching materials (authentic vs. adapted), language competence (native speaker proficiency vs. functional competence) and existing research (long-standing vs. new). In short, they claim that immersion education programs often employ a second language as TL, are taught by native speakers of that TL, start at an early age using authentic teaching materials to achieve native speaker-like proficiency, all of which is based on long-standing research. On the other hand, Lasagabaster and Sierra (2010) conclude that in CLIL programs, the learning of a foreign language is central, it is taught by non-native content experts at a relatively late age using adapted teaching materials with the primary aim of achieving functional competence, all based on a relatively recent research history (two decades at that time).

Similarly, Flores and Baetens Beardsmore (2015, p. 215) insist on distinguishing CLIL from immersion programs due to CLIL mostly being co-taught by a language and a content specialist (which is not a reality in most CLIL programs), and focused on content rather than on language. However, such comparisons, especially between CLIL and immersion education, are often misguided according to Cenoz, Genesee, and Gorter (2014). To view CLIL as a specific type of program that is inherently different to other bilingual approaches is an unnecessarily narrow definition and can, on the one hand, “preclude learning from the experiences of other educators and from the findings of educational researchers working in other contexts” (Cenoz et al., 2014, p. 244). On the other hand, a broader definition of CLIL as a program, namely its use as a synonym or even umbrella term for all kinds of approaches that combine content and language learning, can lead to a lack of “practical and theoretical utility” (Cenoz et al., 2014, p. 246). Nevertheless, Cenoz et al. suggest that CLIL should be viewed as an umbrella term for educational approaches that integrate authentic content learning with language learning, with immersion or CBI as a specific forms of CLIL (Cenoz et al., 2014, p. 255).

In response, Dalton-Puffer, Llinares, Lorenzo and Nikula (2014) argue that this perspective overlooks the historicity of CLIL. Although Cenoz et al. (2014, p. 244) acknowledge CLIL’s unique European origins, they claim this does not make it pedagogically unique, focusing solely on its implementation. Dalton-Puffer et al. (2014) disagree, emphasizing that CLIL was deliberately chosen in the 1990s as a neutral term, unassociated with earlier bilingual programs like immersion, allowing it to be adopted in regions traditionally opposed to bilingual education. Therefore, "CLIL is European in the sense that it has been energized by European language policy and ideology and has in turn energized implementations of these policies at local or regional levels" (Dalton-Puffer et al., 2014, p. 214). Yet Dalton-Puffer et al. (2014) acknowledge that nowadays there is some confusion surrounding CLIL regarding its definition, labelling and implementation. Nevertheless, due to its unique historicity, they list three prototypical features that adhere to all CLIL programs in Europe (Dalton-Puffer et al., 2014, p. 215):

- the TL is often a major or minor lingua franca of Europe (English, French, Spanish, German)
- CLIL lessons are not replacing traditional foreign language lessons, but are taught in addition
- CLIL lessons are scheduled as content lessons, thus most often CLIL teachers are in fact content experts

According to Dalton-Puffer et al. (2014), the historicity of CLIL has consequences with regard to the implementation of CLIL in Europe (and elsewhere) and even though there is considerable diversity in terms of implementation, these three prototypical features are most often adhered to. The third aspect, for instance, is also what distinguishes a CLIL program from a CBI program in their opinion, as Content-Based Instruction historically emerged from another context (North America) with a different pedagogical objective (integrating authentic content into regular foreign language lessons)[5]. Consequently, CBI lessons, unlike CLIL lessons, are scheduled as

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[5] For more information on the emergence and definition of the term CBI, see Brinton, Snow, and Wesche (1989) or Stoller and Fitzsimmons-Doolan (2017).

language lessons and taught by language experts (Bula Villalobos, 2014) and can therefore not be classified as a subcategory of CLIL according to Dalton-Puffer et al. (2014).

A number of other scholarly publications attempt to differentiate and define similar approaches to CLIL (see e.g. Nikula, 2017a, p. for an overview). It is important to emphasize that in examining CLIL as a program, aspects such as context, historicity and research traditions matter as much as its effective implementation. The former three (context, historicity of the label and research tradition) often explain why a bilingual education program is labelled as it is and influence its implementation and pedagogical focus. For instance, EMI (English as a Medium of Instruction) is a popular term in Asian contexts—it foregrounds that the TL is English, that it is content-focused (i.e. not much attention is paid to the role of language), and that it is often implemented at university level. Nevertheless, it is frequently still used as a synonym for CLIL and vice versa (see Dafouz & Smit, 2014; Smit & Dafouz, 2012). Similarly, LAC (Language Across the Curriculum) describes a curricular approach to emphasize language aspects in the general teaching of all subjects, and is thus not primarily concerned with FL teaching, but with the "language and literacy needs of students studying in different subject areas" (Lin, 2016, p. 6).

In sum, the examples above illustrate that while bilingual education programs may have different names, they often denote similar concepts and can still fall under the CLIL label, despite significant differences. As outlined before, defining CLIL either narrowly as a specific type of program or broadly as an umbrella term for various bilingual approaches has both advantages and disadvantage (see also Nikula, 2017a, p. 119). This ambiguity has led to another way of conceptualizing CLIL, viewing it not as a particular program but as an approach to methodologically integrate language and content teaching.

2.1.2 CLIL as a Methodological Approach to Integration

As previously shown, the naming of a bilingual program "depends as much on its cultural and political frame of reference as on the actual characteristics of the program" (Dalton-Puffer, 2011, p. 183). In line with this, Morton and Llinares state the following:

> It seems that it is the national or even local decision of stakeholders to call a programme CLIL, usually with the common denominator of a foreign language (mainly English) as the language of instruction. An alternative use of the term, which has been foregrounded recently, is any type of pedagogical approach that **integrates** the teaching and learning of content and second/foreign languages (...). (2017, p. 1, emphasis added)

Morton and Llinares (2017) note that whether a bilingual education program is labelled CLIL often depends on national or local contextual factors. They also introduce a further use of CLIL, namely as a methodological approach to how language and content are used in integration, or in other words, a CLIL pedagogy. Even though integration of content and language is in the name CLIL, second-wave CLIL research (see Section 2.2.2) has questioned the extent to which language and content are actually integrated in the classroom. Since CLIL teachers are typically content experts, CLIL lessons tend to be content-focused, often with little attention to the TL. Such an implementation hardly integrates language and content, but treats the two as separate entities. However, even when the teacher has little to no language awareness, language plays a pivotal role as medium of instruction in CLIL lessons (see Llinares et al., 2012). Thus, CLIL can be conceptualized as an approach where language and content work together in integration. Consequently, any bilingual program—regardless of its label—can adopt a "CLIL pedagogy". This broader interpretation of CLIL is also reflected in the most recent Eurydice report, which no longer describes CLIL as a specific "type of provision" (Eurydice, 2006) but as a "teaching method" and a "generic term to describe all types of provision" employing this teaching method (Eurydice, 2017, p. 14).

This definition of CLIL allows researchers to analyze a program from a CLIL perspective, independent of the terminology used by its stakeholders. While contextualizing the program's implementation is important, viewing CLIL from this perspective one can, for instance, investigate a CBI program with a CLIL approach. In this way, the particular (research) history of the term CBI, i.e. its implementation and why and how this specific program is referred to as CBI, can be considered, while at the same time the pedagogical practice of integrating content and language teaching, i.e. the CLIL pedagogy, can be examined. Consequently, understanding CLIL as a methodological approach to integration allows the researcher to investigate any bilingual education program from a CLIL perspective, irrespective of its label. It also means that such a CLIL pedagogy can be applied to programs and disciplines that have not traditionally been subject to CLIL teaching (see e.g. Devos, 2016 on CLIL and physical education). A definition of what exactly a CLIL pedagogy entails, is needed though. What constitutes successful integration of content and language in school curricula design, in the classroom, or in the participants' views? Since the integration of language and content is a prominent theme in current CLIL research, these questions are further discussed in Section 2.2.2. In the current study then, CLIL is defined as a type of bilingual education program that employs a CLIL pedagogy while teaching content through an additional language.

2.2 CLIL Research

The terminology, definition and implementation of CLIL vary greatly according to context, leading to diverse research approaches. Before discussing the current state of CLIL research, it is important to first consider its historical development. This section traces the history of

CLIL research, beginning with studies on French Canadian Immersion and exploring the first wave of CLIL research, which focused primarily on linguistic outcomes. This is followed by an exploration of the second wave of CLIL research, which shifted attention on classroom interaction. The section concludes with a discussion of the challenges related to comparative studies and current research focusing on the integration of language and content, as well as CLIL subject literacy.

2.2.1 A Brief History

French Canadian immersion is often accredited as a strong driver in the development of CLIL (Eurydice, 2006, p. 7). In the 1960s, Canada was not yet an official bilingual country. Due to its colonial past, English was the dominant language in most of Canada with the exception of Québec (Patrick, 2017, p. 402). In a grassroots movement initiated by Anglophone parents, who worried that the regular French lessons were not sufficient for their children to achieve the French language proficiency needed to prosper in Québec, the first so-called immersion program was initiated in 1965 (the so-called St. Lambert experiment, see Lambert & Tucker, 1972). In this program, English-speaking children were taught parts of their curriculum in French from kindergarten onwards, with the aim of achieving native-speaker competence in both languages when leaving school (Johnson & Swain, 1997, p. 2). What initially began as a grassroots movement initiated by concerned parents soon gained support from educational authorities and was eventually implemented, though in various forms, across curricula throughout Canada (Johnson & Swain, 1997, pp. 7–12). This was primarily due to studies showing promising results in student learning outcomes and language development, particularly in TL proficiency (see e.g. Bild & Swain, 1989; Swain, 1978; Swain & Lapkin, 1989) and cognitive growth (see e.g. Cummins, 1978). The Canadian immersion programs were in fact so successful that other countries began to reconsider their traditional approach to foreign language learning (Dalton-Puffer & Smit, 2007a, p. 7), leading to a global increase in bilingual education programs and the introduction of the term CLIL in the European context in 1994.

In the first decade of early CLIL research, ranging roughly from the mid-90s to the mid-2000s (hereby referred to as first wave of CLIL research), studies were either concerned with reporting on the implementation of such programs (e.g. Eurydice, 2006; Marsh, 2002; Marsh & Langé, 1999; Marsh et al., 2001; Wode, Burmeister, Daniel, Kickler, & Knust, 1996) or with evaluating and assessing TL proficiency in order to justify the implementation of such educational programs (e.g. Admiraal, Westhoff, & de Bot, 2006; Bürgi, 2007; Lasagabaster, 2008; Zydatiß, 2010). Macro-studies[6] like these provided important information for educational authorities with respect to learning outcomes and thus, justification for these CLIL approaches, at least on a macro level. Furthermore, learning outcomes as reflected in student performances are usually easier to assess than the language learning processes behind it, therefore studies tended to focus heavily on outcomes (Smit, 2010b, p. 41). Numerous more recent studies still maintain a focus on learning outcomes based on students' linguistic performances (e.g. Köller, Leucht, & Pand, 2012; Lasagabaster & Ruiz de Zarobe, 2010; Lorenzo, Casal, & Moore, 2010; Verspoor, de Bot, & Xu, 2015). Overall, CLIL research reported overwhelmingly positive results when it came to TL proficiency development of CLIL students compared to their peers (see e.g. Nikula & Mård-Miettinen, 2014; or Ruiz de Zarobe, 2011 for a synthesis of CLIL research on language learning). This fact, coupled with the previously mentioned three advantages of CLIL programs over traditional language learning (naturalistic learning environment, meaningful communication, and

[6] The macro/micro dimension refers to the researcher's perspective as a so-called outsider or insider. A macro study focuses on the outsider perspective, that is, on the implementation of CLIL programs, its organization, curricula, staffing, teaching materials, or teaching didactics. A micro study focuses on the participants and the setting, that is on teachers and students in the classroom (see Dalton-Puffer & Smit, 2007a, pp. 12–13).

efficiency in implementation) led to "a celebratory tone perceived in some CLIL related publications" (Morton & Llinares, 2017, p. 2), framing CLIL as "the ultimate opportunity to practice and improve a foreign language" (Pérez-Vidal, 2013, p. 59).

Critics (e.g. Bruton, 2011, 2013) were quick to point out the shortcomings of such comparative product-oriented studies because they suggested a causal relationship between the positive results of CLIL students and CLIL instruction. However, the positive effects on TL learning could equally stem from the many contextual variables one cannot control for when doing classroom-based CLIL research (cf. Piesche, Jonkmann, Fiege, & Keßler, 2016): learner motivation, class size, teacher, mode of teaching, topic, exposure to TL, or the culture-specific characteristics of the CLIL program in question, to name just a few. In fact, elitism and selectivity are a problem in many CLIL outcome studies focusing on linguistic performance (Möller, 2017, pp. 359–362). Rumlich (2016), for instance, was able to demonstrate that students enrolled in a German CLIL program already had a significantly higher language proficiency prior to entering the program. This means that CLIL students are, in many contexts, a positively selected group, either through active positive selection (in that there are certain entry criteria students need to fulfil in order to be able to attend a CLIL program) or, as is the case with the upper-secondary school investigated in the current study, passive positive selection (no official entry requirements, but CLIL is framed as a challenge and thus targeted at motivated students). Therefore, CLIL students are often the better and more motivated students compared to their peers in the control group (Möller, 2017, pp. 359–360). While this circumstance is being acknowledged in current CLIL research, it is often still not sufficiently addressed and its operationalization remains a challenge for comparative product-oriented CLIL studies (cf. Möller, 2017; Rumlich, 2017). Comparative outcome studies on CLIL thus show a predominately positive effect regarding TL learning, but due to the selectivity of many programs the "claims made in relation to the success of CLIL require a more profound examination that takes into consideration wider processes" (Hidalgo McCabe, 2020, p. 287).

In response to early CLIL research that focused primarily on linguistic outcomes, researchers began investigating whether learning a subject in an additional language would interfere with the acquisition of subject knowledge, leading to so-called content outcome studies (e.g. Badertscher & Bieri, 2009; Gajo, 2007; Haagen-Schützenhöfer, Mathelitsch, & Hopf, 2011; Jäppinen, 2005; Serra, 2007; Stohler & Kiss, 2009). Most of these studies suggest that there are no significant differences between CLIL and non-CLIL students, i.e. that the acquisition of subject matter is neither positively nor negatively affected by teaching it in a second language (Merino, 2016). One recent outcome study focusing on CLIL students' performances found that contrary to previous research, CLIL students underperformed in the acquisition of content knowledge compared to their non-CLIL peers (Fernández-Sanjurjo, Fernández-Costales, & Arias Blanco, 2019). However, Fernández-Sanjurjo et al. (2019, p. 670) do not primarily attribute these results to the CLIL approach itself, but rather to factors regarding the implementation of CLIL in Asturias and lacking CLIL teacher education and support. More research into how CLIL affects content acquisition is thus still necessary.

2.2.2 Current CLIL Research

Integration, as discussed in Section 2.1.2, is an integral part of defining CLIL as a methodological or pedagogical approach combining content and language teaching.

> [R]esearch is needed that goes beyond examining simply whether teaching content in an L2 or a foreign language promotes L2 competence to examining how teaching content in an L2 works and how it can be improved. Classroom-based research on how best to integrate language and content is necessary if we are

> to enhance teacher effectiveness in CLIL settings. (Cenoz et al., 2014, pp. 258–259)

Cenoz et al. (2014) highlight why, after the first wave of CLIL research focused predominantly on improved linguistic outcomes, the second wave of CLIL research shifted its focus to classroom interaction. A deeper understanding of communication in CLIL classrooms offers insights into what effective CLIL pedagogy looks like and supports much-needed efforts to enhance CLIL teacher education. Consequently, a shift away from product-oriented to more process-oriented CLIL research has taken place (Coyle, 2015; Dalton-Puffer, 2007; Dalton-Puffer, Nikula, & Smit, 2010c; Dalton-Puffer & Smit, 2007b; Evnitskaya & Morton, 2011; Llinares & Morton, 2012; Lo & Macaro, 2015; Morton, 2015; Papaja, 2011; Smit, 2010a; for a detailed overview on CLIL classroom research, see Nikula et al., 2013).

Aside from documenting the role language plays in CLIL lessons, some classroom-based process-oriented CLIL studies compared CLIL with FL lessons. Nikula (2007), for instance, found differences in how interactional sequences were handled in the two contexts, suggesting CLIL classrooms to be a learning environment that allows for more input from students, which could benefit language learning. However, comparing CLIL and FL contexts, one cannot conclusively say whether the observed differences are due to the different pedagogical approaches to the teaching of the respective subject (i.e. content vs. language lessons) or stem from communicative difficulties in the TL. Comparative process-oriented studies comparing CLIL and non-CLIL lessons, on the other hand, can shed light on whether communicative difficulties arise from the content subject in question or whether they are specific to CLIL instruction in that subject.

For example, Llinares and Whittaker (2010) compared language use in CLIL history lessons (English) with regular history lessons (Spanish) and found that CLIL students had a less developed repertoire to express historical causalities than their L1 peers, but appeared to have more opportunities to express themselves in the classroom. Such studies are crucial for understanding the successful integration of language and content in CLIL (and non-CLIL) contexts, ultimately informing an effective CLIL pedagogy across various content subjects. However, to this date comparative process-oriented classroom studies are scarce, which is why investigating best practice in CLIL is still an overarching theme in current research:

> Regardless of the name or specific characteristics of these programmes, immersion, CLIL, CBI, or English-medium instruction (EMI), they all share the aim of finding the best pedagogical practices to teach and learn content and language in integration. For this purpose, prior to effective implementation and practice, it is necessary to understand how language and content integration is enacted and its implications for curriculum development, pedagogy and assessment. (Llinares & McCabe, 2020, p. 4)

As shown in Llinares and McCabe's quote, current CLIL research should prioritize enhancing our understanding of how content and language work in integration and then draw conclusions for successful curriculum design, CLIL pedagogy and integrated assessment. For the remainder of this section, the emphasis is predominately on the integration of content and language in regards to the investigation and development of CLIL subject literacy (but see Nikula, Dafouz, Moore, & Smit, 2016, for an overview of integrated curriculum and pedagogy planning and Morton, 2020b, for an overview on integrated assessment of language and content). Other current research particularly relevant to the present study is dealt with in the respective chapters, e.g. CLIL research in Switzerland (Chapter 3), CLIL and translanguaging (Chapter 4) and CLIL science (Chapter 5).

Nikula, Dafouz et al. (2016) suggest three main areas where integration plays a crucial role in CLIL: curriculum and pedagogy planning, participant perspectives and classroom practices. With regard to curriculum and pedagogy planning, Nikula, Dalton-Puffer, Llinares and Lorenzo (2016, p. 8) state that at this level, "decisions have to be made regarding what will be integrated and how, preferably based on well-articulated ideas about the role of language in content learning". The second area refers to participants' perspectives and beliefs about how content and language are (or should be) integrated in CLIL. Lastly, the third area concerns classroom practices, i.e. how language and content are enacted in integration in the classroom. While it is important to study and conceptualize successful integration of language and content in each of these areas, all three are naturally interconnected and influence each other. On the one hand, classroom practices are always influenced by the participants' beliefs and attitudes, and are enacted in concordance with the curriculum design and pedagogical foci of the school. On the other hand, curriculum design is, among other aspects, affected by the participants' perspectives which are often shaped by their experiences in the classroom (Nikula, Dalton-Puffer et al., 2016, pp. 8–9).

Language and content integration in CLIL research has been primarily explored at the level of classroom practices, but also from a variety of perspectives such as Second Language Acquisition (SLA), Systemic Functional Linguistics (SFL), Discourse Analysis (DA) and sociolinguistics (see Llinares & Morton, 2017 for an overview). A current topic regarding the integration of language and content investigated in all three areas (curriculum and pedagogy planning, participant perspectives and classroom practices) concerns the investigation of subject literacy, or subject-specific language. Subject literacy concerns "the interplay between thought processes or thinking skills on the one hand and their inter-subjectively accessible expression (chiefly via language) on the other" (Evnitskaya & Dalton-Puffer, 2020, p. 1). It thus describes the linguistic and cognitive resources necessary to be literate in said subject, that is, the resources needed to be able to read, understand and communicate scientific ideas particular to that discipline. A unified conceptualization of subject literacy is, however, practically non-existent, i.e. what subject literacy means in CLIL depends heavily on the context, and different models analyze and describe different aspects of subject literacy.

For instance, much of early CLIL research on subject-specific language has focused on vocabulary only, which has primarily to do with the fact that CLIL teachers are usually content experts, and their language awareness is restricted to the most evident linguistic issue, which is subject-specific vocabulary (Dalton-Puffer, 2016, p. 30). However, subject literacy goes beyond the simple use of subject-specific vocabulary or technical terms, as it includes grammatical, pragmatic and cognitive resources necessary to appropriately understand and discuss subject-specific content. Consequently, this brings attention back to the intersection of language and content, and how exactly they work in integration, which is something recent studies on subject literacy in CLIL have begun to take into consideration.

One such approach to subject-specific academic language is Dalton-Puffer's (2013, 2016) model of Cognitive Discourse Functions (CDFs). CDFs are "verbal routines that have arisen in answer to recurring demands while dealing with curricular content, knowledge items and abstract thought" (Dalton-Puffer, 2016, p. 29). In other words, CDFs describe thought processes often encountered as a requirement for students in curriculum and pedagogy planning and are used in instructions in the classroom. There are seven types of CDFs: categorize, define, describe, evaluate, explain, explore and report (Evnitskaya & Dalton-Puffer, 2020, p. 2). The construct of CDFs can be used to investigate the use and function of such CDFs in different disciplines, and thus contribute to our understanding of subject literacy. For instance, with regard to history, Lorenzo and Dalton-Puffer (2016) identified three areas that are particularly relevant for historical literacy: knowledge of subject-specific vocabulary, the use of CDFs, and the genres particular to history. Regarding science specifically, Evnitskaya and Dalton-Puffer (2020) compared students' use of the CDF categorization (classifying, comparing and contrasting) in CLIL science and history lessons and found that comparing is the dominant way of categorizing in history, while classification is the one predominantly used in science lessons. Consequently, different disciplines understand and use CDFs differently, and when teachers are aware of how such CDFs are used in their subject, they can guide their students towards expressing their content knowledge in the TL in ways that are appropriate according to the curriculum requirements.

Other models explore various aspects of subject literacy, such as McCabe and Whittaker's (2017) investigation of grammatical metaphor and abstraction in CLIL and non-CLIL students' history essays, and Hüttner and Smit's (2018) analysis of subject-specific language use in CLIL economics and politics classes by means of argumentation theory. Ultimately, the goal is to apply different frameworks across contexts to identify effective and ineffective examples of subject literacy teaching, thereby informing pedagogical practice in CLIL (Dafouz, Hüttner, & Lo, 2021).

2.3 Positioning of Study

As mentioned in Section 2.1.2, CLIL is defined as a type of bilingual education program that employs a CLIL pedagogy while teaching subject content through a TL. The program that is investigated in the present study is locally referred to as *Immersionsunterricht* [immersion education] by stakeholders, and more specifically as *zweisprachige Maturität* [bilingual baccalaureate] (see Section 3.2.2), even though its implementation is, according to Lasagabaster and Sierra (2010), more in line with what they would categorize as CLIL. More importantly, even though the school in question does not have an official CLIL pedagogy in place (since CLIL teacher training in Switzerland is largely lacking, see Section 3.3), both teachers participating in the study are, to a certain extent, aware of the role language plays in their CLIL lessons and try to integrate language and content to the best of their knowledge on an individual level. Therefore, even though stakeholders call the program *Immersion*, I refer to it as a CLIL program because they employ a CLIL approach, albeit an unsystematic and individual one.

The present study investigates CLIL and non-CLIL biology lessons with a focus on the multilingual and -modal resources (translanguaging) used in the classroom and the technical terminology particular to teaching and learning biology (technicality). It is thus a comparative process-oriented case study. Process-oriented because it investigates what happens in the classroom with regard to translanguaging and technicality, and comparative because it compares these classroom practices in a CLIL and a non-CLIL setting. By focusing on translanguaging and technicality (and the intersection of the two), the study investigates integration of language and content mainly on the level of classroom practices. However, by drawing on teacher interviews and a CLIL student survey (see Chapter 6), the study also incorporates integration at the level of participant perspectives. Integration at the level of curriculum and pedagogy planning is not directly investigated. The upper-secondary school in question treats language and content largely as separate entities in regards to the bilingual baccalaureate, i.e. apart from one additional biology lesson in the first grade the CLIL lessons are simply scheduled as content lessons.

Looking at integration in form of subject literacy, the present study uses various approaches to investigate subject literacy in CLIL and non-CLIL biology lessons in regards to translanguaging and technicality. A mixed-methods approach including the model of semantic profiles from Legitimation Code Theory (LCT, see Section 5.1.2) is employed to examine how translanguaging practices are used in the negotiation of technicality, which is, in my view, one of the core features of CLIL (and non-CLIL) subject literacy in biology. The study hopes to illustrate specific characteristics regarding translanguaging practices and the use of technical terms in CLIL and non-CLIL biology lessons, ultimately contributing to a better understanding of CLIL subject literacy in biology, laying the foundation for a more informed systematic CLIL pedagogy in this discipline.

2.4 Summary of Chapter

The chapter has provided an overview of the term Content and Language Integrated Learning (CLIL), as well as a brief review on past and current CLIL literature. In the present study, CLIL is understood as a type of bilingual education program that employs a CLIL pedagogy while teaching subject content through an additional or foreign language. Whereas previous CLIL research has focused on demonstrating the beneficial effect of CLIL on students' language proficiency, more current CLIL research directs its attention to the integration of content and language, particularly but not limited to how integration is enacted in the classroom. A better understanding of how language and content work in integration can offer important insights into what an effective CLIL pedagogy might look like. Research on CLIL is ongoing and widespread. Research in regards to the integration of language and content and CLIL subject literacy are most relevant for the present study. By investigating CLIL and non-CLIL biology lessons through the lens of translanguaging and technicality, this study explores how integration plays out at the classroom level. This way I am able to contribute to a better understanding of CLIL subject literacy in the discipline of biology. The present study takes place in a Swiss context, where CLIL research is also ongoing but rare, which is the topic of the next chapter.

3 Switzerland: Context of the Study

The present case study takes place at an upper-secondary school in the Swiss-German speaking part of Switzerland. In order to understand the intricacies of the present study, an understanding of Switzerland's multilingualism and its decentralized education system is necessary. The chapter is organized into three sections: linguistic landscape, education, and CLIL research. Section 3.1 examines the linguistic landscape, focusing on Switzerland's multilingualism, the distinction between Swiss German and Standard German, and the role of English—key factors for understanding both the study's data (Chapter 6) and the translanguaging analysis (Chapter 8). Section 3.2 addresses the Swiss education system, highlighting the political significance of its federalist, decentralized structure and its impact on bi- and multilingual education programs, including the CLIL program analyzed in the current study. Finally, Section 3.3 reviews past and current CLIL research in Switzerland, situating it within both the present study and the broader European context discussed in the previous chapter.

3.1 The Linguistic Landscape of Switzerland

The linguistic landscape of multilingual Switzerland primarily consists of four geographically distributed language communities (see Figure 1 below): a German-speaking part (red) covering mainly the center and the North (but also part of the South in the case of Valais [VS]); a French-speaking part (blue) situated in the West; an Italian-speaking part (green) located primarily in the Southeast, and the Romansh-speaking areas (orange) spread in the East. Consequently, in accordance with these four language communities, German, French, Italian and Romansh constitute the four official national languages of Switzerland. This partition into four parts, however, does not provide a complete account. For instance, the German-speaking part, which represents the largest part of Switzerland with 63.5 percent (EDA, 2017), has a diglossic situation, where Swiss German[7] and Standard German are simultaneously used for different purposes of the everyday life. Moreover, due to migration and mobility, the number of people with a linguistic background other than the four national L1s is steadily increasing. Coupled with the continuous spread of English in the workplace (and elsewhere), the linguistic landscape in Switzerland is not simply quadrilingual but actually highly complex.

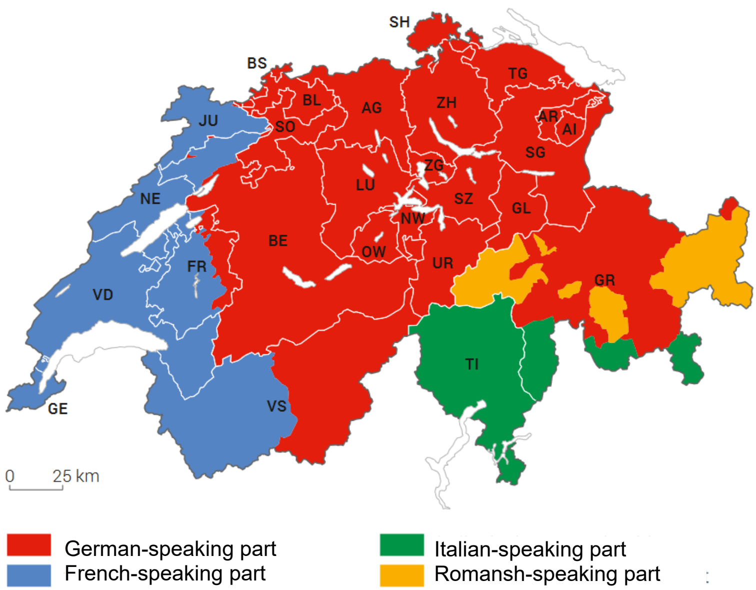

Figure 1: Geographical distribution of the languages of Switzerland (BFS, 2022, p. 7). Reproduced with permission.

[7] Swiss German (*Schweizerdeutsch*) is a collective term referring to all kinds of Alemannic dialects used in the German-speaking part of Switzerland. It differs considerably from Standard German (see Section 3.1.2).

3.1.1 Four National Languages

With four official national languages (German, French, Italian, and Romansh), Switzerland is officially a multilingual country. Due to its highly territorial distribution of language communities, and with it its alleged success in granting equal rights to all of them, it is not surprising that Switzerland has often been suggested as a role model for other states and countries with multiple language communities, such as for instance Puerto Rico (Schmid, 2001, p. 123). However, "the multilingual element, which is usually perceived as an essential characteristic of the country, is not an original phenomenon" (Rosenberger, 2009, p. 103). In fact, the loose confederation of states that was to become Switzerland used to be German-dominated for almost 500 years, from its founding in 1291 up to Napoleon's conquest in 1798.

During that time, German was the only official language, and bilingual member states such as Fribourg or military associates such as the Ticino had to submit themselves to this ruling. Only in 1848 did the newly agreed upon federal constitution officially acknowledge the Helvetic Republic as a multilingual state by declaring German, French and Italian as its official languages. In a time where nation-building was heavily relying on the idea of 'one language, one state, one people' (Wright, 2000, p. 1), Switzerland stood out as an official multilingual state (Rosenberger, 2009, p. 103). Therefore, Switzerland was and still is often referred to as *Willensnation* [nation by choice or will], emphasizing the cohesion of an imagined nation not through one common language, but through volitional force (Stotz, 2006, p. 249).

However, despite German, French and Italian being declared national languages in 1848, Romansh was only acknowledged as a national language in 1938, and as an official[8] one in 1996. This meant

[8] While 'national' refers to the acknowledged existence of a language in a country, 'official' refers to its function in the respective country. Watts specifies that in Switzerland, the term 'official' includes two main functions:

that until 1996, speakers of Romansh were not able to use their own language in matters involving the federal government, nor were any official documents translated into Romansh (Rosenberger, 2009, p. 102). This was changed in 1996 with the revision of the language article in the federal constitution, so that nowadays there are four official national languages in Switzerland (Dröschel, 2011, p. 116). In other words. although multilingualism is now often regarded as a long-standing and central characteristic of Switzerland, it is actually a relatively recent phenomenon. Further, due to its historical development, rather than multiple languages co-existing in one community, Switzerland has developed a multilingualism that is heavily based on the principle of territoriality: Each language community has its own territory, where its own language is the dominant one. Consequently, these language communities are (with some exceptions) largely monolingual areas. Thus, rather than co-existing with each other in the same space, Switzerland has predominately geographically separated language communities[9].

When a country is officially multilingual, it is often assumed that its citizens are multilingual too with regard to these official languages. However, this assumption conflates the official status of a country with

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"it must be able to be used in public debate, either in the federal or the cantonal parliament, or in the media, and it must be able to be used as a written medium" (1999, p. 70). Another important function of an official language lies at the administrative level: any official document needs to be available in the official language. If there are multiple official languages, the respective documents need to be available in each one of them (Rosenberger, 2009, p. 102).

[9] In the discussion, language communities refers specifically to the German, French and Italian language communities of Switzerland, as they are geographically marked. With 0.5 % of speakers, the Romansh language community is the smallest language community in Switzerland, distributed over several valleys in the Canton of Grisons. All of these areas are bi- or even trilingual areas, which is why the Romansh language community does not fit the principle of territoriality.

the individual multilingualism[10] of its people, which at least for Switzerland is misleading since “Switzerland may be multilingual, but by no means all Swiss are” (Rash, 2010, p. 157). Few Swiss people are proficient in all four national languages, largely because the language communities themselves are predominately monolingual. Rash underscores this point with examples from the French-German bilingual cities Fribourg/Freiburg and Biel/Bienne, where, despite the cities’ bilingual status, many residents are not fluent in both languages (Rash, 2010, p. 157). Bickel (2006, p. 325) similarly notes that “[i]n Switzerland, only a small minority of the population is genuinely multilingual,” and that additional national or foreign languages is typically learnt in school. Bickel’s use of the term “genuinely” (2006, p. 325) suggests a narrow definition of multilingualism, implying that it depends on how languages are acquired. He distinguishes between languages learned outside of formal education and those acquired through the school system, arguing that only the former constitutes true multilingualism. By this definition, few Swiss people are “genuinely” multilingual.

However, recent bilingualism research has moved away from this view, instead defining bi- or even multilingualism as the ability to communicate in more than one language, regardless of how or when the language was acquired (see e.g. Block, 2015; De Houwer & Ortega, 2018, pp. 2–4; Moore, 2018). it thus crucial to recognize that just because a country is officially bi- or multilingual does not mean its language communities are in regular contact with each other, or that its inhabitants are naturally or “genuinely” multilingual. Switzerland

[10] Technically, the term multilingual(ism) describes a country, place or institution that uses several languages, and plurilingual(ism) is used to refer to the individual who speaks several languages. However, in this book, multilingual and plurilingual are used as synonyms.

exemplifies this, with its language communities largely separated by linguistic and geographical boundaries[11].

This, in turn, does not mean that most Swiss people are monolingual. Many are bi- or multilingual, though primarily because they have learned other languages in school, rather than through regular interaction with other Swiss language communities. Additionally, about one fifth of the Swiss population has an L1 that is not one of the four official languages (BFS, 2017, p. 32), requiring them to learn the language of their local community to function as a valid member of society. Due to the geographical distribution of predominantly monolingual language communities though, "being bilingual in Switzerland can be characterized as a necessity for linguistic minorities, and as an additional asset for linguistic majorities" (Rosenberger, 2009, p. 112). Consequently, for German-speaking Swiss, learning another language may not be essential, whereas for Romansh speakers, who are spread across five valleys in the canton of Grisons, bilingualism is a necessity. As Rash (2010) notes, this is a case of enforced bilingualism, where "all speakers of RR [Rhaeto-Romansh] have to be competent in SG [Swiss German] and SSG [Swiss Standard German] if they are to join in with the Swiss life and wealth-making" (Rash, 2010, p. 158).

Switzerland's linguistic situation is further complicated by the existence of Swiss German (*Schweizerdeutsch*), which differs considerably from the Standard German used and taught in school. This creates a diglossic situation within the German-speaking community, with Swiss German also influencing other language communities. Since the present study takes place in the German-speaking part of Switzerland, most of the participants have Swiss German as an L1, and are taught biology in Standard German in the non-CLIL program.

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[11] Aside from Switzerland, Canada's French-English relationship is another well-documented example of an officially bilingual country with largely separated language communities (for an overview, see e.g. Leimgruber, 2019; or Patrick, 2017).

Understanding the differences between Swiss German and Standard German is therefore imperative for interpreting the translanguaging analysis in Chapter 8, which is thus the topic of the next section.

3.1.2 Swiss German or Standard German?

With 63.5%, the German-speaking part comprises the largest language community of Switzerland. This being said, it seems imprecise to use the term German-speaking part since "the 'mother tongue' of the majority of German speakers is one of over 30, mostly Alemannic dialects" (Watts, 1999, p. 71). Within the German-speaking part there are "two 'varieties' of German [that] dominate the speech scene" (Hogg, Joyce, & Abrams, 1984, p. 186): Swiss German and Standard German[12]. Swiss German is a collective term for an array of Alemannic language varieties (often also referred to as dialects) spoken in the German-speaking part, whereas Standard German denotes the official variety of German that is used in formal education and official affairs. Swiss German, in all its variety, is a fully fledged language, but is not codified to the same degree as Standard German, and has, therefore, no unified standard when it comes to grammar, pronunciation and vocabulary (Hogg et al., 1984, p. 186). Nonetheless, there are grammars and dictionaries for local Swiss German varieties (e.g. Marti, 1985 on

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[12] Other scholars (e.g. Bickel, 2006; Rash, 2003, 2010) have used the term "Swiss Standard German" to highlight that the Standard German used in Switzerland differs from the Standard German employed in Germany or Austria (Watts, 1999, p. 72). Due to pragmatic reasons and in order to not minimize the difference between Swiss German and the standard variety, the term Standard German is used throughout the book, hereby referring to the official and standardized variety of Standard German as used in Switzerland. For a more thorough discussion of terminology in this regard, see Schmidlin (2017) or Elmiger (2019).

Bernese grammar or the new Basel dictionary by Christian Merian Stiftung, 2020).

Children typically acquire Swiss German at home and learn Standard German in school, as it is the language of instruction in all public schools in the German-speaking part of Switzerland. However, many children are exposed to Standard German through media before starting school (e.g. TV-programs). Swiss German, then, is the variety primarily used at home or in informal contexts, which is why it is often referred to as a spoken variety. Swiss German is, nevertheless, also used in written contexts, as it has a fairly large tradition of dialect literature, poetry and letter writing (see Schweizerisches Idiotikon, 2021 for an overview). Further, with the increasing presence of new media, Swiss German is increasingly used for digital communication on these platforms (Dürscheid, 2011; Hunziker, Soltermann, & Schärer, 2015).

In contrast, Standard German, is the standardized variety used in formal and official settings as well as in education. Calling Swiss German and Standard German two different varieties implies that Swiss German differs considerably with regard to Standard German. In fact, the linguistic distance between the two seems great enough to make it difficult if not incomprehensible for some native speakers of Standard German from Germany[13] to understand Swiss German speakers (Stepkowska, 2012, p. 203; Watts, 1999, p. 71). Table 1 presents a brief and non-exhaustive illustration of some of the differences between Swiss German and Standard German.

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[13] Since some Alemannic dialects spoken in Southern Germany are closely related to the Swiss German varieties, German speakers from these regions have less to no problem understanding Swiss German (Elmiger, 2019, p. 15).

Table 1: An illustration of some of the differences between Swiss German and Standard German.

Swiss German	***Standard German***	***English***
Grammar		
Ich ha gässe	Ich aß/Ich habe gegessen	I ate/I have eaten
Vocabulary		
Ross	Pferd	horse
schaffe	arbeiten	to work
Phonology		
Liebi [lɪəbɪ]	Liebe [liːbə]	love
Chind [xind]	Kind [kind]	child

On the grammatical level, unlike Standard German (and English), Swiss German lacks a simple past tense and uses the present perfect to denote past events. On a lexical level, Swiss German includes many regional and dialectal words not present in Standard German such as *Ross* and *schaffe*. On a phonological level, there are some general differences such as the diphthongization of words that use a monophthong in Standard German (e.g. [lɪəbɪ] vs. [liːbə]) and the realization of /k/ as [x] instead of [k][14] illustrated in Table 1. Despite internal variation among Swiss German varieties they remain mutually intelligible, though they differ enough from Standard German to pose comprehension difficulties for non-Swiss German speakers.

The linguistic situation in the German-speaking part of Switzerland is often described as diglossic, characterized by the co-existence of Swiss German as the variety used primarily in informal settings, and Standard German in formal, official, and educational contexts. This distinction aligns with Ferguson's (1959, p. 329–330) definition of diglossia, where two language varieties coexist with distinct functions: Swiss German as the spoken, informal "L ('low') variety" and Standard German as the formal, written, superior and more

[14] This is though not true for all Swiss German dialects; people from the region of Basel for instance pronounce /k/ as [k].

prestigious "H ('high') variety". However, not all aspects of Ferguson's model apply fully to Switzerland. In Switzerland, "[s]peakers of Swiss German do not regard their dialect in any way inferior to or less prestigious than the Standard" (Rosenberger, 2009, p. 110). Swiss German is thus not a sociolect and used independently from social class or status. In fact, Swiss German remains the dominant language in everyday life and in many professional contexts (BFS, 2017, p. 33). Additionally, the notion that Swiss German is strictly reserved for spoken contexts (as e.g. suggested by the term *mediale Diglossie* [medial diglossia] introduced by Kolde [1981]) is challenged by its use in dialect literature and digital communication (Rosenberger, 2009, p. 110).

It must be emphasized that if German-speaking Switzerland does in fact comprise a diglossic situation, it is at least a heterogeneous diglossia, since there is no single fixed or codified standard variety for Swiss German, but a rich variety of mostly mutually intelligible Alemannic dialects (Hogg et al., 1984, p. 186; Stepkowska, 2012, p. 202; Theodoropoulou, 2015, p. 418). Although there have been several attempts to introduce such a codified national standard dialect, none of them were successful (Rash, 2003, pp. 112–113; Werlen, 1998, p. 23). Consequently, the concept of diglossia in Switzerland is often debated due to its complex and heterogeneous nature (Theodoropoulou, 2015, p. 422).

Although there seems to be little agreement to date on whether the relationship between Swiss German and Standard German should be classified as diglossia (two varieties of the same language with different functions) or bilingualism (two distinctive languages) or a combination of both, it is certainly interesting to see that at least most Swiss German speakers seem to think of Standard German as a different language, or as the first foreign language they acquire (Rash, 2003, p. 109; Watts, 1999, p. 74) and tend to pronounce this difference (Locher & Luginbühl, 2019, p. 270). Swiss German thus functions as a marker of identity, while Standard German is associated with education, formality, and bureaucracy (Rosenberger, 2009, pp. 110–111; Watts, 1999, p. 74).

The everyday use of Swiss German also presents challenges in intra-national communication. Swiss citizens from other linguistic regions learn Standard German in school, not Swiss German, whereas Swiss German speakers learn (standard) French or Italian "suitable as a means of communication in the respective areas" (Rosenberger, 2009, p. 111). In some cases, German-speaking Swiss prefer to speak English rather than Standard German with non-Swiss speakers (Dürmüller, 2002; Rash, 2010, p. 163; Watts, 1999, p. 75). This tension, compounded by the cultural divide between the French- and German-speaking regions (the *Röstigraben*[15]), raises questions about the potential role of English as a lingua franca (ELF) for intra-national communication.

3.1.3 The Status of English

According to the 2015 census (BFS, 2017), more than one fifth (21.5%) of the Swiss population reported a non-national language as one of their main languages (*Hauptsprache*), a significant increase from the 8.5% in 2000 (BFS, 2017, p. 32)[16]. Among these, English and Portuguese are the most commonly indicated non-national main languages (BFS, 2017, p. 32). While this increase partly reflects Switzerland's foreign population, English is also gaining prominence in other areas, such as media and business, or the increasing use of English loan words (see

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[15] Literally translated as [Rösti ditch], whereby Rösti refers to a typical Swiss German potato dish, the *Röstigraben* is a "metaphorical cultural trench on the franco-germanic language border which coincides with the River Sarine" (Dröschel, 2011, p. 114). It signals a geographical, linguistic, political and cultural rift between the two most dominant language communities in Switzerland.

[16] This increase has to be interpreted with caution since in 2000 people were only allowed to select one main language, whereas in 2015 they were allowed to indicate more than one main language.

Rash, 2009; or Strässler, 2018). Through globalization and internationalization, it seems that knowledge of and competence in English have become a “necessary precondition for socio-economic success” (Smit, 2010b, p. 44) and thus indispensable for the workplace. Its perceived necessity in professional life and usefulness for international communication have also had a huge impact on general education in Switzerland, “where learning English, and learning it fast, become[s] more and more important” (Bieri, 2015, p. 1, see Section 3.2).

Today, around 19% of the Swiss population uses English at work, though Swiss German, Standard German, and French remain the most commonly spoken languages (BFS, 2017, p. 33). It seems that English is rather increasingly used for international communication in specific professional contexts, such as multinational companies and international sectors like banking and tourism (Durham, 2016, p. 109; Rash, 2010, p. 164; Rosenberger, 2009, pp. 114, 119). This increase of English use for international communication does, however, not seem to come at the cost of other national languages, as confirmed by Lüdi, Höchle Meier and Yanaprasart’s (2016) research:

> English is increasingly important in the Swiss business world, but rather in addition to, than instead of other languages. As a general rule, English is one of the components of an integrated plurilingual repertoire; and in most cases, the practice of English as lingua franca corresponds to an exolingual / plurilingual mode that bears, more or less, traces of the users’ other languages. (Lüdi et al., 2016, p. 315)

The use of English has not only increased as a means of communication in certain lines of businesses, but more recently also as a lingua franca for intra-national communication between the various language communities. Rosenberger urgently called for more “research into the language choices in intra-national communication” (Rosenberger, 2009, p. 116) particularly in regards to the use of English, since it “has a lot of currency in Switzerland" (Rosenberger, 2009, p. 119). In the meantime, several monographs and articles have investigated the (increasing) role of English in Switzerland, in particular with regard to its intra-national communication[17] (cf. Dröschel, 2011; Durham, 2014, 2016; Pfenninger & Watts, 2019; Strässler, 2018).

Dröschel (2011, pp. 141–142), for instance, attributes the increased use of ELF, on the one hand, to the Swiss being more fluent in English compared to other national languages, thus facilitating intra-national communication. On the other hand, she states that using English as a lingua franca can provide a kind of neutral "value-free" means of communication for the sometimes tense relations among the different language communities. This is echoed by Durham (2014), who investigated the sociolinguistic competence of English Swiss speakers of different national languages (Swiss German, French and Italian). Durham also claims that the neutrality of English as a lingua franca is a driver in its use of intra-national communication, and so is language teaching and comprehension, i.e. Swiss German and French speakers consider themselves more competent in English than in the other respective national languages (Durham, 2014, pp. 41–44). Durham further lists the "economy of expression", i.e. assuming everybody understands English reasonably well so it is more efficient to communicate once in English than having to write an email in German and French for instance (2014, pp. 42–43). Lastly, Durham views the diglossic situation in the German-speaking part of Switzerland, and in particular the varying attitudes of the different language communities towards the consistent use of Swiss German as an additional driving force for the use of English (2014, p. 44).

[17] Particularly noteworthy in this regard is the SNSF project *Language Contact and Focussing: The Linguistics of English in Switzerland* (2001–2005), which sparked various important publications discussed in this section (Dröschel, 2011; Durham, 2014; Rosenberger, 2009).

While the increasing use of English, internationally as well as intra-nationally, is well-documented by now and often seen as an asset, it has also sparked concerns about its impact on national cohesion, particularly regarding multilingualism and language education in Switzerland (Pfenninger & Watts, 2019; Stotz, 2006).

3.2 Education in Switzerland

In order to understand the specifics of bi- and multilingual education in Switzerland, and with it the type of CLIL program investigated in the present study, it is important to outline the structure of the public[18] Swiss education system. Switzerland's decentralized education system is shaped by its political landscape, with each of its 26 cantons largely autonomous in areas such as taxes, education, health system, police and other domains (Rosenberger, 2009, p. 104). In a newspaper article in 2008, one author described the Swiss education system as follows:

> Nowhere in the world are secondary schools as differently structured as in Switzerland. Practically every school has its own curriculum and individual timetable and its specific assessment and selection. (Kunz, 2008, my translation)

Although the newspaper article dates back to 2008, and the author is clearly exaggerating the portrayal of the Swiss education system for emphasis (secondary schools do not all have their own curriculum), the autonomy of schools is indeed a key aspect of the education system in Switzerland even to date. Due to its political situation, Switzerland has a decentralized education system where education is mainly dealt with at the level of cantons. While federal policies set basic standards, such as the starting age (six years) and duration of compulsory education (11 years), cantons have significant control over curriculum and structure.

[18] About 95% of Swiss pupils attend a public school, only about 5% attend a private school (EDK, 2020).

The 11 years of compulsory education typically consist of two years of kindergarten, six years of primary school and three years of lower-secondary school. However, there are still cultural and institutional differences, e.g. in the French part of Switzerland primary education is not divided into kindergarten, primary and secondary school, but instead counted in four-year teaching cycles (cf. EDK, 2019, for more information). There are also some alternative forms of pre-school and early primary school in some cantons of the German-speaking part (Eurydice, 2020). Another important consequence of the decentralized Swiss education system is the fact that there is no national curriculum, which leads to a diversity of how and when certain subjects are or should be taught. Thus, although the federal constitution obliges the cantons to coordinate and harmonize their education systems with regard to structure and objectives, it is eventually the cantons that decide how and to what extent they intend to harmonize.

The federal institution EDK (*Schweizerische Konferenz der kantonalen Erziehungsdirektoren* [Swiss Conference of Cantonal Ministers of Education]) plays a key role in Swiss education since it supervises "[a]ll learning in Switzerland, including language learning" (Rash, 2010, p. 161) and coordinates educational policies across cantons (EDK, 2021a). Although the EDK provides guidance, its recommendations are of consultative nature and not legally binding (Rosenberger, 2009, p. 123). For instance, the HarmoS concordat (2007), aimed at harmonizing compulsory education[19], was adopted by

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[19] Before HarmoS, cantons had different school structures varying from four to six years of primary schools, and several different models of lower- and upper-secondary. One of the most extreme examples in this regard is Basel-Stadt and Basel-Land, two neighboring cantons in the northwest of Switzerland. Until HarmoS, children in Basel-Stadt went to primary school for four years, to orientation school for three years, and either received two years of continuing education or five years of upper-secondary education (EDUBS, 2013). Children in the neighboring canton of Basel-Land went to primary school for five years, spent four years at a lower-secondary school and received an optional three more years of upper-secondary education (Baselllandschaft,

only 15 of the 26 cantons, leading to a partial harmonization education. Consequently, the main goal of a nationwide harmonization of the education system failed, as seven cantons have neglected participation and four have not yet voted on it[20] (EDK, 2010; SKBF, 2018a, p. 35). Nevertheless, a narrow majority of cantons has a more unified and harmonized education system to date, so the initiative was certainly not without merit.

The decentralized manner of organizing education has important implications for language teaching: There is no federal law determining the language of instruction in schools nor the choice of what second languages should be taught, since this is again “a matter for regulation by the cantons” (Rash, 2003, p. 123). Since the language of instruction is usually dealt with according to the territoriality principle, i.e. the language that is most prevalent in the respective language community, the question with regard to what “languages Swiss pupils should learn, and especially in which order these languages should be introduced in the curriculum, is a politically charged issue” (Rosenberger, 2009, p. 125). The general debate revolves around the issue of whether another national language or English should be taught as first foreign language in schools. In 1998, the EDK developed a *Gesamtsprachenkonzept* [general language concept], recommending that nationwide Swiss pupils “should learn another national language as well as English (...) and that language learning should be started at primary school level” (Murray, 2003, p. 93). This *Gesamtsprachenkonzept* was further refined in 2004, where the “3 plus 5 plan” (also called 5/7 Model) was introduced with the aim of coordinating and harmonizing foreign language teaching nationwide: “[O]ne L2 should be introduced in year 3 and another in year 5” (Rash, 2010, p. 162).

2014). One of the main goals of HarmoS was thus the harmonization of the structure of the 11 years of compulsory education across cantons.

[20] Cantons have a certain timeframe in which they have to do the voting. Once this timeframe is exceeded, not voting essentially means not adopting the measure, in this case not joining the HarmoS concordat.

While the EDK mandates that one foreign language must be English and the other a national language, it leaves the order of instruction to the cantons (Rash, 2010, p. 162). As a result, cantons are divided on whether to prioritize English or a national language as the first foreign language, fueling the "English-first"-debate or *Sprachenstreit* [language strife] (Stotz, 2006). English as a school subject has only been systematically taught from the late1990s onwards (EDK, 1998, pp. 2–3) and is thus a fairly recent endeavor. As previously outlined (see Section 3.1.3), the importance and use of English in Switzerland has steadily increased, leading to a debate that is ideologically and politically charged with two opposing positions: Pro-English advocates argue that teaching a "second national language in primary school has been ineffective and unpopular," positioning English as a valuable skill "linked to opportunity and popular choice" (Stotz, 2006, p. 256). In contrast, pro-national language supporters see English as a threat to national cohesion, advocating for national languages to be prioritized to preserve multilingual unity (Rosenberger, 2009, p. 126).

Today, 24 out of 26 cantons have implemented the 5/7 Model (SKBF, 2018a, pp. 39–40). An interesting divide can be observed in the geographical distribution of the 5/7 Model implementation. Figure 2 shows that only cantons in Central and Northeastern Switzerland (German-speaking part) have adopted English as first foreign language, while all other language communities learn a national language as L2 before learning English.

Figure 2: Sequence of introduction of foreign languages (SKBF, 2018b, p. 39). Reproduced with permission.

A specific pattern can also be observed in the German-speaking part where "English is being chosen as the first L2 in the whole of the eastern side of GSS [German-speaking Switzerland], including Zürich" (Rash, 2010, p. 162), but not in those cantons adjacent to a language border or another bilingual canton. This diversity in implementing educational policies is the direct result of Switzerland's decentralized education system and multilingual context, resulting in equally diverse and complex approaches to bilingual education.

3.2.1 Bilingual Education in Switzerland

Systematic bilingual education as the "instruction in at least two languages" for communicative purposes (Elsner & Keßler, 2013, p. 1) is a fairly recent phenomenon in Switzerland[21]. Despite its multilingual nature, Swiss schools are still heavily focused on monolingual teaching

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[21] There are examples of bilingual teaching in individual schools and regions ranging further back, but systematic, i.e. regional or even national implementation of bilingual education programs only started after Watts and Andres (1990), and surged in the early 2000s.

when it comes to language teaching (Rosenberger 2009, p. 123). That is, the most common approach to language learning is still teaching it in fixed 45-minute lessons, “fitted in a weekly timetable together with the other subjects” (Rosenberger, 2009, p. 124). An obvious disadvantage of this system is, according the Rosenberger, “the limitation of time allotted to language learning, and consequently the limited exposure to the language(s) to be learnt” (2009, p. 124).

In 1990, Watts and Andres initiated an interdisciplinary research project attempting to develop a more suitable and successful model for language education in Switzerland. They found that the introduction of early French and early German at primary level is one way to make language teaching more efficient, but has limited range on its own and may therefore be best combined with some sort of immersive education (Watts & Andres, 1990). In their work, they discussed the potential of such an immersive approach, i.e. teaching content subjects *in* French and *in* German with stakeholders (school administration, politicians), participants (teacher, students, parents) and experts, and concluded that the interest is given from all parties, but concrete models of how to implement such approaches systematically in multilingual Switzerland still need more work (Watts & Andres, 1990). While Watts and Andres, in line with school administrations and other scholars working on CLIL in the Swiss context (see e.g. Bürgi, 2007; or Elmiger, Näf, Reynaud Oudot, & Steffen, 2010) use the term “immersion” to refer to educational approaches integrating language and content, I, as discussed in Chapter 2, use CLIL to refer to these initiatives. However, that does not mean that all of these CLIL programs also employ a CLIL pedagogy, as will be discussed later.

Rosenberger (2009, p. 125) claims that even though Watts and Andres’ research was conducted in 1990, and “is partially outdated by the increasing importance of English during the last two decades”, the essential conclusions regarding the value of a combined approach of early introduction of a language followed up by some form of CLIL provision are still valid today. More recent studies such as Pfenninger’s

(2014) longitudinal comparative study confirm Rosenberger's claim: pupils starting with CLIL education at an early age (primary school) and continuing with CLIL education at secondary level achieve the best results in regards to TL proficiency compared to their peers who attended CLIL programs only in primary or secondary school, or not at all.

One of the earliest attempts to systematically implement a CLIL program in primary school was the *Schulprojekt 21* [school project 21] (SP21), conducted in the canton of Zurich from 1998–2003. SP21 was a general attempt to evaluate and build a "basis for the upcoming reformation" (Rosenberger, 2009, p. 127) of primary school in the canton. It had three foci: individual learning, computer-based learning, and implementation of English (Büeler, Stebler, Stöckli, & Stotz, 2010, p. 1). In fact, this project was one of the earliest ones to employ a CLIL program as a potential model for learning English at the level of primary school. The evaluations regarding English CLIL at primary level were mixed. Generally, all participants involved shared a positive attitude towards CLIL, but especially teachers lamented the extra-effort they had to put into teaching (Büeler et al., 2010, p. 2). From a linguistic perspective, the results appeared inconclusive in that it seemed to work for simple tasks, but that "CLIL did not prove particularly successful" when it came to more complex tasks, "i.e., pupils neither acquired more complex structures, nor were they generally able to develop the ability to provide answers consisting of more than one or two words" (Rosenberger, 2009, p. 128). This project is a good example of why it is important to distinguish CLIL as a term for a program and CLIL as a pedagogical and methodological approach to the integration of language and content. In their evaluation, Büeler et al. (2010) talk about implementing CLIL as a program (teaching content subjects in English). The afore-mentioned problems regarding the insufficient scaffolding[22] of tasks and students' inability to pick up more complex TL structures indicate that even though the program was called CLIL, no CLIL pedagogy was actually implemented.

Apart from its inconclusive results regarding CLIL, one of the highly politically debated issues with regard to SP21 Zurich introduced the project independently, without consulting the other cantons, which sparked criticism for undermining efforts to harmonize educational policies (Stotz, 2006). Since then, CLIL programs in primary and secondary schools have remained limited to individual schools, communes, or cantons (for an overview, see Le Pape Racine, 2011).. While comprehensive CLIL programs are not common in compulsory education in Swiss public schools[23], they are well established in post-compulsory education, particularly in the *zweisprachige Maturität* [bilingual baccalaureate]. This CLIL program, implemented almost nationwide in upper-secondary education, is widely regarded as a success in bilingual education (Eberle & Brüggenbrock, 2013, p. 76).

3.2.2 The Bilingual Baccalaureate

After 11 years of compulsory education[24], students with good enough grades can attend a *Gymnasium* [upper-secondary school] for an additional three or four years, depending on the canton. Graduates receive the *Maturitätszeugnis* [baccalaureate certificate], which allows them study at university. The *zweisprachige Maturität* [bilingual

[22] Scaffolding refers to the step-by-step support from a teacher to help students perform a task they would not have managed to perform on their own. See Sections 5.1.1 and 5.2 for more information on scaffolding.

[23] Private schools such as the Swiss International School employ CLIL programs from kindergarten to upper-secondary school (SIS, 2021). However, as mentioned in footnote 18, only 5% of all pupils attend private schools.

[24] The 11 years of compulsory education include two years of kindergarten, which are often not counted when talking about actual school grades (i.e. there are nine compulsory school years, consequently post-compulsory school starts at grade 10).

baccalaureate] was first implemented in 1995. Since then, the demand and the number of these types of CLIL programs has steadily increased (Eberle & Brüggenbrock, 2013, p. 76), making it the most popular form of CLIL in Switzerland. Elmiger (2008, p. 5) attributes this, in part, to its cost-neutral implementation. The specific federal regulations for the recognition of the bilingual baccalaureate at the upper-secondary level are determined by the *Schweizerische Maturitätskommission* [Swiss Baccalaureate Commission] (SMK, 2012). Similar to the way the European Commission handles European CLIL programs, the federal requirements outlined by the SMK are relatively flexible, allowing cantons to tailor their programs. These regulations include the following four requirements (SMK, 2012):

1. *Target language (TL)*: The TL has to be a national language or English.
2. *Subjects:* At least three subjects must be taught in the TL. One of the subjects must be from the humanities.
3. *Exposure:* During the bilingual baccalaureate, students must be exposed to a minimum of 800h in the target language (excluding traditional language lessons but including other activities such as field work or trips to the respective language communities).
4. *Partial/full immersion:* This can be done by teaching content subjects in the TL at the home institution (partial immersion) or by a full exchange with a host institution (full immersion).

These vague guidelines lead to considerable variation in how such CLIL programs at the upper-secondary level are implemented: from the TL to the nature and order of subjects taught in English, from partial immersion with field activities to complete student exchanges with schools in adjacent language communities. The diversity and constant increase in number of these CLIL programs has the disadvantage

> that these projects are generally restricted to single schools and lack co-ordination, which is at least in part a consequence of the educational systems being organized by the individual cantons, and thus, effectively speaking, a consequence of Swiss regionalism. (Rosenberger, 2009, p. 125)

Hence, there are hardly any empirical numbers on how many upper-secondary schools offer what kind of CLIL program. According to the Swiss Education Report, about 70% of all upper-secondary schools had implemented some form of the bilingual baccalaureate in 2012 (SKBF, 2014, p. 150); a number which has increased since (SKBF, 2018a, p. 147) and is most likely still increasing to this day.

The most common form of the bilingual baccalaureate has Standard German as mainstream language (ML) and English as TL, which is especially prevalent in German-speaking Switzerland (Elmiger, 2008, p. 15; SKBF, 2014, p. 150; 2018a, p. 147). This is also true for the school the data for the current study is taken from[25]: This particular upper-secondary school, located in the northwest of the German-speaking part of Switzerland, offers the bilingual baccalaureate with Standard German as ML and English as TL. The students attending the CLIL program at this school speak (mostly) Swiss German, ands begin with mathematics and biology in English during their first year (grade 10, age 15/16), followed by geography and history in later semesters. Their four-year CLIL program concludes with a trip to an English-speaking country.

The bilingual baccalaureate as offered at this school is a highly elite form of bilingual education in that not all students have access to it. Students must have good grades in English to be allowed to attend

[25] See Chapter 6 for more detailed information on the data and participants.

the program. Other schools are less strict and only select students if there are not enough slots, and still others are stricter in their selection by requiring students to have a high grade point average not only in the TL, but also in other subjects (Elmiger, 2008, p. 45). Thus, this type of CLIL program is often elitist on two levels: Only students pursuing post-compulsory education have a chance to attend it, and of these, only the very good ones can actually attend it. While the bilingual baccalaureate might be a success story of bilingual education in Switzerland, its alleged success is reserved for an elite group of students. Compared to other European countries such as Spain, where bilingual education is an integral part of mainstream education (see e.g. Lasagabaster & Ruiz de Zarobe, 2010), Switzerland still lags in terms of CLIL accessibility and equity. While I have positioned this research within broader CLIL themes (Section 2.3), the next section situates the current study on this particular CLIL program, the bilingual baccalaureate, within existing Swiss CLIL research.

3.3 CLIL Research in Switzerland

Due to the decentralized nature of the Swiss education system, there are no nationwide CLIL programs in compulsory education. However, individual projects exist at the cantonal or communal level, with the bilingual baccalaureate being the only widely implemented form of CLIL, which is, as outlined before, diverse in itself. As a result, Swiss CLIL programs vary greatly, reflecting the broader diversity of the education system and warranting equally diverse research.

Research on Swiss CLIL seems to have peaked in the late 2000s/early 2010s, producing several notable studies. For instance, Elmiger (2008), in a macro study, takes stock of the implementation of the bilingual baccalaureate in Switzerland. He does so via a self-reported survey of 70 upper-secondary school administrations in regards to curricular design, target language, number of students, CLIL teacher requirements and other features. He concludes that the bilingual baccalaureate is very popular among stakeholders and participants, but also a demanding task involving extra work for students and teachers (Elmiger, 2008, p. 51). Interestingly, Elmiger identifies the lack of a CLIL pedagogy as a problem already in 2008:

> In the medium and long term, certain aspects of subject and language didactics should also be better integrated into the training and continuing education of immersion teachers where this has not yet been the case, or has only been the case in part. (Elmiger, 2008, p. 51, my translation)

In the meantime, CLIL teacher education and with it, the implementation of a CLIL pedagogy, has been a fairly neglected topic in the Swiss context, which seems somewhat surprising regarding the popularity of the bilingual baccalaureate. A current research project led by Gajo and his team investigates, among other things, what integration of language and content can look like from a teacher's perspective, namely a "plurilingual and integrated NLS [non-linguistic subject] approach" where the teacher consciously uses bi- or plurilingual resources to develop subject knowledge and thus acknowledges the integrated nature of language and content (Gajo et al., 2020, pp. 93–96). However, Gajo et al. (2020, p. 96) also state that "this perspective is still relatively rare and deserves special attention, especially in teacher training". Therefore, Elmiger's (2008, p. 51) assessment regarding the lack of CLIL teacher training with regard to a specific CLIL pedagogy is still valid today and urgently calls for more research on it.

Bürgi (2007) and Elmiger et al. (2010), in line with the first wave of general CLIL research, are classic product-oriented outcome studies reporting on CLIL students' linguistic performances compared to their non-CLIL peers. Bürgi (2007) investigated the development of language proficiency in CLIL programs in three *Langzeitgymnasien* [long-term secondary schools] in Lucerne, Winterthur and Zurich (all in the German-speaking part) over three years and showed that the students attending the CLIL program performed consistently and significantly better in the TL English in all areas than their peers in the control group. Equally, Elmiger et al. (2010) were able to demonstrate that the students of the German/French immersion classes in the canton of Jura and Neuchâtel performed better in all language proficiency tests compared to students of regular classes. However, as already commented on in Chapter 2, these promising learning outcomes do not allow for straightforward conclusions on its causes. In Bürgi (2007), English proficiency prior to entering the CLIL program was not assessed. Bürgi emphasizes that the students entering the CLIL programs were, in most cases, selected based on their good grades, and she attributes the particularly good results of CLIL students in Zurich partly to this cause (Bürgi, 2007, p. 147). While CLIL students outperformed the control groups at all three points in time and in every aspect of English proficiency, the data also shows consistent development of TL language proficiency in the control groups. It would, therefore, have been invaluable to establish the entry level of English proficiency of both prospective CLIL students and the control group to get an insight into the actual effect of CLIL instruction on TL proficiency (see Rumlich, 2013, 2016).

In the other case study, Elmiger et al. (2010) measured TL proficiency upon entry level, and found already statistically significant differences with regard to TL competency of CLIL students and the control group (2010, pp. 68–70). They conclude that even though in their case study CLIL students outperformed the non-CLIL students on all levels, the gap between them and the control group did not widen significantly over time, suggesting other factors at play (Elmiger et al., 2010, p. 83). In line with European CLIL research, Bürgi (2007) and Elmiger et al. (2010) thus demonstrate that CLIL students outperform the control group, though selectivity plays a significant role in these outcomes.

Other CLIL outcome studies conducted in the Swiss context focused on content knowledge, or more specifically, whether instruction in a TL somehow (negatively) affects the learning of content. For that purpose, Badertscher and Bieri (2009) as well as Stohler and Kiss (2009) reported on the same research project evaluating content learning in a French/German CLIL context. Through several interviews with CLIL and non-CLIL students at three different points in time, they were able to show that teaching and learning content through an L2 does not negatively affect the acquisition of content knowledge. This corresponds to what CLIL research focusing on content outcomes has found so far (cf. Merino, 2016).

Serra (2007) reports results from a longitudinal CLIL project at primary school level involving German-Italian and German-Romansh as instrumental languages. Apart from assessing oral and written language development from Grade 1–6, Serra also assessed content learning in the TL. She demonstrated that the CLIL program not only promoted TL language learning, but did also not interfere with content learning (Serra, 2007). Serra is also one of the few scholars to investigate Romansh as a TL in a CLIL program[26]. In another widely regarded process-oriented study using conversation analysis, Pekarek Doehler and Ziegler (2007) investigated the integration of content and language in the classroom, and showed how focus on form and focus on academic content are intrinsically interconnected and build on each other.

Several studies, including Gajo and Berthoud (2008), Gassner and Maillat (2006), Le Pape Racine (2011), Maillat and Serra (2009) and Maillat (2010) all base their analyses on data from a project on *Integrated Construction of Linguistic and Content-Based Knowledge Through Bilingual Education at Secondary and Tertiary Levels*[27]. The

[26] CLIL programs involving dealing with this language community have the goal of not only maintaining but also promoting Romansh as a language of education in order to prevent it from dying out (see e.g. Cathomas, 2005)

[27] This project is again connected to a larger research project on the linguistic diversity and language competence in Switzerland funded by the Swiss National Science Foundation (SNSF) from 2003 to 2009.

corpus consists of data from upper-secondary CLIL programs in Switzerland where the ML is either German or French, and the TLs are German, French or English (Maillat, 2010). While Gajo and Berthoud (2008) and Le Pape Racine (2011) provide a summary of the research project and its pedagogical implications in the Swiss context, respectively, Gassner and Maillat (2006), Maillat and Serra (2009) and Maillat (2010) take a pragmatic approach to CLIL in Switzerland. Maillat's (2010) study is particularly noteworthy in this context for identifying the "mask effect" in CLIL classrooms, where the learning environment fosters interaction and enhances language acquisition by lowering the affective filter (Maillat, 2010, p. 39).

Pfenninger's longitudinal study (Pfenninger, 2014, 2016; Pfenninger & Singleton, 2016) compared TL language competences over five years across four groups to determine the ideal age of onset for effective language learning. One of her most striking findings is that it is not the age of onset—when students begin EFL instruction—that matters most but "it seems to be access to late CLIL, regardless of early instruction, that makes the difference here" (Pfenninger, 2016, p. 137). This suggests that CLIL instruction in secondary school is more beneficial than early EFL instruction, supporting the implementation of programs like the bilingual baccalaureate in upper-secondary schools. However, Pfenninger acknowledges the study's limitations, particularly the absence of a pretest, which raises the possibility that the. CLIL students may have simply been stronger students overall.

Finally, Gajo et al. (2018, 2020) investigated the conditions for and the implementation of CLIL in Switzerland at primary level, including also forms of content-based L2 teaching. They found that not the duration of exposure to the TL matters, but the quality of CLIL or content-based L2 teaching (Gajo et al., 2020, p. 103–104). They further found that especially at primary level, the boundaries of language and content teaching are not fixed and can lead to creative and innovative forms of content and language teaching. If "flexibility of the curriculum and the creativity of teachers [is given], forms of bilingual education can find a place everywhere" (Gajo et al., 2020, p. 103) independent of context or implementation. Swiss CLIL research is thus ongoing but scarce, and because Switzerland offers such a diverse context with regard to the languages, subject, grade or format of the respective CLIL programs, more research is still needed[28]. For instance, only few of the above-mentioned studies actually deal with English as TL, which is noteworthy considering the fact that the most common form of the bilingual baccalaureate is found in the German-speaking part with Standard German as ML and English as the TL (Elmiger et al., 2010, p. 34; SKBF, 2018a, p. 143). Investigating such a CLIL program with the TL English, the present study attempts to fill this gap, making it a much-needed contribution.

3.4 Summary of Chapter

This chapter has described the context of the present study: Switzerland. Switzerland offers indeed a particularly interesting context for the study of CLIL. On the one hand, this is due to its multilingual landscape, with four official national languages, Swiss German as one regional (mostly) spoken language, and the increasing presence of English. On the other hand, this has to do with the decentralized education system of Switzerland. Education, in contrast to other countries, is largely regulated on a cantonal level. The autonomy of the individual cantons to tailor their own educational system, and with it their bilingual programs, has resulted in different realizations of CLIL programs with regard to how and when they are implemented. While there are no nationwide CLIL programs in

[28] In a new research project by Elmiger, Tunger, and Siegenthaler (2021-2023) on *Immersion and Bilingual Education in Switzerland,* the researchers aim to gather existing literature and scientific documentation and to make a thematic evaluation. They argue that there are in fact many scientific studies on bilingual education / CLIL in a Swiss context, but they are not always known or accessible and it is therefore difficult to know which results are comparable or generalizable.

compulsory education, the most popular form of CLIL in Switzerland is the upper-secondary model of the *zweisprachige Maturität* [bilingual baccalaureate], which is also the CLIL program investigated in the present study. Considering the fact that CLIL programs are still increasing in number and diversity, there is an urgent need to investigate the whole range of Swiss contexts when it comes to bilingual education. CLIL research in Switzerland, though still ongoing, is overall scarce, which is why the present case study on CLIL and non-CLIL biology lessons at an upper-secondary school is a much-needed contribution to Swiss CLIL.

Part II: THEORETICAL BACKGROUND

4 Translanguaging

Translanguaging, which refers to the full use of a speaker's multilingual and -modal resources in interaction, serves as a key theoretical lens for analyzing both CLIL and non-CLIL lessons in the present study. To understand the quantitative translanguaging analysis of Research Focus 1 (Chapter 8) and the qualitative analysis of how translanguaging practices are connected to technicality in Research Focus 3 (Chapter 10), an overview of the concept of translanguaging is essential. Since translanguaging can occur in any interaction, it can be observed and studied in any context, which is why this chapter begins by examining the general concept of translanguaging before narrowing the focus to its specific relevance with CLIL contexts. Section 4.1 defines translanguaging, tracing its origins as a pedagogical practice (Section 4.1.1) and its evolution into a theory of language (Section 4.1.2). To develop a more nuanced definition of translanguaging that proves fruitful for the current study, Section 4.2 addresses some key debates surrounding translanguaging, particularly its connection to CLIL (Section 4.2.1) and its relation to other competing terms, with a specific emphasis on the supposed juxtaposition of translanguaging and code-switching (Section 4.2.2). Finally, the chapter concludes by highlighting the value of a translanguaging framework as a theoretical foundation for the current study.

4.1 Defining Translanguaging

In light of the multilingual turn (Conteh & Meier, 2014; May, 2014b), translanguaging has emerged as the new popular term in applied linguistics and second language acquisition (SLA) research, promoting "multilingualism, and not monolingualism, as the new norm of applied linguistic and sociolinguistic analysis" (May, 2014a, p. 1). From establishing new scientific journals (*Translation and Translanguaging in Multilingual Contexts)* to the publication of monographs (e.g.

Baynham & King Lee, 2019; García, Johnson, & Seltzer, 2017; García & Li Wei, 2014; Rabbige, 2019; Wang, 2019) and edited volumes (e.g. Cenoz & Gorter, 2015; García & Kleyn, 2016b; Mazak & Carroll, 2017; Mazzaferro, 2018; Paulsrud, Rosén, Straszer, & Wedin, 2017b), the momentary popularity of translanguaging seems evident. The concept behind it, however, is not that self-evident nor self-explanatory, as is illustrated by the three quotes below.

> (1) [T]ranslanguaging means that you receive information through the medium of one language (e.g., English) and use it yourself through the medium of another language. (Williams, 1996, p. 64, as cited in Lewis, Jones, & Baker, 2012b, p. 643)
>
> (2) Translanguaging refers to the deployment of a speaker's full linguistic repertoire, which does not in any way correspond to the socially and politically defined boundaries of named languages. (García & Kleyn, 2016b, p. 14)
>
> (3) Translanguaging refers to a systematic shift from one language to another for specific reasons. (Coyle et al., 2010, p. 16)

The three quotes above not only reflect the existing diversity when it comes to defining and conceptualizing translanguaging, but they also represent three inevitably important issues when approximating oneself to any understanding of translanguaging. Quote (1) and (2) illustrate the two most common ways to look at translanguaging: The first one looks at the origin of the term as a descriptor for a pedagogical practice involving two or more languages, as exemplified in Williams' original description (quote [1]) of what he coined *trawsieithu* [translanguaging]—a specific pedagogical practice where, as part of a language revitalization program in Wales, lessons were taught using varying input/output in Welsh and English (Williams, 1994, 1996, 2000, 2019). The second approach expands the notion of translanguaging from a purely pedagogical practice to a holistic theory of language, and as exemplified by García and Kleyn's quote (2), focuses on a perspective on translanguaging as a theory of language, or more specifically, a theory of bi-/multilingualism going as far as challenging the concept of 'a language' itself. By claiming that any speaker uses all of her or his linguistic resources strategically and independently from societal labels to communicate and make sense of the world, García and Kleyn (2016b) expand the notion of translanguaging beyond pedagogy. Lastly, quote (3) illustrates one of the fiercest debates to date surrounding the discussion of translanguaging, namely the question of how translanguaging is innovative or different, if at all, from existing concepts such as code-switching, borrowing or language mixing. As shown in quote (3), Coyle et al. merely describe translanguaging as a new fancy term for shifting between languages, thus it is another "type of code-switching" (2010, p. 16).

In my view, however, the concept of translanguaging is neither synonymous nor mutually exclusive with the above-mentioned related terms, as outlined in the remainder of the chapter. The following section provides a detailed examination of the term translanguaging itself, which can be approached from two perspectives—translanguaging as deriving from the Welsh word *trawsieithu,* describing a particular pedagogical practice, or translanguaging, as a compound of *trans* and *languaging,* representing a more dynamic view on bi- and multilingual practices.

4.1.1 Translanguaging as a Pedagogical Practice

The term translanguaging itself originates from the Welsh word *trawsieithu,* which was first coined by Cen Williams (1994, 1996, 2000) to describe a specific pedagogical practice employed in Wales from the 1980s on. As part of a Welsh language revitalization program to counter "English language dominance and Welsh language endangerment" (Lewis et al., 2012b, p. 642), teachers as well as students would use varying English and Welsh language input and output in their lessons. In the early stages, this was mainly implemented in form of teachers speaking Welsh and the students replying in English; later the whole teaching was often completely in Welsh with the additional material in English (Williams, 2019). Baker, in the 3rd edition of his book *Foundations of Bilingual Education and Bilingualism* (2001), first used "translanguaging" as an English translation of the pedagogical concept *trawsieithu* described earlier by Williams. He defined translanguaging as the strategic use of two languages by teachers so that "[i]n 'translanguaging', the input (reading or listening) tends to be in one language, and the output (speaking or writing) in the other language, and this is systematically varied" (Baker, 2006, p. 297). While clearly still describing a pedagogical practice, Williams (1994, 1996, 2000) and later Baker (2001, 2006, 2011) both emphasized four potential educational and cognitive advantages that such a translanguaging approach to teaching may bring with it (Lewis et al., 2012b, p. 645):

- It may promote a deeper and fuller understanding of the subject matter.
- It may help the development of the weaker language.
- It may facilitate home-school links and cooperation
- It may help the integration of fluent speakers with early learners.

The reason why such a translanguaging pedagogy might be beneficial for students goes back to the idea that alternating input and output seems cognitively more challenging in that "[t]o read and discuss a topic in one language, and then to write about it in another language, means that the subject matter has to be processed and 'digested'" (Baker, 2011, p. 289). These potential educational and cognitive advantages of a translanguaging pedagogy prompted scholars such as

García (2009), Creese and Blackledge (2010) and Li Wei (2011) to explore the concept of translanguaging in terms of its value for a broader theory of language that goes beyond the educational level and towards a new understanding of bi- and multilingualism.

4.1.2 Translanguaging as a Theory

In the 20th century, the dominant models of bilingualism viewed languages as something static, “standardized competencies one might ‘acquire’” (Vogel & García, 2017, n.p.). Consequently, “moving between languages” (Creese & Blackledge, 2010, p. 105), a typical bilingual behavior, was predominately seen as a deficit and a lack of knowledge in the target/majority language (Paulsrud, Rosén, Straszer, & Wedin, 2017a, p. 11). Early definitions of bilingualism included “native-like control of two languages” (Bloomfield, 1933, p. 56), alternating between two or more languages (Weinreich, 2011 [1951]) or having minimum proficiency in two languages (Haugen, 1953). These early definitions treated different languages as separate entities that do not interfere with each other; consequently, a bilingual individual was seen as someone having (acquired) two separate monolingual systems.

Cummins (1979, 1980) first challenged this monolingual view of treating languages in bilinguals as separate entities by proposing the Interdependence Hypothesis, also known as the dual-iceberg metaphor. Similarly, Grosjean (1982) postulated that bilinguals are not simply two monolinguals in one, but that they employ their two languages for different purposes. Even though Cummins and Grosjean questioned the monolingual bias—treating languages as separate entities—in bilingualism research early on, but it took another few decades for the research community to embrace this paradox and address it in theory and research. The rise of the multilingual turn in the 2010s (Conteh & Meier, 2014; May, 2014b) brought attention away from monoglossic and monolingual models of bi- and multilingualism to focus on more inclusive and interconnected approaches to bi- and multilingualism. As a result of this late awareness, "[t]oday many educators still refer to these types [additive and subtractive] of bilingualism and their corresponding educational models, using these terms" (García & Kleyn, 2016a, p. 13).

In her book *Bilingual Education in the 21st Century* (2009), García first promoted the idea of a dynamic view on bilingualism to better capture "the multiple discursive practices in which bilinguals engage in order to make sense of their bilingual worlds" (2009, p. 45). In a linguistically increasingly complex and globalized world, bi- and multilinguals are constantly adjusting their discursive practices depending on the context, the medium or the communicative intent (García, 2009, p. 53). This results in "nonlinear ways that bilinguals actually use and acquire language" (Vogel & García, 2017, n.p.) that cannot be described by these traditional linear models of bilingualism. Hence, bi- and multilingual practices are dynamic and fluid in their very essence. In the same vein, Creese and Blackledge (2010, p. 109) called for a more flexible bilingualism, "without clear boundaries, which places the speaker [and not the language] at the heart of the interaction". Viewing bilingualism as dynamic, García postulated that "bilinguals have *one linguistic repertoire* from which they select features *strategically* to communicate effectively" (2012, p. 1, emphasis in original). Bilinguals, according to García, do not have, as earlier perspectives on bilingualism suggested, two different linguistic systems that they use alternately, but instead they have one linguistic repertoire. The way bilingual speakers deploy these linguistic features of their own unique repertoire depending on the context they find themselves in, is called translanguaging.

4.1.2.1 Trans + Languaging

Translanguaging, although originally just a translation of a Welsh term coined to describe a specific pedagogical practice involving the use of two languages, has also proven to be a suitable term for an expanded version of translanguaging as a theory. Li Wei (2011, 2018) approached translanguaging from a psycholinguistic perspective, focusing on the psycholinguistic notion of its components, *trans* and *languaging*. *Languaging* (Swain, 2006) holds that language per se is never a finished product, but an ever-ongoing cognitive process to express thought, negotiate meaning, "mediate cognitively complex ideas" (Paulsrud et al., 2017a, p. 14) and thus "gain understanding, make sense, communicate, and shape our knowledge and experience through language" (Lewis, Jones, & Baker, 2012a, p. 656). Adding the prefix *trans-* to *languaging* emphasizes, according to Li Wei (2018), the fluid nature of multilinguals' practices in two main aspects: First, translanguaging practices as such are not restricted to traditional linguistic resources only, but include non-verbal semiotic and multimodal resources[29] as well.

As a hypothetical example, imagine a teacher explaining the complex scientific concept of *photosynthesis*, the chemical process of how plants gain energy from sunlight. She might first use her linguistic resources by verbally explaining the concept, meanwhile she might underline her explanation by hand gestures and/or by drawing a sketch of how photosynthesis works on the blackboard—all these different resources (linguistic, non-verbal semiotic, multimodal) work in integration towards communicating the concept of photosynthesis to the class. In this scenario, the verbal explanation, as well as the non-

[29] Translanguaging includes all "communicative semiotic resources" (Lin, Wu, & Lemke, 2020, p. 40) used for meaning-making. Throughout the book though, a distinction is made between the use of linguistic (verbalized translanguaging), non-verbal semiotic (e.g. gesturing) and multimodal resources (e.g. use of blackboard) in order to better understand how all of these resources are used in CLIL and non-CLIL biology lessons. Research Focus 1 (Chapter 8) looks at linguistic translanguaging exclusively, while Research Focus 3 (Chapter 10) investigates the role of non-verbal semiotic and multilingual resources in the negotiation of technicality.

verbal gestures and the drawing constitute the teacher's full repertoire that she has at her disposal.

In the same vein, the *trans*-prefix in translanguaging also highlights a second aspect, namely the fact that bi-/multilinguals do not seem to use language "unilingually in a politically named language" (Li Wei, 2018, p. 18). Illustrating this with the same hypothetical example, the teacher might involve the etymology of the technical term *photosynthesis* into her teaching in order to stimulate students' meaning-making processes. This might take the form of a simple translation in that *photosynthesis* is actually a compound of the Greek word *photo*- meaning "light", and the Latin word *synthesis*, describing a complex composition process whereby one bigger element is built up from more minor elements. Hence, only from its etymology, the teacher might be able to communicate the idea that *photosynthesis* is a process where energy is synthesized in plants through sunlight. Recounting this example, I classified the two components of *photosynthesis* as Greek and Latin. However, the teacher might not categorize the components of the term in the same way, instead viewing it as part of academic or scientific English. By all accounts, *photo* and *synthesis* are two perfectly acceptable words in Present Day English, and so is *photosynthesis*. The fact that in this hypothetical example *photo* can both legitimately be assigned to English and Greek goes to show that the concept of what constitutes "a language" is far from clear-cut.

4.1.2.2 Internal and External Views of Language

This aligns with Li Wei's (2018, p. 18) observation that speakers do not use language "unilingually in a politically named language." Although languages are often perceived as distinct linguistic entities (e.g. "I speak Spanish, I speak Portuguese"), the boundaries that define languages are deeply influenced by social, cultural and political factors. Do we think Spanish and Portuguese are different languages because we have been taught to do so? Consequently, would we classify them as distinct even if there was no differentiating societal label attached to them? Languages are thus not primarily (or at least not exclusively) linguistic, but social and political constructs. Hence, what are considered languages are actually politically and socially constructed categories and might differ from an individual's perception of their own language use. Translanguaging theory, then

> draws a distinction between the way society labels and views an individual's use of two named languages (**the external perspective**), and the way a speaker actually appropriates and uses language features (**the internal perspective**). (Vogel & García, 2017, n. p., emphasis added)

Otheguy, García and Reid elaborate on the external/internal view claiming that

> the two named languages of the bilingual exist only in the outsider's view. From the insider's perspective of the speaker, there is only his or her full idiolect or repertoire, which belongs only to the speaker, not to any named language. (Otheguy, García, & Reid, 2015, p. 281)

Taking a dynamic view on bilingualism or language in general, it is often not possible, as illustrated with the hypothetical example of the teacher explaining *photosynthesis*, to assign bi- or multilingual behavior to "one particular external label—their practices go beyond such language categories and people *translanguage*" (Vogel & García, 2017, n.p., emphasis in original). By putting the multilingual speaker and his or her unique language practices at the center, translanguaging theory takes on an internal view of language as a set of features and resources and thus "offers a way of speaking about these individual complex practices of multilingual speakers" (Li Wei & García, 2016, p. 236) free from external labels. Such a translanguaging approach that does not focus on traditional language labels but encourages the individual's use of all of his or her available resources to communicate might prove especially valuable in bilingual environments where societal constraints are still high in that the "dominant language [still] constitutes a powerful sieve that is interposed between the student and the school to trap many idiolectal features and toss them aside as inappropriate or illegitimate" (Otheguy et al., 2015, p. 304).

One question, however, remains: How far is a deconstruction of traditional language categories reasonable? If, as translanguaging theory proposes, "named languages" are viewed primarily as social and political constructs, then categories such as *first language* or *native speaker* must also be considered social constructs with ideological stances (Vogel & García, 2017). In the end, even the categorization of people into mono-, bi- and multilinguals is based on an external labelling of different languages and has thus to be considered a sociopolitical categorization rather than a linguistic one. In line with Otheguy et al. (2015, 2018), García and Kleyn, however, stress the fact that even though languages are

> *socially invented* categories [t]hese categories are *not imaginary,* in the sense that they refer to entities that exist in the societies that have coined the terms and have had real and material effects. (García & Kleyn, 2016a, p. 10, emphasis in original)

Therefore, translanguaging as a theory ultimately offers a way to look at and investigate language practices of individuals by valuing a speaker's full repertoire of meaning-making resources independent from external labels and named languages. As exemplified in García and Kleyn's quote above, in order to do so translanguaging theory needs to walk a fine line between deconstructing existing societal labels of named languages while still considering that these labels influence a speaker's internal view on his or her own language use. When a person says "I speak English", this socio-political construct becomes a linguistic reality for that very speaker. Consequently, the separation between external perspective (named languages) and internal perspective (idiolect, individual repertoire) is artificial in that one inherently influences the other and vice versa. This becomes especially challenging in the operationalization of translanguaging for research purposes and its application in education as the next section show.s

4.2 Current Debates about Translanguaging

Through migration and globalization, our societies and communities have inevitably become more multicultural and consequently, more multilingual. A situation Vertovec (2007) and later Blommaert (2013) have termed "superdiversity". It is thus not surprising that in regards to the role of language in these so-called "superdiverse contexts", a plethora of terms aside from translanguaging has emerged in an attempt to capture this new reality of entrenched and multilingual language use: *polylingualism* (Jørgensen, 2008)*, metrolingualism* (Pennycook & Otsuji, 2015), *plurilingualism* (Marshall & Moore, 2018), *plurilanguaging* (Lüdi, 2016), *supervernaculars* (Blommaert, 2012), *codemeshing* and *translingual practices* (Canagarajah, 2011, 2013) to renewing the concept of *code-switching* (MacSwan, 2014) and *language alternation* (Filipi & Markee, 2018). It is easy to lose oneself in this "maze of terminology" (Lewis et al., 2012a, p. 656). However, it is important to keep in mind that although all of these terms are overlapping in their intent to conceptualize the new multilingual reality of today's globalized world, they are not necessarily synonymous as they come from various research traditions and have thus nuanced differences in their meanings—ranging from broad conceptualizations of multilingualism to more concrete descriptions of multilingual practices. Therefore, one needs to be particularly careful in describing and justifying the use of one term over the other. This is also the case regarding translanguaging:

> There is considerable confusion as to whether Translanguaging could be an all-encompassing term for diverse multilingual and multimodal practices,

> replacing terms such as code-switching, code-mixing, code-meshing, and crossing. It also seems to be in competition with other terms (...). (Li Wei, 2018, p. 9)

As demonstrated in Section 4.1, translanguaging has undergone various reconceptualizations from starting out as a pedagogical practice to describing flexible bilingual behavior to calling for an extensive deconstruction of named languages. Naturally, this development from a practice to a theory of language has not been without challenges and debates. The fact that translanguaging as a concept is far from uncontested may be best illustrated by its use in education, where it "has created the most interest, and yet the most disagreement" (Vogel & García, 2017, n.p.). Hirsu then, in a review of Paulsrud et al.'s edited book *New Perspectives on Translanguaging in Education* (2017), poignantly points to the fact that all chapters of the book work with the notion of translanguaging, but that "the notion is far from having one core meaning" and that this is problematic as educators cannot simply apply or implement "translanguaging without making some key decisions about what the concept means in their own context" (Hirsu, 2018, p. 227). Since there is no clear or at least unified definition of what translanguaging means for practice, the operationalization of the concept with regard to analysis as well as its application in educational settings is equally diverse. Thus, a unified approach to the operationalization of translanguaging is still lacking. Nevertheless, translanguaging has received much attention recently with regard to CLIL contexts, which is dealt with in the next section.

4.2.1 Translanguaging and CLIL

As mentioned above, one criticism of translanguaging concerns its application in educational settings, which is interesting considering that it started out as a pedagogical strategy before being conceptualized as a theory of language attaining a plethora of meanings that now make it difficult to apply in any given context. One way to apply it in the foreign language classroom, as suggested by Vogel and García (2017), is to allow and even encourage (emergent) bilinguals to use their full spectrum of resources in class, shifting away from an ideologically monolingual orientation towards foreign language teaching. Monolingual teaching ideologies are also widespread among CLIL teachers since one premise of CLIL consists of improving the TL (Lasagabaster, 2017). While encouraging students to translanguage sounds promising in theory, it is not that simple to put into practice. Is there a point where too much translanguaging becomes detrimental to the purpose of learning the TL or understanding content in the TL?

Consequently, studies on translanguaging and CLIL have so far mainly focused on the (potential) use of the first language (L1) or mainstream language (ML) for the teaching of content in the TL. Some of these studies have looked at the teachers' attitudes to and self-reported use of the L1/ML in the CLIL classroom and found that CLIL teachers seem generally open towards using the L1/ML, but since they have not been trained on how to use translanguaging as a pedagogical strategy, they feel insecure as to what extent they should use or allow the L1/ML (see Doiz & Lasagabaster, 2017; Gené Gil, Juan Garau, & Salazar Noguera, 2012; Gierlinger, 2015; Lasagabaster, 2013, 2017; Méndez García & Pavón Vázquez, 2012). Other studies on translanguaging and CLIL focusing on classroom data have revealed that translanguaging is not only a feature of many CLIL classrooms, but also that translanguaging practices do indeed serve various purposes, and thus enrich the CLIL classroom on multiple levels (see F. Gallagher & Colohan, 2017; Gierlinger, 2015; Lin & He, 2017; Maillat & Serra, 2009; Moore & Nikula, 2016; Nikula & Moore, 2019; Paulsrud, 2014, 2016; San Isidro & Lasagabaster, 2019; Toth, 2018). Nevertheless, in their investigation of translanguaging practices in the CLIL context, the above-mentioned studies all follow the paradigm of bilingualism by focusing on practices primarily concerned with the use of the L1/ML as a potential resource in CLIL lessons.

Understanding translanguaging as the use of a speaker's full repertoire of meaning-making resources (linguistic, non-verbal semiotic, multimodal) to transmit any kind of information, it follows that one should take an approach to translanguaging and CLIL that goes beyond the simple use of L1/ML and TL but incorporates all facets of the multilingual (and -modal) repertoires of students and teachers, which is exactly what I set out to do in the translanguaging analysis. However, operationalization of such an understanding of translanguaging for analysis is challenging, especially for a quantitative analysis as the one conducted in the present study (see Section 8.2 for details on the methodology).

When reviewing the rapidly growing literature on bi- and multilingual language use and CLIL, not all of them label what they are investigating as translanguaging. For instance, all the studies reporting on teacher attitudes frame their research as investigating the use of the L1 compared to the L2/TL. Following the paradigm of bilingualism is thus exactly what they set out to do. San Isidro and Lasagabaster (2019), for instance, use the term translanguaging and code-switching to label their investigation of bilingual practices. The term code-switching actually emerges as a key concept also in general translanguaging research not focused on CLIL contexts, which has led to a controversial debate about the perceived differences and commonalities between the two.

4.2.2 Translanguaging and Code-Switching

The debate in question revolves around translanguaging and its relation to the previously well-established concept of code-switching. On the one hand, this has to do with translanguaging advocates pushing forward the idea of translanguaging as a new theory of language by explicitly opposing it to code-switching, contemplating that "the notion of code switching still constitutes (...) two separate linguistic systems" (Otheguy et al., 2015, p. 282). On the other hand, translanguaging as a "new" description of bilingual practices without a unified core meaning has led to an almost inflationary use of translanguaging in all kinds of contexts. In many cases, translanguaging simply replaced what otherwise would have been described as code-switching. In fact, Auer (2019) is one of the first scholars who fiercely criticized the concept of translanguaging. He claims that it is the result of a "gross misrepresentation of research on bilingualism and code-switching" (2019, p. 26). Therefore, I would like to propose and discuss three different views on translanguaging in connection to code-switching:

1. Translanguaging is epistemologically different from code-switching (e.g. García & Kleyn, 2016b; Jonsson, 2017; Otheguy et al., 2015, 2018; Li Wei & García, 2016)

2. Translanguaging is another (unnecessary) term for code-switching (e.g. Auer, 2019; Coyle et al., 2010; Creese & Blackledge, 2010; Gené Gil et al., 2012)

3. Translanguaging is inclusive of or at least complementary to code-switching (e.g. Bieri, 2018b; Lewis et al., 2012b; Lin, 2019; Nikula & Moore, 2019)

The first view refers to the one taken up by the most outspoken advocates of translanguaging, framing it as a new theory of language epistemologically different from code-switching. The argument is as follows: Because speakers never actually speak "languages" (as these are primarily socio-political constructs), they all possess a single repertoire of forms that only linguists categorize as belonging to so-called named languages. Code-switching automatically divides the practices of a bi-/multilingual person into codes, which implies that they are separable or at least distinguishable units. This represents a more extreme view of translanguaging that is not shared by all advocates of translanguaging, including myself.

The second view sees translanguaging either simply as a new fancy term for what is essentially code-switching, or, in the case of Auer (2019), offers a thorough criticism of translanguaging based on previous code-switching research. The second viewpoint refers to a thorough criticism of translanguaging, contradicting in particular the claim that it posits a new theory of bilingualism/language seeking to "deconstruct named languages" and the neglect of code-switching all together. Auer (2019) lists several problems with the definition of translanguaging as proposed in Otheguy et al. (2015). He argues that even with the emergence of so-called new multilingual realities in this globalized world, there is little evidence suggesting that bilingual practices will change significantly, and therefore, no new term or concept is required.

Having outlined the two extreme positions in the translanguaging and code-switching debate, I will position myself in the middle ground: Seeing translanguaging as a valuable tool for the analysis of multilingual/multimodal practices without neglecting the work that has been done by scholars focusing on code-switching. I agree with Auer (2019) that the complete negation of existing code-switching research based on the argument that languages do not operate in codes is a dangerous practice. I also agree that many of the examples shown in the translanguaging literature can be described and explained with existing terminology. The view taken in the current study then sees translanguaging as neither mutually exclusive nor exactly synonymous with related concepts such as code-switching, but as an umbrella term. To illustrate this: The most common translanguaging practice in CLIL with regard to subject-specific language consists of translating key terminology, such as in example (1) (taken from Bieri, 2018b, p. 95).

(1) T: Airways are enforced by <u>rings of cartilage</u>, *Knorpelspangen*

In example (1), the teacher introduces the term in question, and then automatically provides the ML equivalent, thereby drawing on a more familiar resource to ensure mutual understanding. This is a good example of what has been called code-switching for interpreting (Auer, 2019, p. 13). Here, the teacher clearly juxtaposes what he perceives as two codes, since the very act of interpreting (translating from one language to another) presupposes the awareness of such codes. However, there might not always be an exact equivalent of the term in question, hence the strategy of simply translating key terminology does not always work. Instead, teachers might have to use circumlocution, or use other multilingual and -modal practices to achieve mutual understanding. Returning to the hypothetical example of the teacher explaining *photosynthesis* to her students, it has already been established that she may use verbal and non-verbal resources to do so. If it is a CLIL class, she will do this verbal explanation in the TL that is probably neither her nor the students' L1, and might from time to time use terms or expressions from the L1 or other linguistic resources known by the students. Aside from linguistic resources, she could equally well underline her explanation with gestures describing how plants get energy from sunlight (non-verbal semiotic resource), or draw a sketch on the blackboard (multimodal resource). In the end, she uses all resources available to her in that moment to negotiate and scaffold the meaning of the scientific concept photosynthesis.

Each of these bi-/multilingual practices could probably be explained by in detail by existing terms such as code-switching, code-mixing/language mixing, borrowing or fused lects. However, in my view, translanguaging seems a more suitable approach to a description of the sum of such practices without yet importing pre-conceived notions of the individual interactional purposes teachers or students try to fulfil when using these kinds of practices. For instance, the distinction made between code-switching and language mixing often occurs at the structural level, with code-switching referring to alternate language use between syntactic units (inter-sentential code-switching) and language mixing to switches within syntactic units (intra-sentential code-switching, see Lin & Li, 2012). Additionally, the dimension of what (social) function code-switching in a particular context fulfils is determined, among other things, by whether speakers perceive the two codes in question as different (see Auer, 2011 for more details).

Subsequently, the present study does not focus on structural patterns of translanguaging practices nor on the orientation of the speakers' perception towards the use of different codes, but explores *all* kinds of multilingual and multimodal resources as they are used in CLIL and non-CLIL biology lessons in a Swiss upper-secondary school. In that particular context then, multiple languages are at work simultaneously: the individual linguistic repertoires of students and teachers (Swiss German or other L1s), the ML and TL (Standard German or English), and the languages present in the technical vocabulary of biology (Greek, Latin and others). Apart from the rich linguistic resources teachers and students can draw on in this context, the non-verbal semiotic and multimodal dimension of teaching (gestures, gaze, use of different media) also has to be taken into account. To accurately describe and capture the interplay of all these resources at work in the classroom, translanguaging is the more appropriate approach since it encompasses all kinds of resources—including code-switching and all the above-mentioned strategies such as language mixing and borrowing—used for communication in a certain situation. As Lin and Lemke point out in their discussion:

> [W]hen one translanguages, one does not follow strictly the grammatical structures and patterns prescribed by the written grammars of the languages involved; however, when one translanguages, there is, nonetheless, some patterning that can be discerned, even though it does not follow strictly the written grammars. So, what is the nature of the patterning that emerges from the dynamic translanguaging performances? (Lin et al., 2020, p. 5)

Describing patterns of dynamic translanguaging practices is exactly the aim of the present study. How translanguaging as a framework is operationalized for the quantitative analysis of multilingual resources is presented in Chapter 8. Additionally, Chapter 10 examines translanguaging practices that go beyond linguistic resources. Together, these approaches contribute to translanguaging theory and its operationalization, enabling the systematic description of dynamic translanguaging practices.

4.3 Summary of Chapter

The chapter has explored the history of translanguaging evolving from a pedagogical practice of alternating language use to a more holistic theory of language up to questioning the concept of a language itself. Translanguaging theory proposes that "named languages" are primarily socio-political constructs, and represent an external view on language that does not have to coincide with a speaker's internal view of what constitutes a language. Translanguaging is consequently defined here as a speaker's full use of all the resources s/he has at his or her disposal (linguistic, non-verbal semiotic and multimodal) attempting to take the internal view as well as external societal labels into account. The operationalization such an understanding of translanguaging for research and practice is challenging and therefore far from unified.

Studies on translanguaging and CLIL have mainly focused on the use and functions of the L1 in the CLIL classroom. Understanding translanguaging as a concept inclusive of all kinds of linguistic, non-verbal and semiotic resources, CLIL research that goes beyond the bilingual paradigm of looking at L1 and TL use is still largely missing The discussion about how translanguaging is different from code-switching has illustrated the different stances and interpretations regarding translanguaging. The translanguaging approach taken in this study then sees translanguaging and code-switching not as competing, but as complementary approaches. In the end, translanguaging and code-switching are two different ways to look at similar phenomena "but the analytical tools, the apparatus, or methodological resources used to do the analysis are totally different" (Lin et al., 2020, p. 36). In a context as diverse as Switzerland, translanguaging is considered the most theoretically and methodologically suitable approach for investigating the use of multilingual, non-verbal semiotic, and multimodal resources by both teachers and students in CLIL and non-CLIL settings.

5 Technicality

This chapter presents the theoretical framework of technicality, which is used as a basis for the analyses of Research Foci 2 and 3 (Chapters 9 and 10). It begins with an overview of what constitutes technical language in general (Section 5.1) followed by a detailed examination of Wignell et al.'s (1993) concept of technicality (Section 5.1.1). As the primary framework for analyzing technical terms, the key characteristics of Wignell et al.'s (1993) conceptualization of technicality are explicitly highlighted, with a particular focus on their definition of technical terms that is then operationalized in the analysis of technical terms (see Chapter 9). Since the present study focuses on classroom data, the definition of technical terms is complemented by the introduction of the semantic profiles model (Maton 2013, Section 5.1.2), which is used in Chapter 10 to analyze how technical terms are dealt with in the classroom. The chapter concludes by linking the concept of technicality to CLIL, discussing the unique challenges of teaching biology in English, and exploring how the technicality and semantic profile approach contributes to CLIL research (Section 5.2).

5.1 Technical Language

What Lewis et al. (2012a, p. 656) called a "maze of terminology" with regard to translanguaging (see Section 4.2) can also easily be said of approaches to technical language. There is a plethora of terms and corresponding definitions to describe technical language or more specifically, what is considered technical language in a given context: academic language, jargon, scientific English, language of schooling, language for specific purposes or terminology research are just some of these terms. And not only are different related terms used to describe technical language in English, also in German there is disagreement regarding what exactly counts as *Fachsprache* [technical language], *Bildungssprache* [academic language], *Schulsprache* [language of schooling] or *Fachterminologie* [specialist terminology] (see e.g. Drumm, 2016; Mezei, 2012a, 2012b). The different approaches may be broadly summarized as shown in Figure 3. In Figure 3, two continua are depicted, one from language to content and the other from plain to complex. On the one hand, this illustrates that all the aforementioned terms aim to describe a form of language that is distinct and more complex than everyday language. The application of the two continua and the positioning of academic language, technical language and jargon above everyday language in Figure 3 is, however, a simplified depiction, as everyday language can be as complex as technical language depending on the factors used to measure complexity[30].

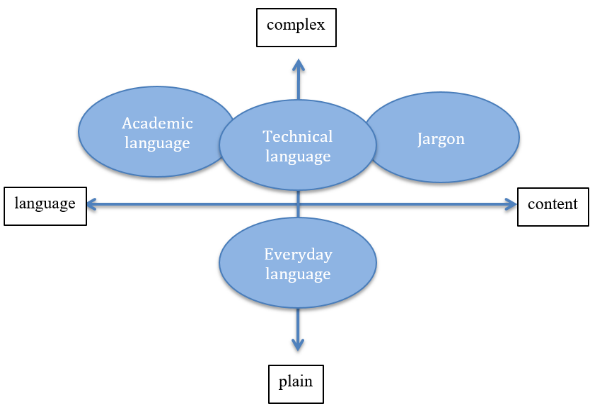

Figure 3: Simplified graphical representation of technical language

Yet Figure 3 also shows that there is one strand of terms (subsumed under "academic language", that includes "language of schooling", *Bildungs- und Schulsprache* [academic and school language],

[30] For instance, academic and scientific language is often characterized by increasing lexical density but decreasing clausal complexity (Lin, 2016, pp. 47–48).

"language for academic purposes") that is oriented more towards the language side of the continuum by focusing on the increased complexity of language itself in a given context. Subsumed under "jargon" are terms like "language for specific purposes" or *Fachterminologie* [specialist terminology], which orient themselves more towards the content end of the continuum in that they focus on a variety of language that is increasingly more complex or dense because of the specific topic or field that is talked or written about. Often, jargon is linked to people working in the same profession and focuses on specialist terminology, having "its own set of words and expressions, which may be incomprehensible to an outsider" (Richards & Schmidt, 2010, p. 305). In the present study, technical language is positioned somewhere in the middle in that it is not simply jargon or specific vocabulary, but it fulfils an important communicative function within the scientific discourse, thereby using many features also seen in academic language.

Thus, what is technical language? If one takes a look at the two excerpts below—the first one in English taken from the textbook *Advanced Biology* used by one of the teachers in the study (excerpt 1, see also Section 6.2.1), the second one in Standard German from a Swiss History textbook (excerpt 2)—there are several aspects to observe that make these texts academic as well as specific, in short technical, to that discipline.

Excerpt 1: Excerpt from Advanced Biology (Kent, 2000, p. 270)

Vascular tissue in the stem takes the form of bundles containing phloem and xylem and reinforced with strong fibres. The xylem is located towards the inside of the stem and the phloem towards the outside. The tough rigid vascular bundles embedded in softer turgid parenchyma tissues have been likened to reinforced concrete, in which rigid steel girders are embedded in softer concrete. This arrangement gives the stem strength and flexibility, making it well suited to resisting sideways bending in strong winds. The vascular bundles of dicotyledonous plants are arranged in a ring pattern around the outside of the stem, while in monocotyledons such as cacti the vascular bundles are scattered throughout the stem.

Excerpt 2: Excerpt from Die Schweiz und ihre Geschichte (Meyer, Felder, & Wacker, 2005, p. 68)[31]

Die zweite Hälfte des 19. Jahrhunderts war geprägt vom Fortgang der Industrialisierung, vom Durchbruch des nationalstaatlichen Prinzips und von der imperialen Ausbreitung der europäischen Mächte in Afrika und Asien sowie auf den Weltmeeren. Europa wandelte sich von einem noch agrarisch geprägten zu einem industriellen Kontinent mit Millionenstädten und einem länderverbindenden Eisenbahnnetz. Der technisch- wirtschaftliche Entwicklungsstand und der Zugang zu Rohstoffen und Absatzmärkten wurden zu wichtigen Faktoren der internationalen Politik.

The most evident aspect in both texts is the specialized vocabulary. There are indeed many nominal group constituents, such as *Industrialisierung* [industrialization] in excerpt 2, or long complex noun phrases such as *the vascular bundles of dicotyledonous plants* in excerpt 1, which already give an insight into the particular topic and the advanced level of the text. Technical vocabulary of course also includes verbs (e.g. *reinforce* or *prägen* [characterize]) or adjectives (e.g. *turgid* or *industriell* [industrial]) that seem particular to the specific discipline, however, both texts above are dominated by a density of nominal group constituents. One can further see that even though there are complex

[31] English translation of the text: "The second half of the 19th century was characterized by the progress of industrialization, the breakthrough of the nation-state principle and the imperial expansion of the European powers in Africa and Asia and on the world's oceans. Europe was transformed from a continent still dominated by agriculture to an industrial continent with cities with millions of inhabitants and a railway network linking countries. The level of technical and economic development and access to raw materials and sales markets became important factors in international politics."

patterns of noun phrases, the grammatical structure of both texts is not such a complicated one—mostly SVO[32] with only few dependent clauses. From a grammatical perspective the passive voices are used in both texts—in the English text the simple present passive (*is located* and *are embedded*) and the present perfect passive (*have been likened*), in the German text the simple past passive (*war geprägt von* [was characterized by]). These grammatical structures and the lexical density are very typical for academic writing in general and the school genres of science and history as found in textbooks in particular (see Llinares et al., 2012, Ch. 4 & 5).

Another aspect to consider in the excerpts presented above are the structural differences between the two languages English and Standard German. Even though they share some characteristics with regard to the lexico-grammatical resources such as nominalizations and the use of the passive voice for the construction of technical language within the particular discipline, there are also some structural differences. German is a language that is generally less analytic than English, using more inflections to indicate grammatical gender or case, and morphological morphemes to compound words. This has consequences for its technical vocabulary: For instance, in excerpt 2 the compound noun *Entwicklungsstand* would need to be translated into English with help of a preposition to indicate the semantic relationship between the two nouns, e.g. as *state of development*. This type of morphological system allows the German language to embed more complex noun phrases than English, since the relationships between subject, direct and indirect objects can always be indicated with inflectional morphemes, whereas in English the semantic relationships indicated through prepositions become unclear at some point.

All of these aspects contribute to form what is known as technical language of a specific discipline or field. The theoretical lens technical

[32] German can follow an SVO or SOV structure. In the passive voice (which is used in excerpt 2), the structure is SVO exclusively.

language is looked at in the present study is the concept of technicality as conceptualized by Wignell et al. (1993). Even though Wignell et al.'s concept of technicality is an older approach, its clear definition of a technical term regarding how such terms become technicalized in the natural sciences make it a particularly useful approach to the analysis of technical language in biology. Further, the concept of technicality can be applied independent of language, which makes it a suitable approach to study technical language in a CLIL and non-CLIL context. Accordingly, the next section explains Wignell et al.'s concept of technicality and introduces their definition of a technical term, which serves as a basis for the analysis of technical terms in Chapter 9 (Research Focus 2).

5.1.1 Technicality According to Wignell et al. (1993)

The approach to technicality taken in the current study stems from research conducted by the Department of Linguistics at the University of Sydney from 1986 to 1990 on "secondary-school discourses of science and humanities" (Halliday & Martin, 1993, p. 134). According to this research, technicality and abstraction are the two main components of the scientific discourse of any given academic subject and thus distinguish it from everyday discourse. While abstraction—"moving from an instance or collection of instances, through generalisation to abstract interpretation" (Wignell, 1998, p. 301)—constitutes the more challenging and prevalent part in the humanities, it is technicality—the way scientific understandings of the world are expressed in and through language—that marks the discourse of natural or physical sciences (Martin, 1993b, pp. 212–213). Technicality, in this sense, encompasses everything that makes language in science technical or specific to a particular scientific field.

This includes lexico-grammatical resources such as the technical vocabulary itself or specific clausal constructions used to express cause-effect relationships, as well as more general functions of technical language. It is this type of language that "enables scientists to reclassify the world" (Martin, 1993b, p. 212). In other words, technical language in science does not simply consist of specific vocabulary as it is often reduced to, but encodes a different understanding of the world compared to common-sense views:

> It does this by creating a technical language through setting up technical terms, arranging those terms taxonomically and then using that framework to explain how the world came to be as it is. (Wignell, 1998, pp. 298–299)

This different understanding or non-commonsense view of the world can be expressed through a range of linguistic resources, technical terms being only one of them. By looking at the function of technical language, the model of technicality presented here provides a holistic framework for analyzing what exactly makes language technical in a particular scientific discipline and, more importantly, what functions such a way of expressing employs. For instance, Wignell et al. (1993), when investigating technicality in the discourse of geography, note that technicality involves a different reordering or classifying of the world. Individuals form an understanding, based on previous knowledge and experiences in the world, of how certain things or phenomena stand in relation to each other. This is what Wignell et al. (1993, pp. 141–143) call a vernacular taxonomy, an ordering of things based on everyday knowledge. A scientific taxonomy, on the other hand, orders phenomena or species in a particular relation to each other. The taxonomies of species as presented in Figure 4 serve as a nice illustration of how a vernacular taxonomy and a scientific taxonomy for the same category of animals (birds of prey) can differ.

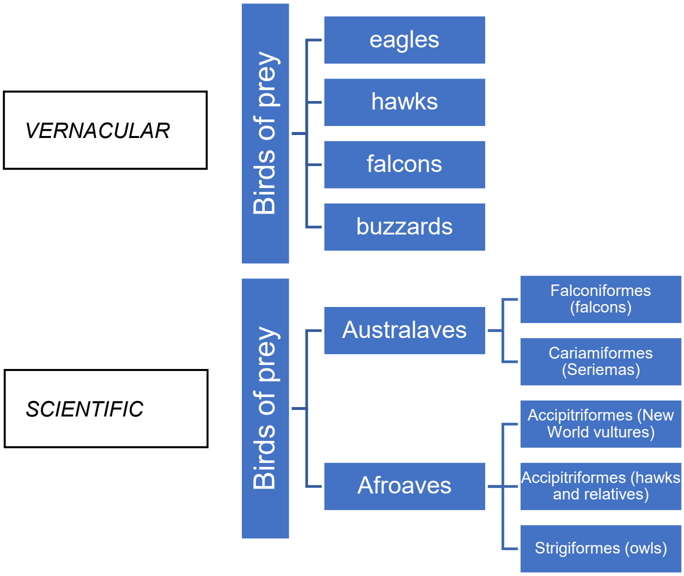

Figure 4: An example of a vernacular and a scientific taxonomy of birds of prey. Based on Wignell, Martin, and Eggins (1993, p. 141) and Jarvis et al. (2014, p. 1322)

Most individuals likely recognize that common birds such as eagles and hawks belong to the same category of birds, namely birds of prey because they prey on smaller animals, a behavior commonly observed in nature or depicted in media. This reflects a vernacular understanding of how these birds are related, based on observable characteristics such as the size, wing shape, or diet. In a scientific taxonomy, illustrated in Figure 4, names are often in Latin, a which is standard in both zoology and botany, and classifications are more precise, detailing family, genus, and species. For instance, in a scientific taxonomy, these types of birds are subsumed in distinct clades (Australaves and Afroaves), reflecting the evolutionary origins of the included bird families. However, even within the scientific community, such taxonomies are not always clear-cut and need constant revisions, especially with the expanding knowledge on the genetic relation of such species (see McClure et al., 2019 for a discussion on the current definition of raptorial birds). Vernacular taxonomies thus order and classify the world according to observable characteristics and lived experiences, whereas scientific taxonomies rely on specialist knowledge. Technical language is therefore not simply a "a fancy way of talking about things" (Wignell et al., 1993, p. 162), but a means of expressing scientific concepts and taxonomies that differ from common-sense understandings of the world.

While the concept of technicality goes beyond labelling technical language as simply a collection of technical terms, it is true that especially the natural sciences are marked by a high density of technical terms. Other approaches to technical language have consequently focused on the prevalence and definition of technical terms in scientific discourse such as for instance in Language for Specific Purposes (LSP) research (see Coxhead, 2018 for an overview). In quantitative ESP or EAP studies, technical or specialist vocabulary is mostly determined through word lists or corpus approaches, where technical or specialist vocabulary is defined as high-frequency words in specialist texts not belonging to general academic vocabulary (see e.g. Coxhead, 2018; or Nation, Coxhead, Chung, & Quero, 2016). In such studies, the definition of a technical term is highly dependent on the method used to identify technical terms. Issues which complicate a neat definition of a technical term are, for instance, the fact that technical terms can be polysemous, i.e. have a vernacular and a specialist meaning (e.g. *force)*, or encode different specialist meanings within different disciplines and are thus highly dependent on context.

Wignell et al.'s concept of technicality (1993), however, is a particularly useful approach to the analysis of technical language because it not only includes a concrete definition of what a technical term is, but also how such a term becomes technicalized in the natural sciences. They define technical terms as follows:

> Technicality, as the term is used here, refers to the use of terms or expressions (but mostly nominal group

> constituents) with a specialized field-specific meaning. (...) The process of technicalizing—for example, of building up a technical vocabulary—involves two steps: (a) naming the phenomenon, and (b) making that name technical. (Wignell et al., 1993, pp. 144–145)

According to Wignell et al., for a term to become technical in science two steps are necessary:

a) one has to name the phenomenon
b) one has to make it technical by giving it a field-specific meaning

Even though Wignell et al. refer to technical terms as "mostly nominal group constituents", there are of course also technical verbs or adjectives, such as the verb *absorb* or the adjective *anaerobic* which have a field-specific meaning assigned to them in the field of biology. However, in science, technical vocabulary mostly consists of nouns or compound nouns because "the taxonomies they [technical terms] establish in fact organize all phenomena as if they were things" (Martin, 1993b, p. 212). Hence, in scientific discourse verbs and adjectives are often transformed into nouns or compound nouns. Through internal word-formation processes such as nominalizations, processes like *condense* can be turned into *condensation* and be described as things, which, in turn, facilitates classification and the establishing of taxonomies. A sentence like (2) can thus be turned into a more complex sentences like (3):

(2) The water vapor *condensed* rapidly.

(3) The rapid but steady *condensation* of the water vapor is a phenomenon often encountered when a decrease in temperature occurs.

In example (2), the phenomenon in question is expressed through a verb, *condense.* Any further characteristics of said process can only be expressed through adverbs ("rapidly"). In (3), *condense* is nominalized and turned into a noun (*condensation*). That way, the process can be described more precisely, since countless pre- and post-modifiers can be added to describe its properties in detail. However, nominalization is not the only way to provide a name for a phenomenon. Borrowing or building on already existing terms from other languages, such as *oxygen* coming from French or *photosynthesis* being a Latin and Greek compound, are equally valid external word-formation processes for name-giving.

The second step of the technicalizing process involves marking a term as technical by giving it a field-specific meaning. This in itself consists of two parts: First, one has to "signal[] or mark[] terms which are going to be given a technical status" (Wignell et al., 1993, pp. 146–147). In textbooks, this is often done via bold font, or other graphic emphasis on the technical term in question. Second, one has to assign it with a field-specific meaning. That is, the technical term needs to be followed by a definition or elaboration of some sort that specifies the meaning of said term in the given context of that field (Wignell et al., 1993, p. 148). Consider for instance example (4), taken from a linguistics textbook (VanPatten, Smith, & Benati, 2019, p. 181, emphasis in original):

(4) The term **integrative motivation** refers to an individual's perspective on the target language and culture.

In example (4), the technical term *integrative motivation* is highlighted in bold, immediately drawing the reader's attention to the term. This is the first part of technicalizing step 2. The second part consists of linking said term to its field-specific meaning. Wignell et al. (1993, pp. 149–150) state that this is often done through identifying relational clauses, such as "*x* means *y*", which usually fulfils two main grammatical functions: the ones of 'token' and 'value' (Halliday, 1985). Roughly speaking, Halliday defined 'token' as the realization of the sign or form, while 'value' is defined as the realization of meaning or function (see Wignell et al., 1993, pp. 149–150). Wignell et al. found that based on their research of scientific texts, "the technical term always realizes the function of token, and that what is thought of as the definition realizes the role of value" (1993, p. 150).

To return to the example (4) above: In this case, the term *integrative motivation* represents the 'token', usually the subject of a clause, and the definition (underlined) its 'value'. The term *integrative motivation* (token) thus gets linked with a specific meaning that it only encodes in the field of linguistics (value). Other grammatical resources to realize a token-value relationship are for instance projecting and non-projecting naming processes[33], where the link between 'token' and 'value' is realized through verbal processes such as "we say", "it is called", "the common name is". An example of this is illustrated in (5), taken from VanPatten et al. (2019, pp. 17–18, emphasis in original):

(5) The plural s- marker is what is called an **inflectional morpheme**.

Example (5) shows a non-projecting naming process, where an example (the plural s-marker) is linked to the technical term *inflectional morpheme.* Projecting and non-projecting naming processes

[33] Projecting and non-projecting naming processes are another grammatical resource that can assign meaning to a technical term. Grammatical projection is a whole field of study in the SFL tradition (see Halliday, 1985, 1994; Halliday & Matthiessen, 2004). The difference between projection and non-projecting naming processes does not become entirely clear from Wignell et al. (1993), but it seems that the former makes use of personal verbal processes such as "we say" "we call it", and non-projecting naming processes involve the same verbal processes but in a more impersonal manner.

> make quite explicit that the term is being set up as technical. They also bring out the point that what the process of technicalizing is really about is translating: giving a field-specific gloss to phenomena which may be known as something else in another field or in folk taxonomies. (Wignell et al., 1993, p. 149)

The second step of the technicalizing process—setting a term up as technical through highlighting the token and relating it to its value—becomes especially important if there is already an existing vernacular meaning of the same term. As mentioned previously, a technical term can also be established using an already-existing vernacular and assigning it a particular meaning, such as for instance *force. Force* is an everyday word used as a synonym for strength. However, in the discipline of physics, *force* refers to any influence which tends to change the motion of an object. Hence, *force* is only a technical term in the discipline of physics, where it has a specific meaning. In such a case, it is all the more important that the term in question, the 'token', is marked as technical, so students are not using it in its everyday meaning, but specifically connect it to a new field-specific meaning. This then needs to be linked to a field-specific meaning, so readers and students can replace their previous notions of said term with the field-specific value. Taking all of these considerations into account, the definition of a technical term used in the current study is:

A **technical term** is a ‘token’, usually in the form of a noun, compound noun or noun phrase, that is assigned a value, in this case a field-specific meaning. A field-specific meaning thereby refers to the meaning encoded in this term whenever it is used within the context of that field.

This definition is revisited and further expanded in the methodology section of Chapter 9, where the detailed identification process of technical terms is presented.

However, in their studies, Wignell et al., as well as later studies using technicality as an analytical model (e.g. González Pueyo & Val, 1996; Maxwell-Reid & Lau, 2016), examine written material—historical scientific essays, textbooks, students’ writing. There are (mostly implicit) references to the differences between scientific texts and spoken interaction, as for instance in Halliday (1993, p. 76) when he refers to the higher lexical density of written texts in general and scientific ones in particular to “informal spoken language”. In the science classroom, there is a mixture of written, oral, everyday and scientific features, and students encounter different levels or degrees of technicality in each.

It is then the teachers’ task to decode the technicality in the language of science in a way that it is accessible to the students. Ideally, this is a step-by-step process, leading them to understand the language of science in the textbooks to being able to find the lexico-grammatical resources to talk about science and eventually, produce writing of their own in a degree of technicality that is seen as an accepted standard for scientific writing (Lemke, 1990, p. 27). Thus, much of the teacher’s task consists of scaffolding the students to a scientific understanding of the concept in question based on the everyday notion of the concept the students bring with them. Scaffolding hereby refers to the “[t]emporary support given by a tutor/teacher to a learner in order to help them perform a task which would be too difficult for them to perform alone" (Llinares et al., 2012, p. 336).

Since science subjects are marked by a high density of technical terms (Drumm, 2016, p. 42), it is imperative to appropriately introduce technical terms in the classroom. Therefore, in science, a great part of scaffolding involves unpacking and repacking of technical terms and concepts. According to Lin, unpacking refers to how teachers "help students simplify academic language into everyday language" (2016, p. 242), whereas repacking refers to the opposite process: "moving from everyday styles of speaking/writing to academic styles of speaking/writing" (2016, p. 238). While Lin (2016) views unpacking and repacking mainly in terms of language, i.e. moving from academic to everyday language and back, this goes hand in hand with the unpacking and repacking of technicality: Complex abstract ideas have to be translated into more concrete notions students can grasp, and then they have to be repacked. In other words, once students have understood their meanings, technical terms have to be used in their intended and abstract way. Semantic profiles, and with it semantic waves, are models stemming from Legitimation Code Theory (LCT) which can capture and thus help depict classroom practices in terms of unpacking and repacking. Semantic profiles are used in Research Focus 3 (Chapter 10) to analyze how translanguaging practices contribute to the unpacking and repacking of a technical term. In order to understand the methodology of Chapter 10, the theory behind semantic profiling is explained in the next section.

5.1.2 Semantic Profiles and Semantic Waves: Unpacking and Repacking Technicality

The concept of the semantic wave was first introduced by Maton (2013, 2014a) and conceptualizes an ideal way of unpacking and repacking technical terms in teaching. It comes from Legitimation Code Theory (LCT), which is a sociological theory of cumulative knowledge-building. More specifically, it examines the organizing principles that govern knowledge practices. Much research on knowledge structures, such as how knowledge is acquired and developed, has focused on typologies of knowledge, e.g. hard vs. soft sciences, academic vs. general knowledge. LCT claims to be the first theory of knowledge that does not build upon such typologies of knowledge, and can therefore be applied to all contexts, no matter the field (Maton, 2017). In doing so, LCT proposes that knowledge structures are built by legitimizing certain practices or codes within specific contexts. Such codes can be analyzed across five dimensions[34]; however, only the dimension of *Semantics* is relevant for this study and thus discussed here.

The dimension of *Semantics* refers to knowledge practices related to meaning and according to LCT, is enacted through two so-called semantic codes: **semantic gravity (SG)** and **semantic density (SD)**. Semantic gravity hereby refers to the degree of which meaning relates to a particular context, i.e. how much something is context-dependent. That means, the "more meaning relies on its local reference for meaning", the stronger is its semantic gravity; "the more de-contextualised and universal the meaning, the lighter it is" (Hugo, 2014, p. 3). For instance, $NaCl^{-}$ (sodium chloride) is less context-dependent, and thus more abstract a term than its equivalent *salt* (Antia & Kamai, 2016, p. 204). *Salt* is more concrete, as its meaning is widely understood, though context is needed to determine whether it refers to table salt, sea salt, or salt in a chemical sense. Consequently, *NaCl* has weaker semantic gravity (SG–) and *salt* has stronger semantic gravity (SG+). Semantic gravity is thus evident "[e]very time a general concept is illuminated by a specific case; every time a local instance is generalised into a universal rule" (Hugo, 2014, p. 3).

[34] Apart from the dimension of *Semantics,* LCT also covers the dimensions of *Specialization, Autonomy, Temporality* and *Density.* For more information, see Maton, Hood, and Shay (2016).

Semantic density, in constrast, describes the degree of complexity of meaning, i.e. how condensed a meaning within a concept or a term is. The more complex or condensed the meanings are in the knowledge practice in question, the more effort is required to simplify or unpack them. For instance, in order to unpack $NaCl^{-}$, one must first understand the chemical elements *Na* (Sodium) and *Cl* (Chlorine), as well as the fact that sodium binds exclusively with chloride, a negatively charged chlorine molecule, to form sodium chloride ($NaCl^{-}$), known in its crystallized form as table salt. As a result, $NaCl^{-}$ has a much stronger semantic density (SD+), whereas *salt* has a relatively weak semantic density (SD–). Maton (2014b) explains that these two semantic codes can be mapped in a so-called semantic plane (see Figure 5).

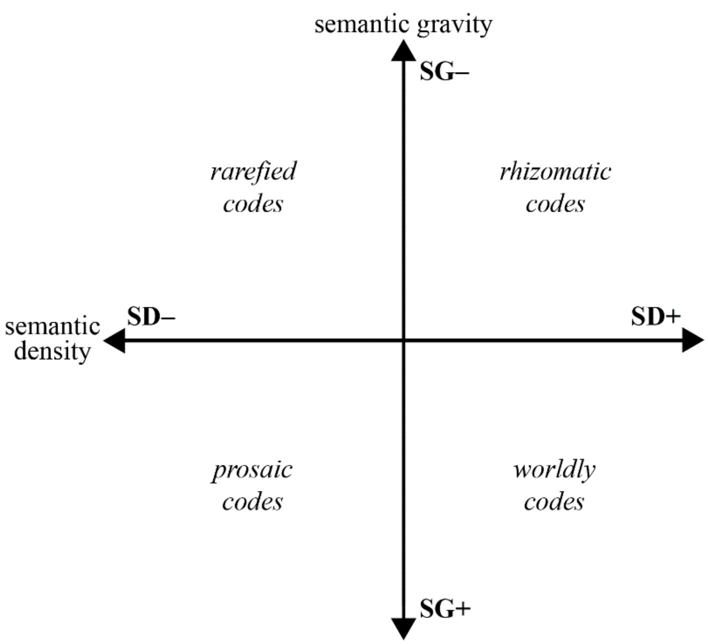

Figure 5: Codes of the semantic plane (Maton, 2014b, p. 131). Reproduced with permission.

This model of the semantic plane not only accommodates the traditional binary distinction of more abstract and complex (SG–, SD+) and more concrete and simpler (SG+, SD–) knowledge practices, but also allows for mapping a wide range of practices (Maton, 2016, 2017). Rarified is relatively abstract and simple (SG–, SD–), as for instance found in management discourse. Prosaic describes the more concrete and simpler semantic codes (SG+, SD–), usually used in everyday discourse. Worldly codes refer to concrete but complex knowledge practices with regard to semantics (SG+, SD+), such as for instance encountered in vocational education. Rhizomatic refers to the more abstract and complex (SG–, SD+) codes used in an academic lecture for example. With this model of the semantic plane, shifts in semantic gravity or semantic density of any discourse or text can be recorded, resulting in what Maton (2013) coined "semantic profiles". In semantic profiles, changes in semantic gravity and semantic density (SG↑↓, SD↑↓) are recorded over time, "whether in classroom discourse, curriculum, student essays, etc." (Maton, 2014c, p. 38).

Semantic profiles in LCT are plotted in form of a semantic scale on the y-axis against time on the x-axis (see Figure 6). On the semantic scale, semantic gravity and semantic density are inversely plotted against each other. Weak semantic gravity and strong semantic density (SG–, SD+), or, in other words, decontextualized (abstract) and complex meanings, are on the top margin of the y-axis, whereas strong semantic gravity and weak semantic density (SG+, SD–) are at the bottom margin of the y-axis.

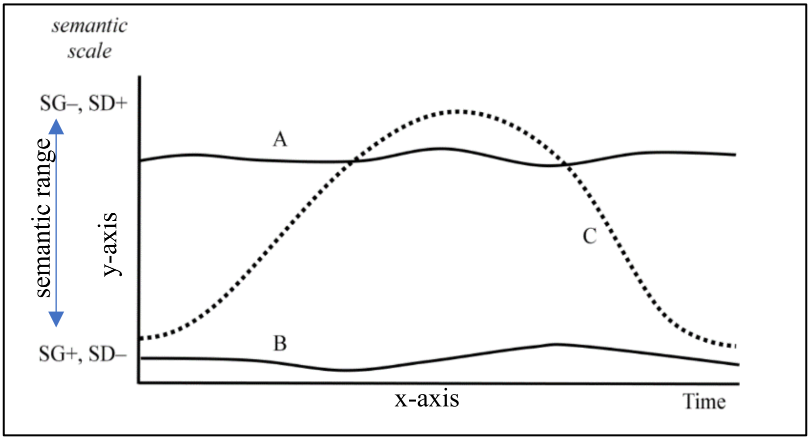

Figure 6: Prototypical semantic profiles (Maton, 2013, p. 13). Reproduced with permission.

In Figure 6, three prototypical semantic profiles are listed: A) a high semantic flatline, B) a low semantic flatline and C) a prototypical curve where shifts in semantic gravity and semantic density occur, which is called a semantic wave (Maton, 2014a). The prototypical profiles of A) and B) show a relatively low semantic range and no changes in SG and SD. A) is projecting a discourse dealing constantly with abstract/complex meanings (SG–, SD+) and B) one that is continuously using a more concrete/simpler meaning (SG+, SD–). The semantic profile of C) then shows a great semantic range describing a shift from SG+ and SD– to SG– and SD+, and vice versa. That is, weakening semantic gravity (SG↓) and strengthening semantic density (SD↑) by moving from simpler and concrete meanings to more complex and generalized meanings, followed by the reverse process (SG↑, SD↓), creates what is known as a semantic wave (Antia & Kamai, 2016, p. 205).

Semantic profiles are particularly useful for classroom research, since they can capture the pedagogical functions of unpacking and repacking (see Lin, 2016, pp. 66–73). Unpacking is a translation process, not only from complex academic language to everyday language, but in the natural sciences also with regard to technicality:

> The most obvious response is to 'translate' scientific language into 'everyday language' [is] to remove the technicality and abstraction so that all 'normal' users of language may have access to it. (Martin & Veel, 1998, p. 31)

Thus, unpacking involves as much language (from academic to more everyday styles of language) as it involves content (deconstructing technical terms and concepts into more concrete and simpler notions). In terms of semantic profiles, technical terms or concepts are often abstract and complex, therefore they generally have weak semantic gravity (SG–) and strong semantic density (SD+). A teacher's task then is to unpack these terms or concepts by strengthening semantic gravity (SG↑), for instance making it more concrete by giving a local example, and at the same time weakening semantic density (SD↓) by unpacking "a concept into its specific components" (Hugo, 2014, p. 4). This is where the concept of semantic wave comes in.

As shown in Figure 6, a semantic wave is a specific type of semantic profile. More specifically, it describes the ideal way of unpacking and repacking technicality in teaching. As mentioned above, technical terms are often abstract and have dense complex meanings (SG–; SD+), which need to be unpacked (SG↑; SD↓) and then repacked (SG↓; SD↑), which can be described by a semantic wave (see Figure 7).

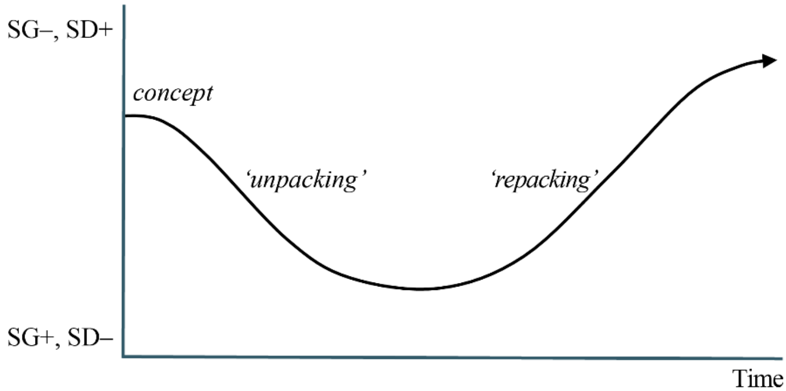

Figure 7: A semantic wave in relation to the pedagogical functions of unpacking and repacking (Maton 2013, p. 15). Reproduced with permission.

Figure 7 shows such a semantic wave, connected to its corresponding pedagogical functions of unpacking and repacking. A technical term, weak in SG and strong in SD, is unpacked “into previously learned terms and everyday language, including examples form everyday life” (Lin, 2016, p. 72), i.e. its SD is weakened and SG is strengthened. The term then has to be repacked or put back into “semantically dense academic language” (Lin, 2016, p. 73).

Research on classrooms using the analytical model of semantic profiling has shown that teachers, more often than not, do not have semantic waves in their teaching. That is, they do unpack complex and abstract knowledge practices such as explaining scientific writing, but do not repack these technical terms and concepts (see e.g. Macnaught, Maton, Martin, & Matruglio, 2013; Martin, 2013; Maton, 2013). However, the repacking of technical terms and concepts is essential for students to acquire academic and disciplinary literacy, enabling them to express themselves effectively in high-stakes speaking and writing.

Maton showed

> that 'semantic waves', where knowledge is transformed between relatively decontextualised, condensed meanings and context-dependent, simplified meanings, are a key characteristic of academic literacy. (Maton, 2014c, p. 34)

Consequently, the goal of any teaching should not only consist of unpacking, but of recurring processes of unpacking and repacking, of recurring semantic waves. The analytical tool of semantic profiles and semantic waves, can thus not only be used to trace how unpacking and repacking is done in the classroom, but also how it "could" be done, so that students not only understand technicality, but also know how to express technical concepts academically. Recently, the LCT model of semantic profiles and semantic waves has also been used as a tool to analyze CLIL classroom practices (see Lin & Lo, 2017; Lo, Lin, & Liu, 2020). To understand the potential contributions of an analysis of semantic codes (SG and SD) to CLIL research with regard to CLIL science specifically, it is necessary to first review prior research on science and technicality in relation to CLIL.

5.2 Challenges in the CLIL Science Classroom

Science subjects are often marked by a high density of technical terms, which is one of the reasons some teachers are reluctant to teach it in an additional language (Langer & Neumann, 2012, p. 93). In addition to this, the so-called conceptual change (Treagust & Duit, 2008), is greatest in the natural sciences. The conceptual change describes the distance between students' everyday knowledge and the specific content knowledge they are expected to acquire in a specific lesson. This is particularly important in science lessons, where "[s]tudents come to science lessons with everyday conceptions that differ from the scientific ones they are expected to acquire" (Morton, 2012, p. 101).

This becomes even more challenging in the CLIL context, since

> [i]n CLIL classrooms, as in all classrooms, there is a double ‘bridging’ process going on. One is between the ideas themselves, from the everyday to the more scientific, and the other is between the two types of language used to talk about these ideas. (Llinares et al., 2012, p. 39)

Even though this “double ‘bridging’ process” is occurring in all classrooms, it is in the CLIL classrooms where it proves to be particularly difficult. CLIL students (and teachers) are usually second or foreign language learners of the TL. Consequently, this bridging between “the two types of language used to talk about these ideas” becomes increasingly complex. Students may discuss everyday concepts in their L1, but have to use the TL to talk about scientific concepts in the CLIL class. It is, thus, not simply a bridging process between “two types of language” (everyday and scientific), but also between two different languages. In this scenario, the teacher—in order to scaffold scientific concepts—needs to be aware of the conceptual change and the “two types of language” used to talk about it in the respective languages, and employ them appropriately in the CLIL lesson.

Taking an example from biology, *respiration* is a term most people are familiar with—inhaling, exhaling, breathing in general. *Respiration* as a technical term, however, has a specific meaning in the field of biology describing the exchange of oxygen and carbon dioxide between an organism and its environment (OED, 2021c). A teacher’s task, therefore, is to build on students’ knowledge of *respiration* as the physical act of breathing, and expand it to the scientific definition of the chemical process occurring during inhalation and exhalation. This shift involves transitioning simultaneously from everyday language and everyday notions of respiration to more academic styles of language and the scientific concept of respiration. With this foundation, students can progress further to examine a specific type of respiration: *cellular respiration.* The naming process already indicates the focus on respiration (in the technical sense) on a cellular level, making the encoding of technicality rather self-evident. The equivalent term in German, *Zellatmung,* (*Zelle [cell]* + *Atmung [respiration]*), employs the same naming process to describe this phenomenon. Thus, CLIL students whose L1 is German and TL is English are unlikely to face additional challenges with this "double bridging process" compared to regular students.

However, technicality is not always encoded in the same way in the L1/ML as in the TL, especially in languages that are not closely related. For example, some languages have borrowed a large number of terms, whereas other languages allow for more internal word-formation processes, and others again have a higher density of vernacular terms becoming technicalized. Hence, there are different ways in which technicality is constructed or encoded in a particular language. When looking at CLIL and technicality from Wignell et al.'s (1993) perspective, one of the most difficult aspects is the encoding of technical terms in the respective language. As established in the paragraph before, in CLIL lessons the teacher is faced with the difficult challenge of juggling the move between everyday and scientific concepts, and simultaneously between two languages, the L1/ML and TL. This is further complicated by the fact that technicality is not necessarily encoded the same way in every language in the respective scientific discourse. This is particularly confusing when a technical term is built up on an already existing vernacular expression:

> Sometimes, the field-specific technical vocabulary looks like everyday vocabulary and can lead to misunderstandings of academic concepts. For instance, words such as 'force' and 'pressure' in physics have specialized definitions, and if students interpret them using their everyday life understanding of these words, confusion can arise. (Lin, 2016, p. 41)

The different encoding of the experiential world in language also has consequences for learning science through another language, as is the case in CLIL. Lin (2016, p. 49) describes the example of *heat* as a technical term (e.g. in physics) and *hot* as an everyday adjective, which in Chinese are encoded in the same term (熱). As there is no equivalent in Chinese, this affects the way Chinese students learn the concept of *heat* in English and consequently also how CLIL teachers have to teach said concept.[35] Nikula (2017b) describes a similar case in a Finnish CLIL physics lesson, where students struggle with the term *moment* since it has an everyday but also the field-specific meaning in English, but Finnish employs different terms for each. It seems logical, to some degree, that topologically distant and structurally different languages such as Chinese (as a Sino-Tibetan language) and Finnish (as a Uralic language) have not only developed different ways of conceptualizing the world, but also various forms of encoding technicality in their respective languages compared to English. Nevertheless, the encoding of technicality can also be a challenge in more closely related languages such as German and English (both Germanic languages), as I was able to show (Bieri, 2019a, see Section 10.2.1 for a full description of this study).

Therefore, not only does a CLIL science teacher need an understanding of how technicality is encoded in the L1 and TL, but also needs to be able to scaffold this in the CLIL science classroom. Process-

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[35] For a more detailed discussion about the structural differences of scientific discourse in English and German see Halliday (1993).

oriented studies have shown how interactional and multimodal resources are key to scaffolding meaning-making in CLIL science lessons (see e.g. Evnitskaya, 2012; Evnitskaya & Morton, 2011; Forey & Polias, 2017; Nikula, 2015). Most recently, Lo and Lin (2019) edited a special issue of the *Journal of Immersion and Content-Based Language* focusing teaching, learning and scaffolding in CLIL science classrooms. Its articles analyze scaffolding in CLIL science classrooms from a variety of perspectives: focusing on teachers' language awareness (Xu & Harfitt, 2019), explicit language instruction for scaffolding (An, Macaro, & Childs, 2019; Lo, Lui, & Wong, 2019), the use of translanguaging (Turner, 2019) or the use of concept maps and concept sketches (He & Lin, 2019; Ho, Kwai Yeok Wong, & Rappa, 2019).

Two common themes can be distilled from these articles: The first concerns the role that language plays in mediating science teaching and learning in a CLIL science classroom and the second refers to integrated assessment of CLIL science (Tang, 2019). Regarding the first theme, the articles illustrate the wide range of scaffolding techniques encountered in CLIL science contexts, varying in their explicitness as well as the level language works at to scaffold content: It can be discursive, cognitive-linguistic, semiotic or epistemic and affective (see Tang, 2019). The second theme concerns the extent to which content and language can actually be integrated in regards to CLIL science instruction and assessment, a question long-echoed not only in regards to CLIL science teaching but in CLIL teaching in general (see e.g. Morton, 2020a; Morton, 2020b). Using a variety of approaches to analyze scaffolding techniques the studies in the special issue illustrate some of the difficulties regarding the study of integration of content and language in CLIL science lessons: Sometimes it might be necessary to separate language and content for analytical purposes (e.g. An et al., 2019; Lo et al., 2019); in other scenarios "it may not be feasible to separate content and language as distinct objectives or foci"

(Tang, 2019, p. 326), both of which make it challenge to assess content and language in integration.

In line with this type of research, Fernández-Fontecha, O'Halloran, Wignell, and Tan (2020) used a systemic functional multimodal discourse analytical approach (SF-MDA) to investigate the use of multimodal scaffolding techniques in CLIL science classrooms, and illustrated how particularly visual thinking strategies can help promote the acquisition of scientific language and facilitate the development of content knowledge. Lastly, Lo et al. (2020) explored the potential of semantic waves as an analytical tool for the analysis of unpacking and repacking of technical terms in CLIL science lessons and were able to illustrate the pedagogical function of a range of strategies such as paraphrasing and translanguaging to the use of visual aids (see Section 10.2.2 for a more detailed summary of that study). In sum, all of these studies on CLIL and science show how complex the integration of language and content in science classrooms is. Still more research is needed to understand exactly how language (or translanguaging) and content work in integration in CLIL science classrooms.

5.3 Summary of Chapter

The chapter has shown that technical language can be approached from a wide variety of perspectives, such as academic language and jargon. Wignell et al.'s (1993) concept of technicality, which describes everything that makes language in science technical or specific to a particular scientific field, has been introduced. Their definition of a technical term as a nominal expression with a field-specific meaning assigned is the one adopted in the present study in the analysis of technical terms (Chapter 9). In the classroom, technical terms need to be properly explained and scaffolded, in other words, they need to be properly un- and repacked.

The chapter has introduced semantic profiling (Maton, 2013) as one way to visualize and thus analyze un- and repacking processes in the classroom. Semantic profiling is later used as a methodology in Chapter 10 to analyze the role of translanguaging practices in the negotiation of technical terms. description of this study). The density of technical terms is a particular challenge in science teaching, and even more so when teaching it in a CLIL context. Students may discuss everyday concepts in their L1, but have to use the TL to talk about scientific concepts in the CLIL lesson. Therefore, teachers need an understanding of how technicality is encoded in the L1 and the TL to properly scaffold technical terms in the CLIL science classroom. CLIL research on scaffolding in science classrooms is ongoing, but more research on how technical terms exactly affect communication in the classroom is needed.

Part III: RESEARCH DESIGN

6 Data

This chapter introduces the types of data used to address the research questions in the current study. It begins with an overview of the EG_BIO corpus (**E**nglish and **G**erman **bio**logy lessons), and outlines its data collection process (Section 6.1). The EG_BIO corpus consists of 31 detailed transcripts of video-recorded CLIL and non-CLIL biology lessons, along with teaching materials and field notes, and serves as primary data source for the analyses of translanguaging and technicality in Chapters 8 to 10. Section 6.1 also addresses the ethical considerations involved including participant consent as well as challenges that come with doing video-recordings in a classroom. In Section 6.2, the data description provides an overview of participants, recorded lessons, teaching materials, and field notes that make up the EG_BIO corpus. Additionally, follow-up data, such as teacher interviews and a CLIL student survey, are discussed. Finally, Section 6.3 explains the rationale behind the data selection for the EG-BIO corpus and outlines the steps taken to prepare the transcripts of the video-recordings for both quantitative and qualitative analysis.

6.1 Data Collection

The EG_BIO corpus (**E**nglish and **G**erman **bio**logy lessons) consists of several kinds of data related to classroom interaction of lessons taught by two teachers teaching their subject biology in English (CLIL program) and in Standard German (non-CLIL) at a Swiss upper-secondary school. The EG_BIO corpus includes prepared transcripts from video-recorded data, teaching materials used in these lessons, and field notes. The video-recorded data used as a basis for the EG_BIO corpus was originally collected for the author's MA thesis (Bieri, 2015), which analyzed four lessons due to limited scope. Building on and expanding this research, the current study utilizes the full dataset of 31 video-recorded biology lessons (~45 min. each). I occasionally comment on some of the ethical and methodological consequences that arose when transitioning from the MA thesis to the PhD project while drawing on the same dataset.

Qualitative research, especially exploratory research as is the case in the present study, often starts with an open or general research question and then “follow[s] the most interesting issue that arises in the course of data collection” (Ingram & Elliott, 2020, p. 161). This is especially true when employing a bottom-up approach, since at the time of data collection the researcher does often not yet have a clear idea what to focus on. This was also the case during data collection for my MA thesis in 2015. I was particularly interested in how teachers adapt their strategies depending on whether they are teaching their subject in the ML (non-CLIL program) or in the TL (CLIL program). I decided to opt for video-recordings in classrooms, as they provide the richest data, including non-verbal cues and gestures, focus on the blackboard and potentially easy speaker identification (Dörnyei, 2007, pp. 137, 185; Ingram & Elliott, 2020, pp. 181–182), which could prove important later. I therefore needed to find a school willing to support the project, teachers who taught their subject in a CLIL and non-CLIL program and were open to participating, and obtain informed consent for video-recordings from the students and their parents.

6.1.1 Obtaining Informed Consent

Informed consent is crucial to any researcher working with participants, and in order to be able to consent, participants need to “have a good understanding of what the study involves” (Ingram & Elliott, 2020, p. 160). In the school context, this can be challenging since multiple parties need to be convinced: the school administration, teachers, students and even parents[36] (if students are not yet 18). Once the school

[36] The students who participated in this project were between 16–18 years old at the time of the recording. Students who were not yet 18 years old needed

approved the project, I found two teachers willing to participate who taught biology in both Standard German (non-CLIL program) and English (CLIL program). After preparatory meetings with the principal and the teachers, it was decided that I would film all their biology lessons (eight different classes[37] in total, four in the CLIL and four in the regular program) over the span of one month (May 2015). The project was introduced in all eight classes, and an information sheet, including a consent form, was distributed to the students. To maximize the likelihood of recording while minimizing disruption, participants could choose to allow both video and audio recordings, audio only, or none at all. Only three out of 152 opted for audio-only, which was resolved by adjusting the camera angle (see Section 6.1.2). One student declined both video- and audio-recording, and it was agreed that the entire lesson would be filmed, with scenes involving that student removed afterward. This issue will be revisited in Section 6.3.1.

One ethical issue worth addressing here pertains to "informed consent in the context of exploratory research" (Ingram & Elliott, 2020, p. 161). In qualitative exploratory research the research focus is not yet set and can shift considerably depending on the developing research questions, and thus might derive from what participants originally consented to with regard to research. Flewitt (2006, p. 31) proposed that in such cases one should think of informed consent as "provisional" consent, and if needed revisit ethical questions such as how the research affects the participants now that the research focus has changed. This is a valid consideration in relation to the current study. Video-recordings were done in 2015 for the purpose of my MA thesis, with both students as well as teachers fully informed and consenting to the use of data "for

their parents to also sign the declaration of consent, therefore it was important to involve and convince the parents as well.

[37] In order to avoid any future confusion regarding the use of "lesson" and "class": Lesson in this study refers to the actual 45-minute slot when biology is taught: Class refers to the specific group of people that is being taught in a lesson (e.g. class 1f, 1b—see Section 6.2 for an overview).

publications by myself or the University of Basel". While this technically includes the PhD project, as it constitutes a publication by myself and the University of Basel, the research focus in the PhD has shifted somewhat from that of the MA thesis. Flewitt (2006, p. 31) suggests that in this case students as well as teachers need to be kept informed, and informed consent needs to be sought continuously when found appropriate. In the case of the students, it was not deemed necessary to seek consent again since their anonymity is granted, and the research foci on translanguaging and technicality do, at least from my perspective, offer no ground for sensitive material. Since the students themselves as well as their parents signed the declaration of consent, I view the informed consent obtained in 2015 as still adequate.

The teachers' situation is different. While they provided oral consent at the beginning of data collection, the PhD project places considerable emphasis on their individual teaching practices and, to a lesser extent, on their attitudes as expressed in the interviews (see Section 6.2.2). Although their names are anonymized, additional consent was sought and obtained from the teachers for the PhD project and its publication.

6.1.2 Doing the Actual Recordings

Even though video-recordings of classrooms have many advantages and offer potentially rich data, there are also some downsides, such as "literal blind spots" and "distraction by the camera" (Dörnyei, 2007, p. 184). The first is connected to what Ingram and Elliott point out:

> [V]ideo recording can produce extremely rich data for research in classroom discourse, the use of video cameras entails making a number of choices every time you use them in the classroom, such as position, frame, angle and closeness to the action (...) These choices will dictate what you can and cannot see from the final recording. (Ingram & Elliott, 2020, pp. 181–182)

That is, the camera needs to be positioned consciously so as to avoid any potential blind spots and get as full a picture as possible. In the case of the video-recordings of the CLIL and non-CLIL biology lessons, the SONY Handycam HDR-XR520VE was placed on a tripod on the windowsills on the back-left side of the classroom. The reasoning for this was two-fold: On the one hand, in order to heighten student anonymity, all students were filmed from the back, and those students who did consent to audio- but not video-recording were seated behind the camera. On the other hand, the picture captured that way includes full view of the teachers, their movements, and teaching material such as the overhead projector

Another decision taken for the classroom recordings concerned my own presence in the lessons as a researcher. In order to be able to take notes ad-hoc about potentially interesting interactions or situations and handle the camera at all times, I positioned myself on the windowsill next to the camera. Even though the camera placement and my position were consciously chosen to be as subtle as possible in order to minimize the observer's paradox (Labov, 1972), it cannot be ruled out that the participants' behavior was affected by my presence or that they were "distract[ed] by the camera" (Dörnyei, 2007, p. 184). In fact, there is evidence within the data suggesting that both my and the camera's presence certainly did distract teacher and students to some degree, some examples of which are shown in the following.

(6) `T: So this is the first day our lessons will be recorded, uhm, so especially now stick to English (xx) okay. Cause it is very important for the analysis of the lesson I guess.`

(7) `S: Ich weiss jetzt scho was (usekunnt). Im Änglisch passt me sicher viel meh uff, will mes nit vrstoht.`
`[I already know now how it (turns out). In English they are surely more attentive because they don't understand it]`

(8) S: Isch d'Kamera no ah?
[Is the camera still on?]
((waves to camera))

In example (6), which occurred at the beginning of the first recorded CLIL lesson, the teacher acknowledges the presence of the camera and encourages students to speak in English. In example (7), a student comments on the research project, stating that they already know the outcome of the study. In example (8), a student directly engages with the camera, asking if it is still recording and then waving at it. These examples demonstrate how my presence as a researcher with a camera influenced participants' behavior. Fortunately, such instances were rare, as both the teacher and students quickly adjusted to my presence over the four-week recording period.

6.2 Data Description

This section provides a detailed description of the data and the participants involved in the present study. While the data collection process focused on obtaining the video-recordings, getting access to the school also enabled the collection of follow-up data such as interviews with participants. The following two sections present an overview of the EG_BIO corpus and the follow-up data obtained from teachers and CLIL students.

6.2.1 The EG_BIO Corpus

The EG_BIO corpus consists of transcripts of video-recordings, the teaching materials used in these lessons as well as my own field notes, which are presented in the following. Regarding the video-recorded material, a total of 31 CLIL and non-CLIL biology lessons were recorded. The recordings took place in an upper-secondary school (*Gymnasium*) in the German-speaking part of Switzerland over a period of four weeks. The two teachers (T1 and T2) participating in this study both teach their subject biology in English (CLIL program) and in

German (regular program). They both have Swiss German as their L1, are content experts, and have no formal education in bilingual teaching or teaching English (as is often the case with CLIL teachers, see Section 2.1.1).

The recordings took place in eight different classes, half of which were CLIL classes and had biology in English, and half of which were non-CLIL classes. Students were in grades 10 and 11, between 16 and 18 years old and most of them had Swiss German as their L1. Six out of eight classes had similar class sizes (18–22 students per class; 1a [n=21], 1e [n 22], 1f [n=18], 2d [n=21], 2e [n=22] 2h [n=18]), while two classes differed in size (T2's CLIL classes 1b [n=9] and 2b [n=11]). In total, 152 students took part in this study, 66 in the CLIL classes and 86 in the non-CLIL classes. Each lesson (with one exception) lasted roughly about 45 minutes. This resulted in video-recorded material of a total of 22 hours and 48 minutes. All video-recordings were labelled according to date and class[38] and saved in a password-protected space. Table 2 provides an overview of the recorded lessons according to teacher and grade.

[38] For instance, "20150507_2e" is the file name for the video-recording of class 2e on the 7th of May 2015.

Table 2: Overview of recorded lessons (L) according to teacher and grade

Teachers:	**Teacher 1 (T1)**	**Teacher 2 (T2)**
Grade 10 CLIL	1e = 5L	1b = 5L
Grade 10 regular	1a = 6L	1f = 6L
Grade 11 CLIL	2e = 3L	2b = 2L
Grade 11 regular	2d =2L	2h = 2L
hours total:	**16 lessons T1**	**15 lessons T2**

Key: L= lesson (45min); 1a, 1b, 1e, 1f, 2b, 2d, 2e, 2h = class names

Table 2 shows that the collected data, though small in size it may be (as it only involves two teachers), lends itself for comparisons on several levels: There are roughly the same number of lessons by each teacher (T1=16, T2=15), of CLIL and non-CLIL lessons (15 vs. 16), as well as an equal distribution within the respective grades. A more detailed look at the lessons according to teacher and topic is important in regards to the quantitative analyses of translanguaging and technicality of the EG_BIO corpus (Research Foci 1 and 2, Chapters 8 and 9) and is therefore provided in Tables 3 to 6.

In terms of content, all of T1's recorded lessons (Tables 3 and 4) deal with biochemistry. T1 follows a similar schedule for both his CLIL (1e and 2e) and non-CLIL classes (1a and 2d), often with overlapping topics and one or the other class occasionally progressing at a faster pace. T1 also confirms this in the follow-up interview (see Section 6.2.2), where he mentions that he uses the same script, once in German and once translated into English, for his non-CLIL and CLIL classes, respectively.

Table 3: Video-recorded lessons according to class and topic grade 10 (T1)

Class	Program	Topic	Class	Program	Topic
1e	CLIL	Cellular respiration	1a	Non-CLIL	Kohlenhydrate [Carbohydrates]
1e	CLIL	Metabolism	1a	Non-CLIL	Zellatmung [Cellular respiration]
1e	CLIL	Fermentation	1a	Non-CLIL	Zellatmung [Cellular respiration]
1e	CLIL	Fermentation	1a	Non-CLIL	Zellatmung [Cellular respiration]
1e	CLIL	Metabolism, biomass	1a	Non-CLIL	Zellatmung [Cellular respiration]
			1a	Non-CLIL	Fermentation [Fermentation]

Table 4: Video-recorded lessons according to class and topic grade 11 (T1)

Class	Program	Topic	Class	Program	Topic
2e	CLIL	Blood circulation	2d	Non-CLIL	Hämoglobin [Hemoglobin]
2e	CLIL	Alveoli, Hemoglobin	2d	Non-CLIL	Epidemiologie [Epidemiology]
2e	CLIL	Oxygen transport			

Tables 5 and 6 provide an overview of T2's lessons, which primarily focus on botany (1b and 1f) and zoology (2b and 2h). Unlike T1, T2 does not follow the same schedule for his CLIL and non-CLIL classes. This is also confirmed in in his interview (see Section 6.2.2), where he mentions that he employs different textbooks for his CLIL and non-

CLIL classes. The different schedules are also related to the fact that T2's CLIL classes (1b and 2b) have biology as a *Schwerpunktfach* [major subject], resulting in smaller class sizes (eight to 12 students), allowing them to cover more content in less time.

Table 5: Video-recorded lessons according to class and topic grade 10 (T2)

Class	**Program**	**Topic**	**Class**	**Program**	**Topic**
1b	CLIL	Roots	1f	Non-CLIL	Pflanzen (Blätter) [Plants (leaves)]
1b	CLIL	Stem structure	1f	Non-CLIL	Pflanzen [Plants]
1b	CLIL	Dendrochronology	1f	Non-CLIL	Fotosynthese [Photosynthesis]
1b	CLIL	Water transport in plants	1f	Non-CLIL	Fotosynthese [Photosynthesis]
1b	CLIL	Roots	1f	Non-CLIL	Licht (Fotosynthese) [Light (photosynthesis)]
			1f	Non-CLIL	Energie + Enzyme [Energy + enzymes]

Table 6: Video-recorded lessons according to class and topic grade 11 (T2)

Class	**Program**	**Topic**	**Class**	**Program**	**Topic**
2b	CLIL	Arthropods	2h	Non-CLIL	Wirbeltierherzen [Hearts of vertebrates]
2b	CLIL	Exam discussion	2h	Non-CLIL	Blutdruck messen [Measuring blood pressure]

Apart from the video-recordings, the teaching materials used by the two teachers were also continuously collected. It consists of worksheets, parts of a script and textbooks used by the two teachers in their lessons. More specifically, T1 primarily uses a self-compiled script in German and English for his non-CLIL and CLIL biology lessons. T2 uses worksheets based on Lytle and Meyer's (2010) book on practical training in zoology for both the CLIL and non-CLIL classes, and works with a German textbook (Markl, 2010) in the non-CLIL lessons and an English textbook (Kent, 2000) in the CLIL lessons, respectively. The fact that in their CLIL lessons T1 uses a self-compiled script and T2 an textbook designed for native speakers is evidence that only few ready-made CLIL teaching materials are available (Coyle et al., 2010, p. 86)[39]. The teaching materials are particularly important for the investigation of technical terms, as is shown later in Section 6.3.2 on the selection of teaching materials.

The EG_BIO corpus also includes field notes that I took during the video recordings. As I was present for all lessons, I documented specific details such as particular situations, gestures, gazes, and specific wordings. These notes have been especially useful in selecting and conducting in-depth analyses of episodes containing technical terms and translanguaging instances (see Chapter 10).

6.2.2 Follow-Up Data

Apart from the video-recordings, follow-up data was gathered through two teacher interviews and a CLIL student survey. Both the teacher interviews and the CLIL student survey were initially collected for, and partially analyzed in, the author's MA thesis (Bieri, 2015). Although the primary data for the present study is the EG_BIO corpus, the follow-up data is occasionally referenced in the subsequent analyses.

In addition to the video-recordings, two semi-structured interviews were conducted with both teachers involved in the case study after the video-recordings had taken place in 2015. The

[39] In the meantime, there have been considerable efforts to develop more adequate CLIL teaching materials, see e.g. Moore and Lorenzo (2015) in Spain, Marongui (2019) in Italy or Banegas (2016) in Argentina.

interviews were conducted in Swiss German[40], the L1 of both teachers and myself, the interviewer. The semi-structured interviews lasted 35 and 45 minutes, respectively, and were recorded on a mobile phone device and later transcribed into Standard German. The interviews formed the basis for previous research (Bieri, 2015, 2018b) and contributed to identifying the focal points of the current study's analyses—translanguaging and technicality—both of which emerged as recurring themes in the interviews. The catalogue of questions used for the interviews is available from the author upon request.

Apart from the teacher interviews, a student survey involving only the CLIL students (n=60)[41] was also conducted in 2015, after the video-recordings had taken place. The CLIL student survey was conducted in English and contained a quantitative part with close-ended and multiple-choice items, and a qualitative part with open questions. Apart from providing background information on the CLIL students themselves (and class composition), the overall aim of the survey was to gain insight into their attitudes, beliefs and experiences about the CLIL program itself. Since the CLIL student survey was already analyzed in detail elsewhere (Bieri, 2015), its results will not be repeated in the present study, but referred to occasionally where deemed relevant.

[40] In order to not restrict the "natural flow" (Dörnyei, 2007, p. 140) of the interview, the interviewees could choose the language the interview was conducted in.

[41] Of the 66 CLIL students, 63 took part in the survey. Three students only answered partially, and were therefore excluded (see Bieri, 2015, p. 80).

6.3 Data Selection and Data Preparation

The immense richness of video-recorded data has advantages and disadvantages: On the one hand it offers a large amount of material to investigate, on the other, the large amount of data can make it challenging to find a focus or departure point for analysis. Thus, inevitably with qualitative data collection where the research focus is primarily established in a bottom-up process, a selection process needs to take place. This happens on several levels simultaneously as illustrated in Figure 8.

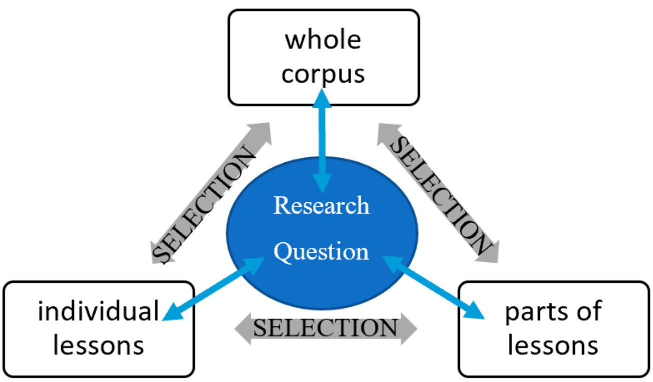

Figure 8: Selection processes on several levels

These selection processes are, in turn, again highly dependent on the developing research question(s). In brief, I selected the theoretical frameworks of translanguaging (Chapter 4) and technicality (Chapter 5) as the most suitable for addressing the general research questions, which aim to describe and compare language use in CLIL and non-CLIL biology lesson (see Section 1.2). An analysis of the entire corpus required the transcription of all 31 lessons. However, despite identifying two overarching research foci, the research questions first needed refinement in order to make any further decisions regarding the transcription process itself. To refine the research questions and establish the theoretical and methodological approaches to the data, rough transcripts were produced for the remaining 27 lessons. Rough transcripts in this case refer to transcripts that focus on what is said by whom without yet following any particular transcription conventions or making any decisions regarding leaving out stretches of talk—since potentially everything might be valuable, everything that was audible had to be transcribed.

Transcribing data, even if attention to detail is low as is the case with rough transcripts, is a time-consuming matter (Bucholtz, 2007; Mondada, 2007, 2018), which is why three MA students were employed as interns to help with the transcription process[42]. For the transcription, the software f4transkript[43] was used. Each rough transcript was again reviewed by me. During the review process, I encountered the issue described by Ingram and Elliott (2020, p. 179), where individuals hired for transcription may misinterpret terms that an insider would accurately recognize. Although Ingram and Elliott (2020) refer to professional transcription services, this applies to the current situation as well. Having studied biology and been present during the lessons, I had a clear understanding of the content. Despite providing the interns with field notes and contextual information, technical terms were occasionally misheard and inaccurately transcribed, making the review process more laborious. For future studies, recruiting students with subject-specific knowledge could therefore be highly beneficial.

6.3.1 Detailed Transcripts for Quantitative Analysis

Once the research questions regarding translanguaging and technicality were refined, a mixed-methods approach was identified as the most

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[42] They did this as part of an internship for their MA degree in "Language and Communication" at the University of Basel. Since they had access to the video-recorded data, they signed non-disclosure agreements in order to protect the participants' anonymity.

[43] https://www.audiotranskription.de/f4

suitable for the analysis (see Chapter 7). This approach involved investigating translanguaging practices and technicality from both a quantitative and a more qualitative perspective. The next step required refining the rough transcripts into into more detailed version suitable for analysis in the UAM CorpusTool (O'Donnell, 2008)[44]. This process involved deciding what to retain or omit from the rough transcripts and determining appropriate transcription conventions (see Ingram & Elliott, 2020, p. 192). One of the most important decisions concerned the question of what to focus on with regard to classroom discourse.

Classrooms are complex social environments, with the teacher usually in charge of topic and speaker allocation. However, whenever a researcher is recording in classrooms, parallel discourse—students talking among each other while the teacher is lecturing in the front—is unavoidable (Dalton-Puffer, 2007, p. 28). Sometimes parallel discourse serves to clarify technical terms (accompanying talk), while at other times it relates to personal matters (side talk, see Dalton-Puffer, 2007, pp. 27–28). Especially when reflecting students' practices about clarifying topics or terms at hand, but also when discussing on an interpersonal level, parallel discourse is a highly interesting matter for classroom research in general (e.g. Götz, 1994). However, as the name implies, it happens parallel to the teacher-led main discourse, therefore it is often unintelligible in the recordings. This is also one of the pragmatic reasons most research on classroom discourse so far has focused on investigating main discourse, because it is "most likely to provide the most audible whole-class data" (Ingram & Elliott, 2020, p.

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[44] The UAM CorpusTool (O'Donnell, 2008) is a state-of-the-art free annotation software developed by Michael O'Donnell in 2006 at the Universidad Autónoma de Madrid (UAM). It is used by many researchers working on CLIL (e.g. Llinares & Lyster, 2014; McCabe & Whittaker, 2017), which is one of the reasons I decided to work with this software as well. Other reasons are the fact that it is a free software, it does not require any programming experience, and it allows manual as well as semi-automatic annotation of texts (and images).

177). This study continues this tradition due to pragmatic reasons—with only one camera used, parallel talk was, with exception of a few cases, inaudible, which is why these types of talk were removed from the detailed transcripts and consequently excluded from analysis.

In addition to this, activity types[45] such as group work, pair work, individual seat tasks as well as individual teacher-student interactions were also excluded from analysis. Due to the single camera and the camera angle, only the groups or interactions closest to the camera were intelligible (if at all), thus an analysis of group work or individual teacher-student interactions would have been biased from the start and reduced to only those that were intelligible, which in turn would skew the results of any quantitative overview. This is unfortunate because pair and group works are of particular interest with respect to the phenomenon of code-switching and thus translanguaging (Dalton-Puffer, 2007, p. 31; Hancock, 1997; Moore & Nikula, 2016; Nikula & Moore, 2019, p. 244; Storch & Wigglesworth, 2003). In order to still keep an overview of the different activity types employed in a lesson while at the same time excluding them from analysis, these situations were indicated as follows in the detailed transcripts: In square brackets the activity type was listed, and next to it the time they spent on that activity (from 10 seconds onwards), as shown in the following example (9).

(9) ((activity type; time)), e.g. ((individual seat task; 1:30 min))

[45] For an overview of typical activity types in a lesson, see Hatch (1992, p. 93) or Dalton-Puffer (2007, p. 31).

The following activity types were indicated in the detailed transcripts:

- *Individual seat work:* Students working quietly on a task.
- *Pair work*: Students working in pairs on a task.
- *Group work*: Students working in groups on a task.
- *Individual T-S interactions:* The teacher interacts with students individually, mostly as part of the former three activity types or in-between tasks.
- *Silence:* There is no task, but no interaction either.

Excluding descriptions of all these activity types for analysis, three activity types remain: whole class interaction, teacher monologue, and student monologue. Based on Hatch's (1992, p. 93) definitions of different activity types in a lesson, Dalton-Puffer makes a distinction between whole class interaction as one activity type and teacher monologue as another one. Whole class interaction, according to her, "consists of the teacher conducting a dialogue with the class as a collective conversational partner" (2007, p. 31), whereas teacher monologue refers to "[l]onger stretches of coherent teacher talk [that] is the classic lecture-type format" (2007, p. 32). Similarly, Dalton-Puffer (2007, p. 31) describes student monologues as situations where "students are given the floor for longer stretches of time" such as in a student presentation.

However, even in teacher and student monologue as described by Dalton-Puffer, interaction with the class or the teacher, respectively, is happening, for instance in form of non-verbal cues such as gestures or gaze. Thus, the present study does not distinguish between the activity types of whole class interaction, teacher and student monologue, but instead employs the term *teacher-led whole class interaction* referring to all three, whole class interaction as well as teacher and student talk. Classrooms are essentially multimodal in nature, consequently non-verbal actions such as the teacher distributing worksheets, writing on the blackboard, doing an experiment or leaving the room were abundant in the data. In order to make sense of the *teacher-led whole class interaction* in each transcript, it was important to include the descriptions of these non-verbal actions, even more so in regards to Research Focus 3 (Chapter 10) where translanguaging practices (involving multimodal and non-verbal semiotic resources) are investigated in the negotiation of technicality. Such instances of non-verbal actions were indicated in the detailed transcripts, illustrated in example (10).

(10) ((T writing “germinate” on blackboard))

In sum, the detailed transcripts of the EG_BIO corpus solely contain *teacher-led whole class interaction,* which includes the activity types of whole class interaction, student and teacher monologue, but excludes all other activity types listed above. The full transcription conventions for the detailed transcripts are provided in App. I.

Since the focus of the quantitative analysis regarding translanguaging and technicality in the UAM CorpusTool is primarily still on *what* is said as compared to *how* it is said, paralinguistic cues such as stress, pauses or pronunciation were not considered relevant for the detailed transcripts, and were thus not included (i.e. punctuation in the detailed transcripts does not represent pausing or pacing). What is relevant for the detailed transcripts is consistent orthography, so automatic annotation in the UAM CorpusTool can be used (see e.g. Mondada, 2018, pp. 93–94). This ranges from standardizing different spellings of technical terms (e.g. haemoglobin vs. hemoglobin in English, or Photosynthese vs. Fotosynthese in Standard German) to consistent conventions when it comes to spelling out numbers. As a general rule for the CLIL transcripts, the English orthography follows the American spelling according to the Merriam Webster’s Dictionary

(2021) and the Duden (2021) is used as a reference for the non-CLIL transcripts. This also has to do with the fact that the Dictionary of Biology (Cole, 2015) used for the analysis of technical terms in Chapter 9 follows this tradition as well. In contrast to English, where a decision on American spelling resolves many cases in regards to spelling (e.g. hemoglobin instead of haemoglobin), Standard German has several accepted spellings. For instance, in the case of Photosynthese vs. Fotosynthese, the former represents the traditional and the latter the more current spelling. Both are accepted spellings in Standard German. In the detailed transcripts it was decided to stick to the traditional spelling whenever there are multiple versions of accepted spellings. With regard to Swiss German, since there is no common standard orthography or spelling conventions (see Section 3.1.2), it was generally transcribed as closely as possible to what is said in the respective dialect.

Cleaning up the transcripts also meant applying consistent conventions with regard to the anonymization of students. For the analysis, anonymization followed the simple transcription conventions *S* for student and *Ss* for multiple students. With regard to name-calling within the class, e.g. the teacher calling a student by the name, (NAME) was used to in place of the student's name. A special case is the student who did not give consent for the data to be used (see Section 6.1.1). Thanks to the video-recordings and the teachers often calling their students by their name, the respective student's scenes were all identified and cut-out. In the transcript this is indicated by double brackets and time, shown here in example (11):

(11) ((Cut-out answer of student who did not give permission to use video- or audio-material; 0:05min))

All detailed transcripts were again double-checked by me to make sure that they are suitable for analysis in the UAM CorpusTool. This resulted in the EG_BIO corpus containing a total of 119’337 words of spoken teacher-led whole class interaction and represents transcriptions of 16.5 hours of the original more than 22 hours of video-material.

All 31 transcripts actually contain 125’237 words. Of these 4020 refer to meta-information in the transcripts (e.g. “T:” indicating it is the teacher who is speaking), 1849 words describe activity types or non-verbal actions in double brackets (e.g. ((T writing on blackboard))), and 31 words refer to the individual names of the transcripts (e.g. Non-CLIL_1a_20150521). All of these do not concern spoken discourse, therefore they are subtracted from the total word count, which results in the EG_BIO corpus containing 119’337 of spoken teacher-led whole class interaction. With regard to time, group and pair work, individual seat tasks, and individual T-S interactions made up 6 hours and 20 minutes, which, as these were excluded activities, were subtracted from the total of video-recorded material of 22 hours and 48 minutes, which results in 16 hours and 28 minutes of transcribed teacher-led whole class interaction. For a detailed overview, see App. II.

6.3.2 Selected Teaching Materials

The teaching materials collected for the present study are especially relevant considering the second research focus on technicality (Chapter 9), where technical terms are investigated in the EG_BIO corpus including a comparison of classroom discourse and written teaching materials (see Sections 9.2.2 and 9.2.3). Since analyzing all the teaching materials would go beyond the scope of the present study, only parts of the teaching materials were selected for comparative analysis of technical terms. In the case of T1, the selected teaching materials consist of one page each from the script dealt with in T1’s classes 1a and 2d (non-CLIL classes) and 1e and 2e (CLIL classes). The pages were selected according to containing similar amounts of texts and being about different topics. Since T2 primarily used worksheets to supplement the textbooks at hand, his worksheets contain minimal text.

Therefore, I selected two pages of each textbook (Markl, 2010, for non-CLIL classes and Kent, 2000, for CLIL classes) that were used in the first lesson of each of his classes 1f and 2h (non-CLIL classes) and 1b and 2b (CLIL classes). A brief summary of the selected written materials is provided in Table 7.

Table 7: Overview of selected teaching materials for comparative analysis regarding technical terms

Class	T	Topic	WC
1a (non-CLIL)	T1	Die Gärung [fermentation]	515
1e (CLIL)	T1	Fermentation solves the problem	537
2d (non-CLIL)	T1	Die Steuerzentrale der Atmung [the control center of respiration]	463
2e (CLIL)	T1	The oxygen carrier	531
1f (non-CLIL)	T2	Fotosynthese [photosynthesis]	518
1b (CLIL)	T2	The root	639
2h (non-CLIL)	T2	Kreislaufsystem [circulatory system]	440
2b (CLIL)	T2	Arthropods	418

Key: T= teacher, WC = word count

These samples of written text, with a total word count of 4061, cannot give a full picture of how technical density and relative frequency of technical terms differs in spoken versus written text, since the written corpus is too small for this and not representative compared to the classroom recordings with a total word count of 119’337. However, they should serve to illustrate how lexical density and frequency of technical terms differs, if at all, from the one encountered in classroom data. The teaching materials are also occasionally referred to in the other two analyses where relevant (Chapters 8 and 10).

6.4 Comparability of the EG_BIO Corpus

In Section 6.2.1 (Table 2), it was noted that the data lends itself to comparison, given the similar number of lessons taught by the two teachers (T1=16, T2=15), as well as between CLIL and non-CLIL contexts (15 vs. 16), and across different grades (e.g. both teachers teach 11 lessons in grade 10 and five and four in grade 11, respectively). However, as not all lessons contain the same amount of teacher-led whole class interaction—some focus more heavily on lab work, resulting in less talking—it is crucial to evaluate the comparability of the EG_BIO corpus with respect to word count and lesson type. Lesson type describes the type of instruction (CLIL vs. non-CLIL), the respective teacher (T1 or T2), and grade (10 vs. 11) of a specific lesson, and constitutes a variable that is explained in more detail in the methodology chapter (Chapter 7). Nevertheless, a brief overview is provided here to offer an initial insight into how word count is distributed within the EG_BIO and how this may impact comparability.

Looking at the word count of spoken teacher-led whole class interaction, the distribution of the EG_BIO corpus according to lesson type is as follows: 43.2% of teacher-led whole class interaction occur in the CLIL lessons, and 56.8% in the non-CLIL subcorpus. Further, T2's lessons, even though he is teaching one fewer lesson compared to T1, contain overall more teacher-led whole class interaction (52.4% vs. 47.6%). The fact that both teachers teach considerably more lessons in grade 10 (n=22) than in grade 11 (n=9) is also reflected in the word count: Grade 10 makes up 66.3% of the EG_BIO corpus, and grade 11 34. 7%. Consequently, the EG_BIO corpus, though small in size, is fairly balanced in regards to type of instruction and teacher. Nevertheless, for the subsequent analysis it is vital to keep in mind the respective distributions (higher part non-CLIL and T2). This is especially true for the grade, where grade 10 takes up the double amount of lessons than grade 11. This makes a comparison more challenging in that the grade 11 subcorpus might be too small to yield representative results in comparison to grade 10. Taking relative frequencies into account, comparison of grades for the EG_BIO corpus is feasible, keeping in mind the overall low word count of lessons in grade 11. More details on the distribution with regard to word count and lesson type are further discussed in the next chapter (Section 7.2.1).

6.5 Summary of Chapter

This chapter has provided an overview of the types of data used in the present study. The EG_BIO corpus is a self-compiled corpus consisting of detailed transcripts of video-recorded lessons, teaching materials and field notes, all collected at an upper-secondary school in the German-speaking part of Switzerland. 31 biology lessons in eight different classes taught by two teachers were recorded over the period of a month in 2015, half of them CLIL (English) lessons and the other half non-CLIL (Standard German) lessons. Follow-up data in form of teacher interviews and a CLIL student survey was also obtained. Ethical protocol was consistently followed, from obtaining informed consent to the handling of the video-recordings and the storage of the data. Since a mixed-methods approach is applied, the video-data was transcribed in a manner so it can be read in the UAM CorpusTool software. In the transcripts, the focus is on teacher-led whole class interaction, everything else was excluded from analysis, which results in the EG_BIO corpus containing a total of 119’337 of spoken classroom interaction and 4061 words in the selected teaching materials. Lastly, the EG_BIO corpus is fairly balanced in regards to type of instruction (CLIL vs. non-CLIL) and teacher (T1 vs. T2) and lends itself for comparison in these respects. With regard to grade, the distribution is unbalanced, which is suboptimal but comparability can nevertheless be ensured by calculating relative frequencies.

7 Methodology

The methodology chapter provides an overview of the mixed-methods approach used in the present study. More specifically, Section 7.1 explains its relevance and how it applies to the three research foci: translanguaging, technicality, and the role of translanguaging in the negotiation of technicality. While offering a general overview, the particular methodologies including the coding schemes for each research focus are detailed separately in the respective analysis chapters (Chapters 8, 9 and 10). Section 7.2 outlines the primary categorization of the EG_BIO (**E**nglish **G**erman **Bio**logy lessons) corpus by lesson type, speaker and classroom register (Section 7.2). These variables form the basis for the quantitative analyses of translanguaging and technicality. Since this categorization represents an essential step in data preparation, its distribution is presented and discussed in this chapter.

7.1 General Methodology: A Mixed-Methods Approach

The general methodology applied in the present study is best described as mixed-methods approach, combining quantitative and top-down with qualitative and bottom-up research. Quantitative research is usually theory-driven and uses a top-down approach, meaning it develops research questions and hypotheses based on existing literature and theoretical frameworks to then look for appropriate ways to collect data that could answer said research questions and test the hypotheses made at the beginning. It uses a variety of statistical means "to make inferences about the validity and generalisability of the explanations reached at the sample level" (Riazi, 2016, p. 259). Prominent examples of quantitative research in the humanities are, for instance, questionnaire surveys or experimental studies, or in CLIL research particularly, product-oriented studies (see Section 2.2.1). Qualitative research, on the other hand, is usually data-driven and often uses a bottom-up approach, meaning it starts out with a general idea or research theme that is then refined based on what seems most interesting to look at with the data at hand. Ethnography or single case studies are prominent examples of this type of research in the social sciences. In CLIL research specifically, process-oriented studies are a good example too (see Section 2.2.2). Both these depictions of quantitative and qualitative research are, of course, simplifications in that there is much variation within the respective research paradigms with regard to individual methodologies. A mixed-methods approach combines some aspects of quantitative with qualitative research, which offers the possibility to address more complex problems or research questions from a variety of perspectives, and thus reach a deeper understanding of the phenomenon in question (Dörnyei, 2007, pp. 164–165). The classroom as a site for learning offers a highly complex social environment with regard to knowledge building, social interaction and power dynamics (teacher vs. students) to name just a few. Therefore, the classroom setting "lends itself to mixed methods research because combining several research strategies can broaden the scope of the investigation and enrich the researcher's ability to draw conclusions" (Dörnyei, 2007, p. 186). In the following paragraphs, the mixed-methods approach applied in the present study is explained in more detail.

The mixed-methods approach in the present study works on two levels: For one, even though the EG_BIO corpus is primarily made up of transcripts of video-recorded data, other types of data (field notes and teaching materials) complement the EG_BIO corpus. Furthermore, follow-up data (teacher interviews and CLIL student survey) was also collected and is drawn upon in the analyses as well. On the other hand, the EG_BIO corpus is analyzed from three different perspectives using quantitative and qualitative measures to varying degrees. For all three research foci, the computer software UAM CorpusTool (3.3v Windows version) was used for the analyses. In the following, a brief summary of the mixed-methods approach particular to each of the three research foci (translanguaging, technicality and the role of translanguaging in the negotiation of technicality) is presented.

In order to answer the research questions connected to the first research focus on translanguaging practices (“What translanguaging practices are present and how are these practices distributed in the EG_BIO corpus?”, see Chapter 8), the analysis is quantitative. Even though the data was prepared for quantitative analysis, the unit of analysis—the translanguaging instance (see Section 8.2)—is an inherently qualitative unit in that it cannot be coded automatically but depends on a manually developed codebook and subsequent manual coding, including the inclusion of context to determine whether or not it is in fact a translanguaging instance. This process is commonly referred to as quantitizing data: “Quantitizing involves converting qualitative data into numerical codes that can be further processed statistically” (Dörnyei, 2007, pp. 269–270). Therefore, in the UAM CorpusTool the unit of analysis (the translanguaging instance) is coded according to four categories (type, source, form and assigned language), to be able to descriptively compare translanguaging instances across different variables such as lesson type, speaker or classroom register. Even though the main part of this analysis consists of descriptive statistics and thus frequency and percentage analysis based on the quantitized data, the mixed-methods approach in this research focus includes illustrative examples and deviant case analyses as well, which are more qualitative in nature. In sum, for the analysis of Research Focus 1 on translanguaging, the quantitative overview is the dominant part giving way to the more qualitative analysis of certain episodes and deviant cases.

The second research focus on technicality has two main research questions (see Chapter 9) and the research design consists of a quantitative and a separate qualitative part. In order to answer the first research question regarding technicality (“What technical terms can be found in the EG_BIO corpus and how are they distributed?”), the unit of analysis (technical terms) is quantitized and coded according to different categories. For the quantitative part, one could make the case that the unit of analysis—technical terms—is, even though still inherently qualitative, more quantitative in that the identification of technical terms can be done semi-automatically in the computer software. Hence, a statistical overview of the occurrence and nature of technical terms in the EG_BIO corpus can be given. The second research question regarding technicality ("How are technical terms introduced in written vs. spoken mode?") is answered in a qualitative analysis of a selected subsample of the EG_BIO corpus with the aim of describing how exactly the introduction and definition of technical terms is realized in classroom discourse and the written teaching materials. The mixed-methods approach specific to the analysis of Research Focus 2 on technicality, quantitative and qualitative parts carry equal weight.

In the third research focus on the role of translanguaging in the negotiation of technicality, a qualitative approach to a subsample of the data in the EG_BIO corpus is taken in order to answer the research question ("What is the role of translanguaging in the negotiation of technical terms?" see Chapter 10). The subsample consists of four episodes selected based on the quantitative overviews of the two previous analyses on translanguaging and technicality. These episodes are analyzed and interpreted qualitatively, using semantic profiling (Maton, 2013) as an analytical tool. Semantic profiles allow me to illustrate the role of translanguaging practices in the un- and repacking processes of technical terms. For Research Focus 3, the dominant part is thus qualitative, but the data selection of the qualitative part is based on the previous quantitative analyses.

Overall, the mixed-methods approach used in the present study is, on the one hand, employed at the level of data collection, where a range of different types of data has been collected and is drawn upon in the analyses' sections. On the other hand, the mixed-methods approach is also employed at the level of analysis, combining a range of quantitative and qualitative measures in the respective research foci as explained above. A mixed-methods approach thus offers a more holistic understanding of the phenomena of translanguaging and technicality by looking at the data from a multitude of perspectives.

In order to gain an even more nuanced picture of the distribution of translanguaging practices and technical terms within the EG_BIO corpus, the three variables lesson type, speaker and classroom register are coded for in the corpus. An understanding of these variables is therefore key to comprehend the subsequent analyses, which is why they are detailed here in the general methodology chapter in the following section. The respective methodologies and codebooks particular to the three research foci concerning translanguaging and technicality are explained in detail in the respective chapters (see Chapters 8, 9 and 10).

7.2 The EG_BIO Corpus

This section describes the three general variables of the EG_BIO corpus are presents their distribution. These variables—lesson type, speaker and classroom register— are considered part of data preparation, as they are crucial for the descriptive statistics used in the analyses of translanguaging and technicality. All three variables are exhaustively coded for in the corpus, and understanding their distribution is essential for interpreting the subsequent analysis in Chapters 8, 9 and 10. While the first two variables (lesson type and speaker) are unambiguous in their coding (see Sections 7.2.1 and 7.2.2), the variable of classroom register is qualitative in nature, requiring the development of a codebook, which is detailed in Section 7.2.3. Each section first explains the respective variable, followed by some results on its general distribution within the EG_BIO corpus.

7.2.1 Lesson Type

The first variable, lesson type, refers to the general characteristics of a specific lesson, namely its type of instruction (CLIL or non-CLIL), the respective teacher (T1 or T2) and the grade students are in (grade 10 or 11). For that, each lesson was coded as a whole according to the coding scheme presented in Figure 9.

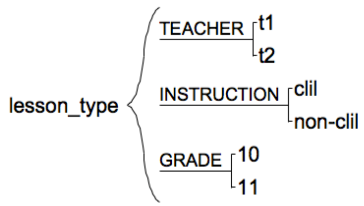

Figure 9: Coding scheme for lesson type

Coding for lesson type is important for the descriptive analyses of translanguaging and technicality, as it enables the analysis and comparison of translanguaging instances and technical terms across these different subsets (type of instruction, teacher, grade). More specifically, with regard to the translanguaging analysis, this variable allows me to compare CLIL with non-CLIL lessons, which is particularly relevant in that non-CLIL lessons have been rarely the subject of translanguaging research so far. Furthermore, it lets me differentiate translanguaging patterns that are particular to the respective teaching styles (T1 or T2), as well as what influence the grade (10 or 11) might have on the extent of translanguaging practices in the classroom. Similarly, regarding the analysis of technicality, the variable of lesson type allows me to find potential differences or patterns with regard to what and how technical terms are used depending on the language of instruction (CLIL or non-CLIL), the respective teachers (T1 or T2) and the respective grades (10 or 11). In order to do that in the subsequent analyses, it is important to first have an idea of the distribution of said variable and how it is distributed in the EG_BIO corpus, which is why the results of said distribution are presented in the following.

To recap, the EG_BIO corpus consists of a total of 31 biology lessons: 16 are taught by T1, and 15 by T2. 15 are CLIL lessons, and

16 are non-CLIL lessons. 22 of the lessons come from grade 10, and nine from grade 11. The overview with regard to word count of the respective categories of lesson type was already summarized in Section 6.4, but they are briefly presented here again. Important to keep in mind is that the word count only refers to teacher-led whole class interaction[46] in these lessons.

Adding the word count, it shows that of the total of 119’337 words of teacher-led whole class interaction in the EG_BIO corpus, the 16 biology lessons taught by T1 account for 47.6% (n=56’814) and the 15 lessons taught by T2 for 52.4% (n=62’523, see Figure 10, left). Thus, lessons taught by T2, even though one lesson short compared to the lessons taught by T1, contain overall more teacher-led whole class interaction. With regard to the distribution of word count in the EG_BIO corpus according to type of instruction (CLIL vs. non-CLIL) and grade (10 or 11), the graphs in Figure 10 provide an overview.

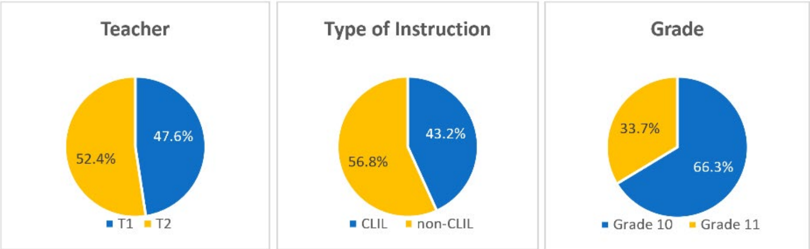

Figure 10: Overview of lesson type distribution in teacher-led whole class interaction in the EG_BIO corpus according to the subsets of lesson type variable: Teacher, Type of Instruction, and Grade

[46] Teacher-led whole class interaction is used as an umbrella term in this study, referring to interactions between the teacher and the class as a whole, individual teacher and student contributions (as long as they address the whole class). Excluded from teacher-led whole class interaction are for instance individual seat work, or pair and group work. For more details on what exactly constitutes teacher-led whole class interaction, see Section 6.3.1 in the previous chapter.

As can be seen in Figure 10 (middle), the biology lessons in English (CLIL) contain overall less teacher-led whole class interaction (n=51'585, 43.2%) than the ones in German (non-CLIL, n=67'752, 56.8%). This can be explained by the fact that for one, as explained above, the EG_BIO corpus contains one more non-CLIL lesson compared to the CLIL lessons. In addition to this, the average word count for teacher-led whole class interaction in a 45-minute biology lesson in the CLIL subcorpus is lower (mean=3439 words) and has greater standard deviation (σ=1342.5) than the average biology lesson in the non-CLIL subcorpus (mean=4234.5, σ=875.4).

This is illustrated in Figure 11, where the average lessons of each subcorpus (CLIL and non-CLIL) are plotted. "X" represents the mean, which for CLIL is at 3439 words and for non-CLIL at 4234.5. The boxes represent the range where 50% of the data points lie within, the whisker lines at each end represent the maximum and the minimum value of word count in each subcorpus: the maximum and minimum value (word count) of teacher-led whole class interaction in the two subcorpora. In the CLIL subcorpus, the word count for lessons ranges from a minimum of 962 to a maximum of 5264 words.

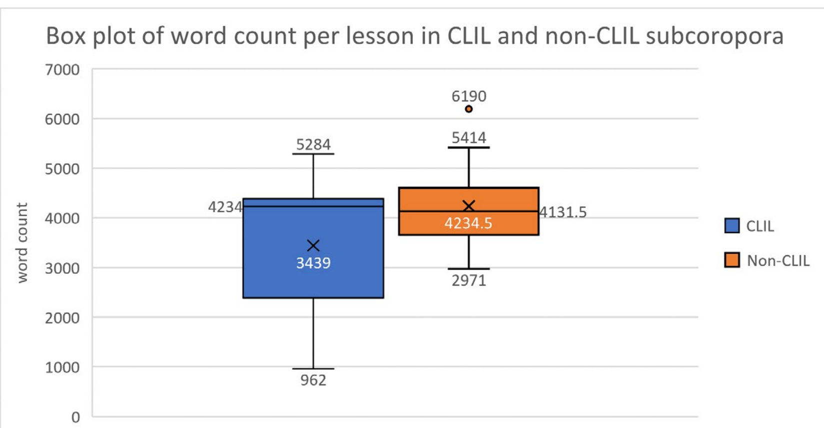

Figure 11: Box plot of word count per lesson in the two subcorpora (CLIL and non-CLIL)

As mentioned before, the mean (represented by an "x" in the box plot), is 3439 words. In the non-CLIL subcorpus, the lowest word count of a lesson is 2971, and the highest 6190, the mean is 4234.5 words per lesson. Thus, apart from the fact that there is one more non-CLIL lesson, overall the non-CLIL lessons itself are wordier on average with regard to teacher-led whole class interaction than the CLIL lessons. This mainly has to do with the fact that in the CLIL lessons, more time is allocated to activities such as individual seat tasks or group work[47], which leads to less teacher-led whole class interaction that is the basis of the present study. In fact, two of the 15 CLIL lessons contain particularly few words due to them being lab classes[48] with lots of group work, and thus less teacher-led whole class interaction.

As for the word count distribution according to grades (Figure 10, right), grade 10 accounts unsurprisingly for more words overall (n=79'164, 66.3%) in the EG_BIO corpus than grade 11 (n=40'173, 34.7%), since there are overall more lessons taught in grade 10 (n=22) compared to grade 11 (n=9). Relatively speaking, however, the nine lessons in grade 11 contain considerably more words on average (mean=4670) than the lessons in grade 10 (mean=3782). Thus, the lessons in grade 11 are generally wordier than their counterparts in grade 10. This can be explained by the fact that on average, all lessons in grade 10 contain more group work and individual seat tasks,

[47] Of the 11 hours and 9 minutes of recorded CLIL lessons, 3 hours and 44 minutes are allocated to activities such as group or pair work or individual seat tasks, and are therefore not part of the transcribed teacher-led whole class interaction. In the 11 hours and 39 minutes of recorded non-CLIL lessons, only 2 hours and 35 minutes are allocated to such activities. See App. II for a detailed overview of the calculation of the recorded and transcribed times.

[48] Both of these lessons (1b_20150504 and 1b_20150521) contain less than 1500 words of teacher-led whole class interaction. 1b_20150504 (n=1391) is a practical about roots with 23:30 minutes of its time allocated to group work; 1b_20150521 (n=962) is a lab class about water transport in plants with 36:50 minutes allocated to group work.

consequently they contain less teacher-led whole class interaction on average compared to the lessons in grade 11[49].

In summary, 43.2% of the transcribed teacher-led whole class interaction in the EG_BIO corpus stem from CLIL lessons and the other 56.8% non-CLIL lessons; 47.7% come from lessons taught by T1, and 52.3% taught by T2; 66.3% in grade 10 and 34.7% in grade 11. Even though the EG_BIO corpus is not an experimental corpus where each subset of the variable is equally balanced, it is still a fairly balanced corpus with regard to type of instruction (CLIL or non-CLIL) and teacher (T1 or T2). Grade is where the corpus is unbalanced, however, this is not considered particularly problematic for the subsequent analyses in the present study, since the frequency of translanguaging practices or technical terms are calculated relative to the occurrences.

It is expected that CLIL lessons will exhibit more translanguaging, as non-CLIL lessons typically do not involve the use of multiple languages. Additionally, different translanguaging practices are anticipated to dominate in each context; for example, translations are likely to occur more frequently in CLIL lessons, a strategy commonly observed in such classrooms (see e.g. Moore & Nikula, 2016; Nikula & Moore, 2019; Then & Ting, 2011). With respect to the teachers, it is expected that both will employ distinct translanguaging practices, consciously or unconsciously, particularly in their CLIL lessons. Furthermore, translanguaging is expected to be more prevalent in grade 10, especially in CLIL classes, as students are in their first year of upper-secondary school and CLIL instruction. In grade 11, the CLIL students are already more accustomed to biology being taught in English, so teachers might use less translanguaging.

With regard to the subsequent analysis of technicality, it is expected that there will be minimal differences in the use or frequency

[49] The average amount of excluded time (due to group work, individual seat tasks etc.) in grade 10 lessons is 13:57 minutes, while it is 8:07 minutes for grade 11 lessons.

of technical terms across lesson type (CLIL or non-CLIL), as this is likely more influenced by the topic than by the lesson format. What seems particularly interesting with regard to lesson type and technicality is the introduction and explanation of technical terms and concepts in the classroom. On the one hand, differences are anticipated between CLIL and non-CLIL lessons, as CLIL is taught in a language foreign to both teachers and most students, which may lead teachers to employ different strategies when introducing and explaining technical terms. On the other hand, Individual patterns are also expected in how teachers introduce and explain these terms, although significant differences between the two teachers are not anticipated. Regarding grade, technicality is expected to pose greater challenges in grade 10 than in grade 11, as younger students typically require more explanations or varied approaches when learning new or abstract terms. This is especially relevant in grade 10 CLIL lessons, where students are less accustomed to biology being taught in English.

7.2.2 Speaker

With the speaker variable, who translanguages how much can be determined. For this, each turn of the teacher-led whole class interaction is allocated to a speaker, either the teacher, a student, or students all together (see Figure 12). This type of coding according to speaker adds an additional variable (teacher vs. student) to the analyses of translanguaging and technicality.

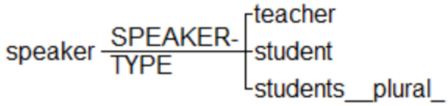

Figure 12: Coding scheme for speaker

This enables the identification of who uses what type of translanguaging practices the most, as well as how teachers and students use and co-construct technicality in their teacher-led whole class interactions.

With regard to the distribution of turns in the transcripts, there is a total of 4020 turns coded and allocated, 2114 (52.6%) of these are uttered by the teacher, 1848 (46%) by students and 58 (1.4%) by multiple students simultaneously. Teacher turns range from one to 1076 words, while student turns only range from one to a maximum of 195 words, meaning the longest student contribution consists of 195 words. Figure 13 presents an overview of the overall speaker distribution of teacher-led whole class interaction in the EG_BIO corpus (n=119’337).

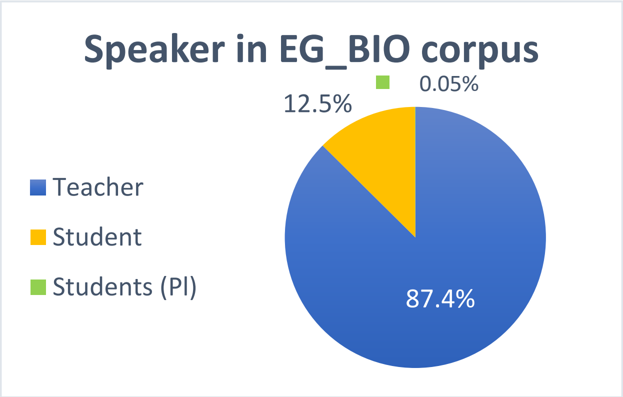

Figure 13: Overview of speaker distribution in teacher-led whole class interaction in the EG_BIO corpus

87.4% of words (n=104’334) are spoken by the teacher, 13.4% (n=14’942) are single student contributions, and 61 words (0.05%) are uttered by multiple students together. The distribution shown in Figure 13 is an expected distribution, since classroom discourse is often still marked by frontal teaching and thus monologic in nature, with student participation frequently limited to responses as part of Initiation-Response-Feedback (IRF) sequences (van Lier, 2001). An examination of speaker distribution according to lesson type reveals the patterns shown in Figures 14 and 15 (for the exact word counts and ratio per subsets, see App. III).

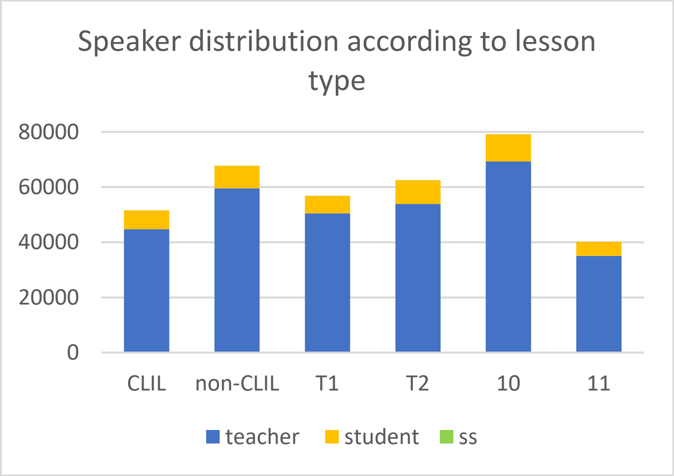

Figure 14: Speaker distribution according to lesson type variable with regard to word count; ss=students.

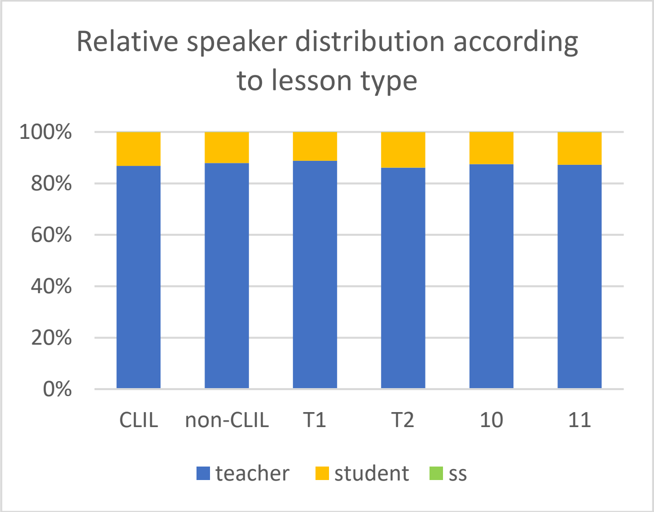

Figure 15: Relative speaker distribution according to lesson type variable in percentages; ss=students.

Figure 14 shows that the teacher talks more than the students across all subsets of the lesson type variable. The overall distribution of teacher-led whole class interaction mirrors the pattern observed in Figure 10: Non-CLIL lessons feature more teacher-led whole class interaction than CLIL lessons, T2-taught lessons are wordier than T1 lessons, and grade 10 lessons contain more talk than grade 11 lessons due to the higher number of lessons. However, looking at the relative distribution of teacher and student talk within these subsets, the ratio remains consistent across all groups: The teacher always takes up between 87–89% of teacher-led-whole class interaction, and the student contributions make up between 11–13% (see Figure 15).

There are a few outliers of lessons that do not come to the forefront in the summaries in Figures 14 and 15. For instance, there are two lessons which contain both less than 80% of teacher talk and consequently, more than 20% of student talk within teacher-led whole class interaction. In the lesson with the most student talk (Non-CLIL 1f2_20150505; 26.2% student and 73.8% of teacher talk), the fact that the students had to give presentations about the characteristics of certain plants explains the high amount of student contributions. In the other lesson (CLIL 1b_20150504, 21% student and 79% teacher talk), enhanced student contribution can be traced back to the fact that its topic was exam preparation, which explains the highest amount of student turns (n=150) out of all 31 lessons. As for the lessons with a particularly high amount of teacher talk, there are a total of nine lessons that have over 90% teacher talk. Of these, three lessons have even more than 94% teacher talk. For a complete overview of the teacher-student ratio across all lessons, see App. IV.

In summary, the overall speaker distribution of teacher-led whole class interaction in the EG_BIO corpus is 87.4% teacher talk, and 12.6% student contributions. This is also reflected in the speaker distribution according to lesson type, where similar distributions apply. Certain lessons depart from these distributions. Overall, looking at the speaker variable in the subsequent analysis of translanguaging, the teachers will naturally translanguage more than the students, simply because they dominate more time of the teacher-led whole class interaction. However, with regard to the nature of translanguaging, it is expected that teachers translanguage mostly when it comes to technical vocabulary, while students are likely to use more Swiss German. In terms of technicality, teachers are expected to use overall more technical terms than students, given their role as experts. Additionally, teachers will introduce most new technical terms. Nonetheless, it will be interesting to examine how technicality can also be co-constructed by teachers and students.

7.2.3 Classroom Register

While the other two variables (lesson type and speaker) use system-assigned coding and are therefore unambiguous in their coding, the variable of classroom register is qualitative in nature and needs an act of interpretation to be assigned correctly. Therefore, for the variable of classroom register, a detailed explanation on the coding criteria as well as on how coder agreement was established is provided hereafter. Register is a term that is used variably in several research traditions within linguistics, from very broad definitions such as register being "a cover term for any language variety defined by its situational characteristics" (Biber, 2006, p. 847) to more specific definitions of registers, as for instance in the SFL tradition where registers are defined as "the linguistic features which are typically associated with a configuration of situational features—with particular values of the field, mode and tenor" (Halliday & Hasan, 1976, p. 22). The term register in this book, however, does neither refer to a sociolinguistic understanding of register (e.g. Hymes, 1974) nor to a text-linguistic one (Biber & Conrad, 2009, 2019), but instead refers to a specific approach to classroom discourse developed by Christie (2000, 2002) growing from an SFL tradition of genre and register theory.

Based on Bernstein's theory of "pedagogic discourse" (1990, p. 183), in which Bernstein describes two types of discourses occurring in the classroom—the discourse of skills and knowledge which he calls **instructional discourse,** and the discourse of social order, relations and identity, which he calls **regulative discourse**—Christie (2000, 2002) notes that there are shared linguistic conventions, or sets of language choices typical of these two types of classroom discourses, which in accordance with Bernstein, she named **instructional and regulative registers** in the classroom. Thus, Christie (2000, pp. 186–190) distinguishes between two registers that prove particularly relevant to the setting of the classroom. The first-order register—the regulative register—hereby refers to the social organization of the classroom, e.g. when the teacher asks his or her students to close the window because it is noisy outside. The second-order register—the instructional register—applies to the actual content of a lesson, e.g. when the teacher asks the students to explain something related to the subject content. The regulative register usually makes up the smaller part of a lesson than the instructional register, and is often embedded at the beginning or at the end of a lesson (Christie, 2002, pp. 24–25). However, it can also occur throughout the lesson as Dalton-Puffer (2007, pp. 29–30) illustrates.

In the analyses of the present study, the distinction into regulative register and instructional register is relevant since I am interested in the use of multilingual resources across all registers, and in the use of technical terms mostly within the instructional register. However, as already mentioned by Christie herself (2000, p. 186), the distinction into regulative and instructional register is not straight-forward, as they often overlap or are embedded in each other in a "zone of convergence" (Dalton-Puffer, 2007, p. 30). In the case of content-specific lessons, such as biology in the present study, there is a need for a further subdivision within the regulative register, into **general regulative register** and the **specific content regulative register**. This roughly corresponds to what Christie calls the two dimensions of regulative register:

> One dimension has to do with establishing what constitute acceptable patterns of behaviour interpersonally, where these involve behaving within the terms, both spatial and temporal, that apply within the classroom and the wider school context and its community. The other has to do with establishing behavioural patterns of another sort: those to do with the patterns and methods of handling information, reasoning, thinking, arguing, describing and explaining particular to the instructional fields (...). (Christie, 2002, p. 163)

Christie claims that there are two dimensions of regulative register where the first one primarily deals with general classroom management and the organization of student behavior. This dimension is called **general regulative register** in this book. The second dimension of regulative register refers to the organization of classroom activities that are particular to the specific instructional field, which I call the **specific content regulative register**. There are two reasons as to why the second dimension of Christie's regulative register is coded as a separate classroom register within the regulative register: For one, it is specific (but not exclusive) to the field of biology. Biology lessons contain typical genres (in the SFL sense), for instance *science report* which is the most used genre in science textbooks (see Llinares et al., 2012, p. 112; and Martin, 1993a, p. 187) and tasks such as *experiment* or *practical trainings,* which require specific instructions (regulative) that simultaneously also deal with specific content (instructional). This type of overlap or convergence is particular to the instructional field of biology and other practical fields. Second, while Christie explains the two dimensions of regulative register using data from elementary students, students in the EG_BIO corpus are already in grades 10 and 11 (16–18 years old). As Christie (2002, pp. 29–30) herself notes, the regulative register becomes less prominent over time, as students quickly adhere to the accepted classroom behavior. In the case of biology lessons in grade 10 and 11, this means that the general regulative register focusing on student behavior may be less prominent during lessons, but due to the nature of the field the type of specific content regulative register will still be present.

The category of **specific content regulative register** is considered a subcategory of the regulative register because its main function is essentially still regulative, even though the tasks are particular to the field (biology). In the end, distinguishing between general regulative register and specific content regulative register provides me with the opportunity to look at translanguaging practices in a more nuanced way: how translanguaging is used when it relates to general classroom management (general regulative register), when it refers to specific content instructions (specific content regulative register), and how this differs to translanguaging practices in the instructional register (see Chapter 8). Similarly, with regard to the use of technical terms, adding this category allows me to investigate where technical terms are predominately used (presumably in the instructional and the specific content regulative register), but also where and how technical terms are primarily introduced (see Chapter 9).

Some researchers (e.g. Llinares & Evnitskaya, 2020; Pastrana, Llinares, & Pascual Pena, 2018), while adopting Christie's categories of regulative and instructional register, have added a third category of **social talk** (Ellis, 1992; Ernst, 1994) referring to stretches of talk that are neither related to classroom management nor content teaching. While Dalton-Puffer (2007, p. 29) did not use this category as social talk was scarce in her data, the EG_BIO corpus actually contains several stretches of social talk. In social talk, even though it takes place in an institutional setting, the topic that is talked about does neither concern the organization of the classroom nor the content to be learned, and has thus less official character topic-wise, e.g. when a personal anecdote is shared in class. More translanguaging is expected in social talk, as the topics discussed lack the formal nature of classroom management or content learning and are therefore not entirely teacher-led. It is thus anticipated that students (and teachers) may switch more frequently to Swiss German in the non-CLIL classes and to German in the CLIL classes during these interactions. Coding social talk as an additional category of registers is therefore particularly relevant with regard to the analysis of translanguaging practices: This approach enables the investigation of how translanguaging practices vary between the regulative and instructional registers, as well as in social talk.

In some stretches of talk or interaction, much of what is said is inaudible (indicated by brackets and (xx), see transcription conventions App. I). Due to the limited information available, it is not possible to assign a particular register to these scenes; which is why these stretches are coded as **unclear.** Coding classroom register as an additional variable to play with in the subsequent analysis of translanguaging is relevant because different types of translanguaging are expected across registers. For example, translations of technical terms are likely to be part of either the instructional register or the regulative specific content register. Conversely, switching to Swiss German (the L1 of both teachers and most students) is anticipated mainly in the regulative or social register. With regard to the analysis of technicality, most technical terms are expected to occur, be introduced, and explained in the instructional and content-specific regulative registers, as these passages focus on the lesson content.

7.2.3.1 Coding Scheme for Classroom Register

Figure 16 provides an overview of the variable of classroom register, followed by the corresponding codebook introducing the individual categories in this coding scheme (Table 8).

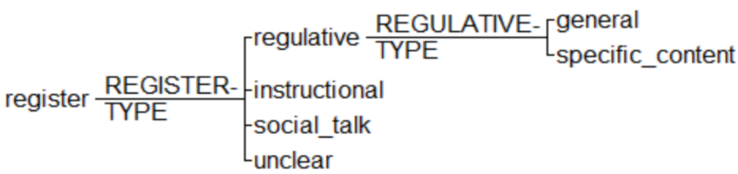

Figure 16: Coding scheme for classroom register

This is followed by some elaborations on the specific decisions that were taken in accordance with a second coder while coding classroom registers.

Table 8: Codebook for classroom register

<table>
<tr><td colspan="3">REGULATIVE</td></tr>
<tr><td colspan="3">Definition</td></tr>
<tr><td colspan="3">First order register: concerns classroom management, organization of student behavior and classroom activities such as pacing, sequencing, pedagogic directions, defining goals etc. → Overall purpose/function: organization of social world</td></tr>
<tr><td colspan="3">REGULATIVE_general</td></tr>
<tr><td>Definition</td><td>Example</td><td>Comments</td></tr>
<tr><td>Corresponds to the first dimension of regulative register (Christie, 2002, p. 163) and focuses on general classroom management and student behavior.

The regulative register_general includes:

Curriculum or lesson planning
– “What I would like to do now…”
– “Can we look at that later next semester?”</td><td><code>CLIL_1e_20150504</code>
<code>T:I hope you understand all the parts of the movie, it’s really uhm I think in a very clear language. And if you uh if there’s something you do not understand, please interrupt or we can I can replay it. I can look at it later</code></td><td>Openings (e.g. “Good morning”) and closings (“Enjoy lunch break.”) also belong in this category. They could be looked as parts of social talk (social conventions), however, since their function is to officially start or end a lesson, respectively, they regulate classroom management and are thus coded as regulative register_general.</td></tr>
</table>

Student behavior – "Please speak up" – "Can you make a sentence?" *Exam procedures* (grades, marking, results) – "I think you counted wrong my points" – "That's the distribution of the rounded grades of the test" *General task management* – "Please take the script" – "I give you three minutes for this task" *Administrative stuff* – "Is this homework for Thursday?" – "Don't we have a date yet?"	**`CLIL_2b_20150528`** `T:Now we only have very little time for to set our exam date. Uhm first of all would you prefer to have, that's something I can offer, we can actually, this will be without preparing pressure for you. We could do uhm I could set another mark for lab class for the next one, next lab class.`	General task management, which is coded as regulative register_general, also includes the introduction and explanation of parts of tasks that are not specific to biology, i.e. directions for reading a passage in a textbook, directions for organizing students in groups, or directions for giving a time frame for the task at hand. In transitional stages from one classroom activity to another, the regulative register_general might thus be first used to introduce the next task at hand in more general terms, before the regulative register_specific content is used to explain the task more specifically with regard to content.
REGULATIVE_specific content		
Definition	**Example**	**Comments**
Corresponds to the second dimension of the regulative register according to Christie (2002, p. 163) and focuses on the management of tasks particular to the field of biology. The regulative register_specific content includes instructions, directions and explanations of:	**`CLIL_1b_20150504`** `T: Try see what a cell is in the endodermis and then really have a close look they're all a few cells which are different from the others and those are the interesting cells or also interesting.`	In transitional stages from one classroom activity to another, the regulative register_general might thus be first used to introduce the next task at hand in more general terms, before the regulative register_specific content is used to explain the task more specifically with regard to content.

– Experiments and lab work – Drawings, figures, diagrams, tables – Appliance of specific devices (microscope, blood pressure machine etc.) – Foreign word list – Exam topic discussions	**CLIL_1e_20150511** T: Discuss it with your table mate. While we look at this, just look at the electron transport. What happens if the last process here is not running? ((Pair work; 1:30min))	
INSTRUCTIONAL		
Definition	**Example**	**Comments**
Second order register: concerns the actual content of a lesson, building the knowledge and skills relevant to the subject being studied, e.g. teachers and students talking about key concepts and ideas related to the content.	**CLIL_1e_20150504** T: Why are there four electrons and four protons that are needed? (NAME)? S: From the oxygen molecule T: And oxygen is? S: Two (oxygen) T: Exactly. The molecule or oxygen ha- contains two atoms right O_2	Overall purpose/function: Building content knowledge
SOCIAL TALK		
Definition	**Example**	**Comments**
Any talk of teacher or students that is neither related to the content of the subject (instructional register) nor to general classroom management (regulative register_general) or specific content management (regulative register_specific content).	**CLIL_2b_20150505** T: Test Homo Faber okay. S: You like the book? T: Yeah. Yeah. S: That was the wrong answer. T: I even read it in English.	

UNCLEAR		
Definition	**Example**	**Comments**

Any stretches of talk that are not clearly identifiable as either of the above categories.	**`CLIL_2b_20150505`**
	`S: (xx) very`
	`T: Yeah ah (we) only (need) four (xx)`
	`S: (How many are) mammals?`
		This is the case with scenes where parts of the talk are unintelligible, which is why one cannot clearly determine which register it belongs to.

Thus, as a general rule, the coding into the different registers as explained in the codebook above follows Christie's idea of "foregrounded" registers in that there are instances of one register embedded in another, and the whole sequence is coded according to the register that is foregrounded. As mentioned previously, the distinction into regulative and instructional register is not always straight-forward. Indeed, other scholars who have used Christie's distinction into regulative and instructional register regularly commented on the difficulty of distinguishing clearly between the two because they often converge (e.g. Dalton-Puffer, 2007, pp. 29–30; Llinares et al., 2012, pp. 45–47), which is especially challenging for quantitative analyses (see Dalton-Puffer & Nikula, 2006, p. 247). Christie herself noted that these classroom registers are embedded within each other, but mentions that in these situations, one register is usually foregrounded while the other runs tacitly in the background (Christie, 2000, p. 186; 2002, pp. 29–39, 65, 90, 143, 163).

This is particularly relevant for the instructional register: Even when the content that is talked about is instructional, conversational and interactional resources that technically belong to the regulative register are constantly used, for instance to regulate speaker succession, manage student behavior or refer to overall lesson planning. The two extracts 7.1 and 7.2 illustrate (in bold) how some of the different realizations of the regulative register can be embedded in the instructional register. In Extract 7.1, the teacher makes a temporal reference to the later content of the lesson ("we will come to that later"), which is typical of the regulative register[50], in particular with regard to lesson and curriculum planning. In this extract, the teacher also uses name-calling to organize turn-taking, which is a realization of the regulative register in that he regulates speaker succession and thus manages the classroom.

Extract 7.1: Non-CLIL_1a_20150504 (entire passage coded as *instructional*)

01	T:	Die sind dann gut für unsere Bakterien weiter unten im Darm, **dazu kommen wir später.** Was haben wir hier drin **(NAME)**? [These are good for our bacteria further down in the bowel, **we will come to that later.** What do we have in here **(NAME)**?]
02	S:	Uhm (xx)
03	T:	Ja zu einem grossen Anteil, und was noch? [Yes to a great extent, and what else?]

In the second extract (7.2), the teacher uses the regulative register to give the floor back to the class ("does anybody have a better word for that") and to signal to the student s/he should speak up or repeat the word ("Pardon?"). Based on the idea of foregrounded registers, in both extracts 7.1 and 7.2, "the instructional register is eventually foregrounded, while the regulative register remains operating only tacitly, predisposing students to behave in ways valued for pedagogic purposes" (Christie, 2000, p. 186).

Extract 7.2: CLIL_2e_20150521 (entire passage coded as *instructional*)

01	S:	What means affinity?
02	T:	*Begehren*? Uhm you can also call it just call

[50] Temporal orientation within the classroom, i.e. referring to the timeframe of a lesson, recounting what has been dealt with in the previous lesson or giving an outlook on the content of future lessons are typical for the regulative register (Christie, 2000, 2002).

```
            simply call it uhm love for oxygen, I mean it
            really is or eh uhm, anybody have a better word
            for that?
03    S:    Magnet?
04    T:    Pardon?
05    S:    Magnet?
06    T:    Magnet?
```

The conversational and interactional resources highlighted in the extracts above are just a few examples of how the regulative register can be realized within the instructional register; others include for instance deictic expressions[51] or explicit regulation of student behavior[52]. With regard to coding this means that the individual tacit realizations of regulative register (in bold in extract 7.1 and 7.2) are not coded separately as regulative register when they are embedded within the instructional register, instead the whole passage is coded according to the register that is foregrounded, which in both cases (7.1 and 7.2) is the instructional register. Embedded within another register means here that before and after the realization of regulative register comes the instructional register.

For the opposite case, when the instructional register is embedded in the regulative register, a separate category of classroom register was created—the regulative register_specific content. As already mentioned in the previous section, Christie herself (2002, p. 163) describes the regulative register as having two dimensions—one

[51] Classrooms are per se multimodal in nature, thus spatial references to teaching materials such as "on the handout it says" or "if you look here" are abundant in the data. These deictic expressions are part of the regulative register because they allow the teacher and students to navigate the classroom as a space.

[52] Explicit regulations of student behavior such as "Please speak up" belong to the regulative register. However, if they are embedded within the instructional register, they are coded as instructional.

on the interpersonal level (regulating acceptable student behavior in class), and the other on a more instructional level (regulating acceptable behavior with regard how to talk about the content). In the present study, the former is coded as regulative register_general, and the latter as regulative register_specific content. To illustrate what the regulative register_specific content looks like in the EG_BIO corpus, see extracts 7.3 and 7.4 below. In extract 7.3, the teacher explains an experiment to his students. He uses deictic expressions ("if you look across here") and instructions ("if you lift those up", "don't hold them like this") to direct students' attention spatially to specific parts of the experiment. These are realizations of the regulative register, while at the same time talking about the content ("it's not mold, it's part of the roots"). Similarly, in extract 7.4, the teacher offers the floor to the students ("do you have any questions") and uses temporal references ("you will need this later", "then you will see") to emphasize the importance of the experiment for their future schedule. In extract 7.4, the instructional register is realized in the explanation of the germinating process itself. Both extracts include the instructional register, but "foreground" the regulative register in the second dimension (in Christie's sense), i.e. "the patterns and methods of handling information, reasoning, thinking, arguing, describing and explaining particular to the instructional field" (Christie, 2002, p. 163). These cases of convergence of the regulative register in the second dimension and instructional register are coded as regulative register_specific content.

Extract 7.3: CLIL_1b_20150504 (entire passage coded as *regulative_specific content*)

01 T: So if you lift those up, **if you look across here** you see something which looks like mold. *Schimmel*. It's not mold it's part of this the roots. Now, it's important that you don't hold them like this.

Extract 7.4: CLIL_1e_20150511 (entire passage coded as *regulative_specific content*)

01 T: **Do you have any questions** considering this experiment and what's going in the seed when it's germinating, just one of the processes. Okay. You all need the result of the outcome of this experiment, **you will need this later** to understand what happens during a day or 24 hours of a plant. Because **then you will see** that respiration plays an important role. Also at the point or in a phase where they do photosynthesis in addition. That process is always running. Because as long as the plant needs energy, cellular respiration is running.

Coding only foregrounded registers leaves out much information regarding the individual realizations of classroom registers, particularly the regulative register when it is embedded in the instructional register. However, in order to operationalize classroom registers most efficiently for the purpose of the study (investigating translanguaging and technicality quantitatively), it was decided to focus on foregrounded registers.

Validity of the classroom register categories was established with a second coder. Sample coding of three lessons were checked by a second coder, who agreed with all codes except for two instances. Both of these instances referred to the inclusion of explicit student behavior (regulative register) as part of the instructional register—in both cases it was eventually agreed to code both as instructional register. The rest of the data was coded by the author individually according to the codebook and the decisions explained above. In the next subsection, an overview of the distribution of classroom registers in the EG_BIO corpus is given.

7.2.3.2 Overview of Classroom Registers in the EG_BIO Corpus

Figure 17 shows the overall distribution of the classroom registers occurring in the EG_BIO corpus. The instructional register accounts for most of the corpus (n=87'533, 73.3%), followed by the regulative register (n=31'032, 26%).

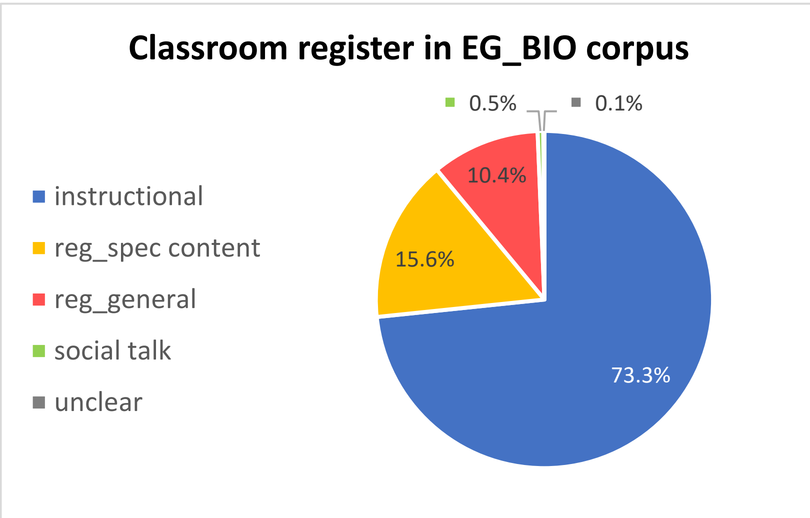

Figure 17: Overview of classroom register distribution in teacher-led whole class interaction in the EG_BIO corpus

Within the regulative register, the specific content regulative register accounts for 15.6% of the data (n=18'663), and the general regulative register for 10.4% (n=12'369). 0.5% (n=645) is covered by social talk and 0.1% (127 words)[53] are coded as unclear.

In line with the overall distribution of classroom registers presented in Figure 17, the instructional register is dominant in all categories of lesson type. The spikes of instructional register in the non-CLIL lessons (vs. the CLIL lessons), T2 (vs. T1) and grade 10 (vs.

[53] 127 words of a total of 119'337 words equal 0.11%.

grade 11) are all due to the fact they generally have a higher word count (see Section 7.2.1). Indeed, in relative numbers (see Table 9) the instructional register represents 73–74% in all categories, concurring with the overall distribution in.

Table 9: Distribution (n= word count) of classroom registers according to lesson type in percentages

	CLIL (n=53'744)	**non-CLIL** (n=69'644)	**T1** (n=58'546)	**T2** (n=64'842)	**10** (n=81'846)	**11** (n=41'542)
instructional	74.2%	73.0%	73.0%	74.0%	73.7%	73.3%
reg_spec cont	13.3%	16.8%	17.1%	13.6%	16.6%	12.7%
reg_ general	11.2%	9.9%	9.9%	11.0%	9.1%	13.1%
social talk	1.1%	0.2%	0.0%	1.1%	0.5%	0.7%
unclear	0.3%	0.0%	0.0%	0.3%	0.1%	0.2%

Where differences can be seen among the categories of lesson type is the ratio of general and specific content regulative register: In all the categories that have a higher word count (non-CLIL, T1 and 10), the specific content regulative register is also relatively higher compared to the general regulative register. This shows that regarding type of instruction, non-CLIL lessons in general have more specific content regulative register (16.8%) and less general regulative register (9.9%), which can be traced back to the non-CLIL classes having more hands-on tasks or experiments during class. Similarly, lessons taught by T1 also contain a higher percentage of specific content regulative register (17.1%) and less general regulative register (9.9%) than their counterpart lessons taught by T2 (13.6% and 11% respectively). There are no outlier lessons, therefore T1's lessons generally contain more hands-on tasks and content-specific instructions.

With regard to regulative register and lesson type, it is also interesting that the category of grade 11 is the only category where there is more general regulative register (13.1%) than specific content regulative register (12.7%). A possible explanation for this might be that two of the nine lessons in grade 11 explicitly deal with practical matters (exam discussion and measuring blood pressure). With regard to social talk, it is the CLIL lessons and the lessons taught by T2 that contain most of this register. However, with less than 1% across the EG_BIO corpus, the amount of social talk is extremely low, meaning this category is not going to be representative in the quantitative analyses of translanguaging and technical terms. Nevertheless, the category of social talk might reveal some interesting translanguaging phenomena from a qualitative perspective, which is why it is kept as a separate category also for the quantitative overview. In the end, coding classroom register this way, especially for the quantitative analyses, is challenging, as the elaborate codebook in section 7.2.3.1 shows. Even so, this proves to be an important variable especially when it comes to the analysis of translanguaging practices and how these vary (or not) depending on classroom register.

7.3 Summary of Chapter

This chapter has reported on the mixed-methods approach taken in the present study. In order to be able to gain a better understanding of translanguaging and technicality in the EG_BIO corpus, it was decided to use qualitative and quantitative measures–a mixed methods approach–for each of the three research foci. While the three research foci employ specific methodologies particular to the respective analyses of translanguaging or technicality, which are explained in detail in the corresponding chapters, they work with different general variables, namely lesson type, speaker and classroom register. Lesson type is a variable with three categories and distinguishes between type of instruction (CLIL vs. non-CLIL), teacher (lessons taught by T1 vs. T2) and grade (10 vs. 11). With regard to word count distribution according to lesson type in the EG_BIO corpus, non-CLIL lessons generally have a higher word count than CLIL lessons, so do lessons taught by T2 compared to T1 and grade 10 over grade 11. With regard to the speaker variable, 87% of the EG_BIO corpus consists of the teacher speaking, the rest being the students. Comparing the speaker variable to the lesson type variables, the speaker distribution is consistent across all contexts.

For classroom register, a codebook had to be developed in order to exhaustively code the EG_BIO corpus according to this variable. With regard to classroom registers, the instructional register takes up a three-quarter majority of the data, the rest being regulative register. Within the regulative register, the specific content regulative register takes up three fifths and the general regulative register two fifths. Comparing classroom registers with lesson type, the instructional register consistently makes up a three-quarter majority across all contexts. The only difference being that the contexts with higher word counts (non-CLIL, T2 and 10) also have a higher amount of regulative register_specific content and less regulative register_general compared to their counterparts (CLIL, T1 and 11). With this groundwork in place, the analysis now turns to the specific research foci, beginning with the first: translanguaging.

Part IV: ANALYSIS

8 Research Focus 1: Translanguaging

This chapter looks at the first research focus of the present study: translanguaging. It begins by revisiting the rationale and the detailed research questions related to translanguaging practices and their distribution in the EG_BIO corpus in Section 8.1. Next, the methodology for the quantitative analysis is outlined in Section 8.2, including the definition of a translanguaging instance and the development of the codebook specifically designed to analyze translanguaging practices in the EG_BIO corpus. Section 8.3 presents the findings based on the previously introduced variables of lesson type, speaker, and classroom register, followed by a discussion of the findings in Section 8.4.

8.1 Research Questions

Translanguaging describes the use of a speaker's full linguistic, non-verbal semiotic and multimodal resources to transmit any kind of information (see Chapter 4). In CLIL research, translanguaging as a concept inclusive of multilingual repertoires has recently received much attention, however, research so far has not gone beyond the L1-TL paradigm. Therefore, research describing the use of multilingual resources other than the L1 in CLIL lessons is largely still missing (see Section 4.2.1). Hence, the objective within this first research focus is to get an empirical overview of and compare translanguaging practices in CLIL (English) and non-CLIL (German) biology lessons, thereby going beyond the simple use of the L1/ML and TL but incorporating all facets of the multilingual repertoires of students and teachers. This is especially relevant considering the data at hand (see Chapter 6), since there are multiple languages on various levels simultaneously at work: the individual linguistic repertoires of students and teachers (Swiss German or other L1s), the languages of instruction (Standard German or English), the source languages of the subject-specific terminology

(Greek, Latin and others) as well as any other linguistic influences that might occur. Thus, the first two overarching research questions of the present study are the following:

1. What translanguaging practices are present in the EG_BIO corpus?
2. How are these translanguaging practices distributed within the EG_BIO corpus?

More specifically, the distribution of translanguaging practices in the EG_BIO corpus is checked against the variables presented in the previous chapter in Section 7.2:

a. Lesson type, with a specific focus on the comparison of translanguaging practices according to type of instruction (CLIL vs. non-CLIL), and to a lesser extent teacher instruction (T1 vs. T2) and grade (10 vs. 11)
b. Speaker (teacher vs. students)
c. Classroom registers (instructional register, regulative register_specific content and regulative register_general, social talk)

This way, a fuller, more nuanced picture of how translanguaging practices in the EG_BIO corpus are distributed in regards to these variables emerges. The corresponding methodology to answer these research questions is presented in the next section.

8.2 Methodology: Translanguaging

Two pilot studies were conducted on the same data in order to be able to answer the above-mentioned research questions and to create a codebook that can reliably represent the various translanguaging practices encountered in the EG_BIO corpus. The pilot studies are presented in the following subsections (Sections 8.2.1 and 8.2.2). This is followed by an explanation of the final codebook (Section 8.2.3) and the corresponding coder agreement (Section 8.2.4).

8.2.1 Pilot Study 1: Qualitative Analysis of Translanguaging in the EG_BIO Corpus (Bieri, 2018b)

A first pilot study on the EG_BIO corpus with regard to translanguaging was conducted in early 2018[54]. There is a substantial number of studies covering language use of L1 and TL in CLIL lessons (may they label it translanguaging, code-switching, language alteration or else, see Section 4.2), which is why the primary aim of pilot study 1 was to broadly explore the use of multilingual resources in the EG_BIO corpus focusing on the following two questions:

(1) Can the concept of translanguaging also be applied to the non-CLIL data in this context?

(2) Are there any translanguaging practices that go beyond the L1-TL paradigm in the EG_BIO corpus?

To do so, Moore and Nikula's (2016) approach to translanguaging in CLIL lessons was taken as a departure point in the pilot study. Moore and Nikula (2016) conducted a qualitative study of translanguaging practices in CLIL classroom data across three different contexts (Spain, Finland and Austria) and across different subjects, and found that there are two main ways in which translanguaging is used: as salient and as

[54] For more details on this pilot study, please see the article published by Bieri (2018b).

unmarked translanguaging[55]. The methodology for pilot study 1 was the following: In a first step, every instance that was not the language of instruction (English in CLIL and Standard German in non-CLIL lessons) was marked as translanguaging. Then, these instances were analyzed using Moore and Nikula's (2016) categories of salient and unmarked translanguaging. Results showed that many of the translanguaging practices (salient and unmarked) identified in Moore and Nikula were also found in the CLIL biology lessons, such as for instance clarifying key lexis according to the principle of least effort (salient translanguaging, extract 8.1) or in the use of discourse markers (unmarked translanguaging, extract 8.2).

Extract 8.1: Teacher clarifying key lexis (CLIL_1e_20150511)

```
01    T:    There's water, uh, they will germinate. Keimen
```

Extract 8.2: Use of discourse marker (CLIL_2b_20150505)

```
01    T:    Ja, okay yes, that's thank you for pointing that
            out.
```

It is an important finding that many of these were also encountered in the non-CLIL lessons (see extracts 8.3 and 8.4). This means that these translanguaging practices are not restricted to CLIL lessons.

Extract 8.3: Teacher clarifying key lexis (Non-CLIL_1f2_20151526)

```
01    T:    Holo heisst
            [Holo means]
```

[55] Briefly defined, salient translanguaging takes place when there is an explicit focus on language, and participants "orient to language to facilitate content learning" (Moore & Nikula, 2016, p. 219), whereas unmarked translanguaging refers to instances where there is no explicit language focus but "participants [use translanguaging to] orient primarily to the flow of interaction" (Moore & Nikula, 2016, p. 219).

02	S:	Ganz [Whole]
03	T:	Dankeschön, ja. Ganz. [Thank you, yes. Whole]

Extract 8.4: Use of discourse marker (Non-CLIL_1a_20150528)

01	S:	Uhm *jo*, ich hab es nicht ich habs nicht verstanden [Uhm *yeah*, I didn't I didn't understand it]

Extract 8.3 also shows another important finding of pilot study 1, namely that there is translanguaging occurring with languages outside the L1-TL paradigm, specifically with source languages of technical vocabulary (in this case Greek). This, in fact, occurs in both, non-CLIL and CLIL lessons (see extracts 8.3 and 8.5).

Extract 8.5: Translanguaging with source language (CLIL_2b_20150526)

01	T:	What is a *blastoderm*? (NAME)?
02	S:	*Blasto* means germs; *derm* skin

The results of pilot study 1 showed that the concept of translanguaging can be applied to non-CLIL classes as well, and that there are indeed translanguaging instances with source languages that go beyond the L1-TL paradigm in the EG_BIO corpus. Pilot study 1 also showed that salient and unmarked translanguaging are not straight-forward categories and therefore not ideal units for a comparative and quantitative analysis as planned in the present study. Instead, the initial analysis in pilot study 1 showed that in the EG_BIO corpus, translanguaging is mainly used in two ways, which I call **translation** and **integration**. Translation hereby refers to the use of translanguaging in order to translate a corresponding (technical) term or concept. Integration, on the other hand, refers to translanguaging instances that are directly integrated into the discourse without a corresponding translation. Starting from these two initial categories, a second pilot study was conducted in 2019, with the aim of checking whether these categories, translation and integration, could prove useful for a quantitative analysis.

8.2.2 Pilot Study 2: Qualitative Analysis of Translanguaging in CLIL Lessons (Bieri, 2019b)

For pilot study 2, all instances of translanguaging in the 15 CLIL biology lessons of the EG_BIO corpus were coded according to an initial coding scheme (Figure 18) developed based on the previous pilot study. Pilot study 2 tried to answer the following research question:

(1) Can the categories of translation and integration, developed in pilot study 1, be used for quantitative analysis?

(2) How are the translanguaging practices distributed in CLIL biology lessons in the EG_BIO corpus?

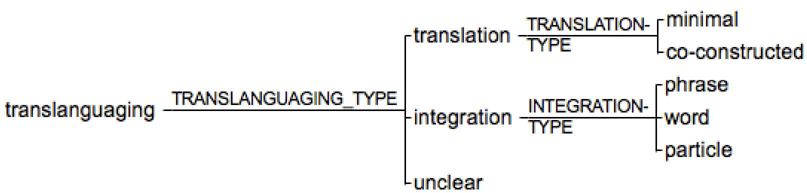

Figure 18: Initial coding scheme for the analysis of translanguaging practices

In a bottom-up approach, the two broad categories of translanguaging, translation and integration, were further subdivided with regard to their respective properties occurring in the corpus. With regard to translation, a distinction was made between minimal and co-constructed. Minimal hereby refers to instances of translation where one speaker utters the word and the corresponding translation occurs in the same turn (e.g.

extract 8.1 in the previous section). Co-constructed refers to instances of translation where one speaker utters the translation, and another speaker the corresponding unit, thereby co-constructing the translation (e.g. extract 8.3 in the previous section). In the bottom-up process I further noticed that translations mainly occurred in the form of a single word, whereas integrations often occurred as strings of words or single words. In order to capture this dimension in regards to integration more clearly, it was decided to use the additional subcategories of phrase, word and particle.[56]

An initial analysis of the 15 CLIL lessons in the EG_BIO corpus (Bieri, 2019b) revealed that the main division into translation and integration worked well, but the subdivisions based on the bottom-up approach ended up being problematic since they mixed several levels of analysis: For translation, it looked at turns and speakers, whereas with regard to integration it focused on the form of the translanguaging per se. Therefore, the whole initial coding scheme was revised, working out the different levels so that comparative quantitative analysis across these levels becomes possible. The resulting coding scheme for the analysis of translanguaging is presented in detail in the next section.

8.2.3 Final Coding Scheme for the Analysis of Translanguaging

Based on the two pilot studies (Bieri, 2018b, 2019b), a comprehensive codebook was developed to analyze and compare translanguaging practices in CLIL and non-CLIL biology lessons. Ultimately, every instance of translanguaging is coded according to several categories, namely: TYPE, SOURCE, FORM and ASSIGNED LANGUAGE. Even though translanguaging in theory includes not only the use of multilingual but also multimodal resources (see Chapter 4), the quantitative analysis of translanguaging practices here refers to

[56] For more details on the pilot study, see Bieri (2019b).

linguistic resources only. This is a pragmatic decision in that transcriptions including all non-verbal semiotic and multimodal resources for 31 full lessons would go beyond the scope of this project. A more in-depth and dynamic look at translanguaging including non-verbal semiotic and multimodal resources is taken in the qualitative analysis of Research Focus 3 (see Chapter 10).

An instance of translanguaging is hereby defined as an instance where the use of languages other than the language of instruction (English in CLIL lessons and Standard German in non-CLIL lessons) becomes prevalent. As a measure for what counts as English in a CLIL lesson, the Merriam-Webster Dictionary (2021) is used as a reference since the transcripts were prepared adhering to American English (see Section 6.3.1). With regard to Standard German, the Duden (2021) as well as the most recent edition of Bickel and Landolt's *Schweizerhochdeutsch [Swiss Standard German]* (2018) are used as references for what counts as Standard German in a non-CLIL lesson since Standard German refers to Swiss Standard German in the present study (see Chapter 3). For instance, consider the following extract from a CLIL lesson:

Extract 8.6: Teacher closing lesson (CLIL_1e_20150521)

```
01   T:   Okay. Good, impressive. Uhm, next time, I just
          wanna, no, next time, in a week we will make a
          class lesson, uhm. So it will not be biology (x)
          we'll talk about what's coming up soon, namely
          the Arbeitswoche and then, uh, the next time,
          uhm, the lesson after that we will talk about
          what's happening in here, in the chloroplasts.
          Have a good day.
```

In this extract, the teacher uses the Standard German term *Arbeitswoche* [project week] to refer to what students are expected to be doing in the following week. *Arbeitswoche* is not a term used in English, therefore the use of that linguistic resource makes the translanguaging instance prevalent in this situation. The prevalence of translanguaging becomes especially relevant with regard to the inclusion of source languages of technical vocabulary as translanguaging, as exemplified in extracts 8.3 and 8.5 in pilot study 1 (Section 8.2.1). Consider extract 8.7 from a non-CLIL class, where translanguaging is used to translate chlorophyll (source language Greek) into Standard German.

Extract 8.7: Teacher clarifying key lexis (Non-CLIL_1f2_20151526)

01	T:	Was heisst *chloro*? Wer weiss es gerade? Ja [What does *chloro* mean? Who knows it? Yes]
02	S:	Grün [Green]
03	T:	Genau, grün. Also *Chlorophyll* heisst auf Deutsch Blattgrün. [Exactly, green. Therefore, *chlorophyll* in German is leaf green]

Even though *chlorophyll* originally comes from Greek, it is now an accepted and codified term in Standard German. In fact, many technical terms in English and Standard German have etymological roots from languages other than English and Standard German. As a consequence, the bare mention of these technical terms does not yet constitute a translanguaging instance. Going back to extract 8.7 above, every other time the teacher simply mentions chlorophyll he is not translanguaging. Only when the use of linguistic resources other than Standard German in non-CLIL lessons and English in CLIL lessons becomes prevalent, as with the explicit translation of chlorophyll in extract 8.7, does it count as a translanguaging instance.

Since in the CLIL lessons, English is a foreign language for both teachers as well as most of the students, language transfer in form of interference (Richards & Schmidt, 2010, p. 323) can easily happen. That is, a pattern from the L1/ML is taken and transferred to the TL, producing an error or a newly invented word. In these cases, the following rule applies: If these cases are restricted to inflections (e.g. third person or plural *-s* is missing or added where it should not), they are <u>not</u> counted as a translanguaging instance. If they refer to derivations (by error or creativeness, e.g. *unefficient* instead of inefficient), they are marked as a translanguaging instance. In the present study I am interested in all types of multilingual practices teachers and students use in the classroom, which includes types of errors or creative combinations that include an alteration of meaning (derivations). Therefore, derivations are counted as translanguaging instances, whereas inflections that mainly change the grammatical meaning of a word are not.

Invented words formed through word formation processes other than derivations (e.g. compounding such as *searose* instead of water lily) are consequently also marked as translanguaging instances. Lexical errors, on the other hand, are <u>not</u> treated as translanguaging instances in this definition unless they can be attributed to a language other than the TL/language of instruction (i.e. does not occur in the dictionary of the TL/language of instruction). Species' scientific names or any biological entity's scientific names (e.g. *Araneus diadematus* for the common garden cross spider, or *medulla oblongata* for the extended spinal cord) however, are counted as translanguaging instances because they are often directly taken from Latin. Meanwhile, proper names of people (e.g. the teachers' names, or the mentioning of other scholars' names in class), and of places (locations or institutions) are <u>not</u> counted as instances of translanguaging. Lastly, since the data of the EG_BIO corpus consists of transcripts of spoken interaction, the data is full of markers of spoken discourse that do not conform with the definition of a translanguaging instance given above, as they often do not appear in a dictionary (the measurement used for what is considered to be part of the language of instruction). These makers of spoken discourse[57] are not considered translanguaging instances, as they primarily arise from the orality of the interaction transcribed. Taking all of these considerations into account, the revised definition of a translanguaging instance is as follows:

> A **translanguaging instance** is an instance where the use of languages other than the language of instruction (English in CLIL lessons and Standard German in non-CLIL lessons) becomes prevalent, either by not being included in the respective dictionaries, or by explicitly being translated. Language errors are counted as translanguaging instances if they are derivational. Invented words formed through processes other than derivation (e.g. compounding), are also considered translanguaging. However, grammatical, lexical and syntactic errors, even though they might be a product of language transfer, are not considered translanguaging, neither are markers of orality.

After the identification of translanguaging instances in the EG_BIO corpus, each instance is coded according to four categories. Below the coding scheme as imported from the UAM CorpusTool is presented (see Figure 19), followed by a detailed codebook for each category (Tables 10 to 13).

[57] For instance, non-standard spellings or abbreviations such as *gonna* for *going to* in English or *wärs* instead of *wäre es [it would be]* in German are not considered translanguaging instances, neither are clitics (*don't*, *I'm, you're*). Cut-offs and false starts are also typical markers of spontaneous language production, which are not coded as separate translanguaging instances since the corrected word or version usually follows. Further, interjections that do not carry referential meaning but indicate an emotional state (Richards & Schmidt, 2010, p. 293) such as *ou, aha, hehe, oops, shhh* are not considered translanguaging instances, and neither are hesitation markers (*uh, uhm*).

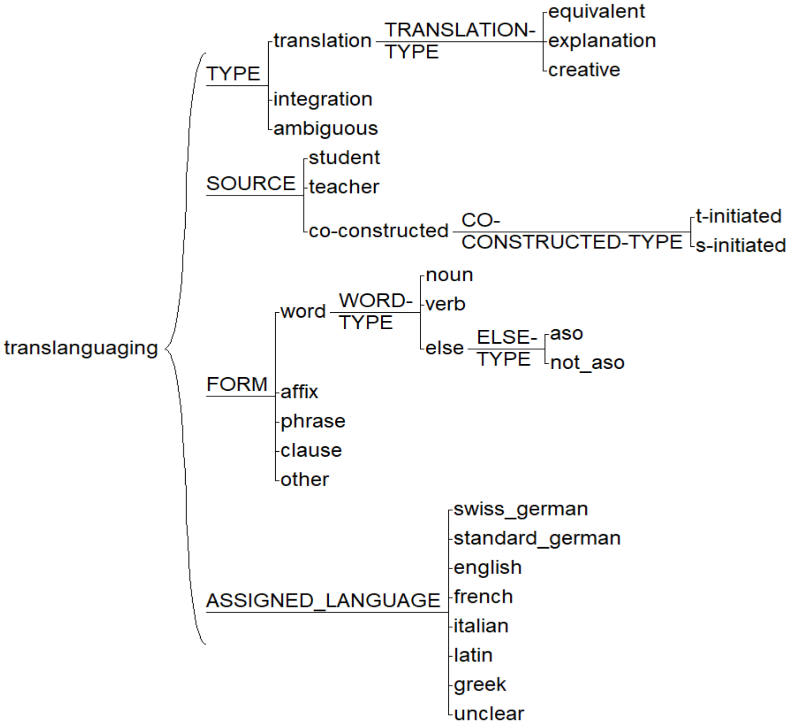

Figure 19: Coding scheme for translanguaging analysis

8.2.3.1 Category 1: TYPE of Translanguaging

The coding scheme differentiates between two main TYPES of translanguaging, translation and integration. In Table 10, the detailed codebook for this category and its subtypes is presented.

Table 10: Codebook for category 1—TYPE of translanguaging

TYPE_translation		
Definition	**Example**	**Comments**
Refers to the use of translanguaging in order to translate a corresponding (technical) term or concept. Does a translanguaging instance have a corresponding unit (CU)? If yes = translation.	**CLIL_1e_20150518** T: unicellular organisms like yeast, yeast that's *Hefe*	translanguaged word = *Hefe;* CU = yeast
TYPE_translation_equivalent		
Definition	**Example**	**Comments**
The translanguaged word or expression is an equivalent translation of the CU, meaning both terms exist in a dictionary (unless one part of the translation is TYPE_translation_creative).	**CLIL_1b_20150504** T:which looks like mold, *Schimmel.*	translanguaged word = *Schimmel*; CU = mold
TYPE_translation_explanation		
Definition	**Example**	**Comments**
The CU is neither an equivalent nor a creative translation of the translanguaged word, but instead consist of s a multi-worded explanation of the translanguaged word.	**CLIL_1b_20150518** T:that's the inner part, *Palmherzen.*	translanguaged word = *Palmherzen;* CU = the inner part

TYPE_translation_creative		
Definition	**Example**	**Comments**
The translanguaged word in question is a newly coined/unknown/invented/ non-existing word.	**CLIL_1b_20150528** S:So <u>peanuts</u> in German should actually (be) called *Erd-, Erd-* T:*Erderbsen.*	First example: translanguaged word = *Erderbsen* [earthpeas] (→ invented word, does not exist in Standard German)*;* CU = <u>peanuts</u>
	CLIL_1b_20150528 T:But we have talked about uh, uh ugh, what's it called. With flowers. <u>*Searose,*</u> it's not <u>*Seerosen.*</u>	It can happen that in the case of TYPE_translation _creative, the CU is also a translanguaged word, so that in one translation there are two instances of translanguaging. Such is the case presented in the second example: There is a translation from *Searose* to *Seerosen* [water lily]. Both are instances of translanguaging, since neither of them exist in an English dictionary (language of instruction in the CLIL lesson), and both are each other's CUs, i.e. *Searose* corresponds to *Seerosen* and vice versa. Thus, the coding works as follows: *Searose* is an instance of TYPE_translation_ creative with its CU *Seerosen,* and *Seerosen* is a TYPE_translation_ equivalent with its CU *Searose.*

TYPE_integration		
Definition	**Example**	**Comments**
Refers to translanguaging instances that are directly integrated into the discourse without a corresponding unit. Does a translanguaging instance have a CU? If no = integration.	**CLIL_1b_20150507** T:And then there is a *Pfingstmontag* coming **Non-CLIL_1f1_20150512** T:die wurden ganz verkabelt mit Schläuchen, oder *verschlaucht* muss man sagen	Integrations are words or phrases that are clearly assignable to a language other than the language of instruction, but do not have a CU e.g. the first example on the left, where *Pfingstmontag* [Pentecost Monday] comes from Standard German and is directly integrated into the discourse without translating it. Integrations can also refer to derivations/ language transfers/ creative new words not existing in the language of instruction. In these cases, it is the same as TYPE_translation_ creative but without the CU. For instance, in the second example, *verschlaucht [tubed]* is a newly coined verb that does not exist as such in Standard German.
TYPE_ambiguous		
Definition	**Example**	**Comments**
Ambiguous cases: 1. unclear whether it is a translanguaging instance at all. 2. unclear whether a translanguaging instance is a translation or integration.	**CLIL_1b_20150518** T:what we call a stopwatch was originally called a *chronologer*	Chronologer does exist in the dictionary, but not in the sense used here, i.e. chronologer = chronologist

8.2.3.2 Category 2: SOURCE of Translanguaging

Since this study is interested in who translanguages how much, the category SOURCE of translanguaging refers to the speaker who translanguages (the student or the teacher). A simple distinction between teacher and student contributions is actually already covered by the speaker variable (see Section 7.2.2). However, this separate category is necessary because the codebook distinguishes not only between teacher and student as a source, but also whether the translanguaging instance is co-constructed or not, as well as who initiated the co-constructed instance. Therefore, the category SOURCE was added to the coding scheme of translanguaging. In Table 11, the detailed codebook for said category is presented.

Table 11: Codebook for category 2—SOURCE of translanguaging

SOURCE_student		
Definition	**Example**	**Comments**
It is a student who translanguages.	**CLIL_1e_20150507** S:the Krebs cycle and uh *was isches gsy?*	
SOURCE_teacher		
Definition	**Example**	**Comments**
It is the teacher who translanguages.	**CLIL_2b_20150505** T:*Qu'est-ce qu'il y a?*	
SOURCE_co-constructed		
Definition	**Example**	**Comments**
If TYPE_translation, one speaker starts the translanguaging instance, and another one ends it by providing or confirming the CU. This can occur in multiple turns.	**Non-CLIL_1f2_20150526** T:*Chloro?* Was heisst *chloro*? Wer weiss es gerade, ja? S:Grün. T:Genau, grün.	First example: The first instance of *chloro* is coded as a simple integration, and only the second *chloro* as a translation (translanguaged word = *chloro;* CU = grün).

		It is also coded as co-constructed if e.g. the student asked "Does x mean y?" and the teacher replied "Yes".
If TYPE_integration (example 2 on the right), one speaker finishes the other speaker's sentence using translanguaging, but there is no CU.	**CLIL_2b_20150526** T:I think the only person who do it are those who buy it the whole, uh S:*Harasse* T:*Harasse.*	Second example: Both instances of *Harasse* are coded as co-constructed integration. It is student-initiated, since it is the student who translanguages. However, he only does so in response to the teacher's turn, therefore it is co-constructed.
SOURCE_co-constructed_t-initiated		
Definition	**Example**	**Comments**
The teacher initiates the co-constructed translanguaging instance.	**CLIL_1e_20150511** T:What are <u>chickpeas</u>? S:*Kichererbsen.* T:*Kichererbsen,* exactly.	translanguaged word = *Kichererbsen*; CU = <u>chickpeas</u>. In this case specifically, there are two co-constructed translanguaging instances, since the teacher repeats the translanguaged word in his answer.
SOURCE_co-constructed_s-initiated		
Definition	**Example**	**Comments**
The student initiates the co-constructed translanguaging instance.	**CLIL_2b_20150505** S: And <u>Malpighian tubules</u>? T: *Malpighische Gefässe*	translanguaged word = *Malpighische Gefässe;* CU = <u>Malpighian tubules</u>

8.2.3.3 Category 3: FORM of Translanguaging

This category concerns the FORM of the translanguaging instance, whether it consists of one word only (thus differentiating between word classes such as noun and verbs), an affix, or more words, in which case the coding scheme differentiates between clauses, phrases and other. The pilot studies have shown that translanguaging can take on many different forms—from students talking to each other in Swiss German to the teacher translating a single word. Based on the bottom-up approach to the data in the EG_BIO corpus, there seem to be particular patterns depending on the type of translanguaging, i.e. translation and integration, in that translations usually consist of single words, whereas integrations are often strings of words. In order to take stock of how exactly translanguaging instances look like structurally with regard to the other three categories (TYPE, SOURCE and ASSIGNED LANGUAGES) and find possible correlations, this category is added to the overall codebook. Table 12 presents the category of FORM and its subtypes in detail.

Table 12: Codebook for category 3—FORM of translanguaging

FORM_word		
Definition	**Example**	**Comments**
The translanguaging instance in question consists of one word only (with exception of compound nouns).	**CLIL_2e_20150507** T:And they're further divided into lobes, *Lappen*	Translanguaged word = *Lappen;* CU = lobes
FORM_word_noun		
Definition	**Example**	**Comments**
The translanguaged word in question is a noun (single or compound noun).	**CLIL_1e_20150518** T: we call it s- uhm *Muskelkater*	Compound nouns also belong in this category, since due to the different structural properties of Standard German and English, noun compounds in

		the former are often formed within one word, whereas in English noun compounds are often two separate words (e.g. *Herzstränge* ⇔ heart strings). Proper names of species (often in Latin, e.g. *Iris germanica)* are also counted as FORM_word_noun, even though they could technically also be seen as noun phrases.
FORM_word_verb		
Definition	**Example**	**Comments**
The translanguaged word in question is a verb.	**`CLIL_1e_20150518`** `S:uhm no- nothing that we put in` *`verschwindet?`*	In Swiss German, verbs can be inflected for person and number, e.g. *gsehsch [do you see]* or *hämer [we have].* Therefore, even though in Swiss German this is spelled as one word, it is coded as a clause (→ see FORM_word_ clause).
FORM_word_else		
Definition	**Example**	**Comments**
Any translanguaged word that does not belong in any of the above-mentioned classes.	**`Non-CLIL_1f1_20150505`** `T:`*`Guet`*` (xx) ein zwei drei Fragen hab ich noch.`	The example of *guet* illustrates well why the category of "else" is not divided into further subcategories such as adjectives or adverbs. Depending on what the unintelligible stretch (xx) represents, it changes the meaning and word class or *guet*: If it is

	Non-CLIL_1a_20150504 S:*Aso* der Stamm ist uhm breiter	followed by a participle (*gmacht*), it would work as an adverb as in *well done*. It could also be simply a discourse marker in what follows could be good, *let's continue*. Cases of *aso* belong in this category too, as they are used as both adverbs and discourse markers and it is not always possible to distinguish between the two. Consequently, because context cannot always help deciding the word class of such words, they are all grouped under the category "else".
FORM_word_else_aso		
Definition	**Example**	**Comments**
A subcategory of FORM_word_else. Exclusively includes instances of *aso*.	**Non-CLIL_1f2_20150512** S:*Aso* es gibt ja diese NADP	A majority of FORM_word_else are cases of *aso.* In case these need to be excluded from analysis later on, a distinction between cases of *aso* and other instances of FORM_word_else is made here.
FORM_word_else_not aso		
Definition	**Example**	**Comments**
Any translanguaged word in the FORM_word_else category that is not an instance of *aso.*	**Non-CLIL_1a_20150507** S:*Nei,* jetzt muss ich schauen	

FORM_affix		
Definition	**Example**	**Comments**
The translanguaging instance is an affix: "An element (as a prefix, suffix, infix, etc.) added to the base form or stem of a word, in order to modify its meaning (in inflection) or create a new word (in derivation)" (OED, 2020)	**`CLIL_1b_20150504`** `T:but what does` *`epi`* `mean?`	Parts of words that cannot stand on their own in the respective language (e.g. *chloro-, homo-, epi-, endo-, chrono-*) are coded as affixes as well.
FORM_clause		
Definition	**Example**	**Comments**
The translanguaging instance contains a clause, that is, an S-V construction: a syntactic unit consisting of at least a subject and a finite verb. Clauses can stand on their own (independent clauses) or form part of a sentence (dependent clauses).	**`Non-CLIL_1a_20150507`** `S:`*`Jä mir kunnt dr Name nümm in Sinn`* **`CLIL_1b_20150528`** `S:`*`Lueg mol do`* **`Non-CLIL_1f2_20150512`** `T:Thylakoidstapel fehlt` `S:`*`Liecht au`*	Clauses are coded separately, i.e. if teacher or students use multiple clauses in one sentence, each is coded separately. If either the subject or the finite verb is missing but implied, the translanguaging instance is coded as a clause. E.g. in directives like *Lueg mol do [Look here]*, the subject "you" is implied, it is coded as a full clause. Similarly, in the student's response *Liecht (fehlt) au [Light (is lacking) too]*, the verb *fehlen [to lack]* is implied and coded as a full clause.[58]

[58] In Swiss German, verbs can be inflected for person and number, e.g. *gsehsch [do you see]* or *hämer [we have]*. Therefore, even though in Swiss German these are spelled as one word, they are coded as clauses.

FORM_phrase		
Definition	**Example**	**Comments**
The translanguaging instance is a phrase. A phrase is hereby defined as a syntactic unit consisting of a grammatical head and at least one modifier, and does not contain an S-V structure.	**`Non-CLIL_1f1_20150505`** `T:Das andere ist jetzt ein bisschen` *`fifty fifty joker`* **`Non-CLIL_1f2_20150526`** `T:ein Foto,` *`es Föteli i dr Hang ha`*	Translanguaging instances containing infinite verbs such as in the second example (*es Föteli i dr Hang ha [to hold a picture in your hand])* are coded as phrases. If phrases as such are repeated, each is coded as a separate phrase.
FORM_other		
Definition	**Example**	**Comments**
Anything that is more than one word but neither a phrase nor a clause.	**`CLIL_1b_20150528`** `S:` *`Hei nomol.`*	This category also includes repetitions of words. E.g. a single instance of *Ja* in a CLIL lesson = word; several instances of *Ja,* e.g. *Ja ja ja* = other.

8.2.3.4 Category 4: ASSIGNED LANGUAGE (AL) of Translanguaging

Translanguaging theory posits that the multilingual resources a person uses do not necessarily adhere or correspond to the external societal labels of languages (see Chapter 4) e.g. when I as a researcher label someone's use of Anglicisms while speaking Swiss German as "English", they might not perceive it the same way. Nevertheless, in order to gain an overview of the particular multilingual resources used in the EG_BIO corpus, I see added value in assigning, if possible, the corresponding language to a particular translanguaging instance, fully aware that this assignment of language is based on my own criteria and does not have to coincide with the speaker's own perception thereof.

For the analysis of translanguaging regarding assigned languages, the use of Swiss German in non-CLIL classes constitutes a special case. Swiss German and Standard German share many linguistic features (as outlined in Section 3.1.2), therefore many instances of Swiss German and Standard German cannot be distinguished at all (e.g. the use of *genau [exactly]* or *okay*). One exception forms the word *also [therefore],* which has a Swiss German variant *aso* (pronounced [ˈazo] or [azˈo]). Through coder agreement[59] it was confirmed that the Standard German variant *also* (pronounced [ˈalzo]) and the Swiss German variant *aso* (pronounced [ˈazo] or [azˈo]) can be reliably distinguished from each other. Therefore, in this special case, the following rule applies for the analysis of translanguaging:

- **aso** = Swiss German variant = translanguaging instance in non-CLIL classes (and CLIL classes)
- **also** = Standard German variant ≠ translanguaging instance in non-CLIL classes
- **a(l)so** = unclear whether Swiss German or Standard German variant is used ≠ translanguaging instance in non-CLIL classes

[59] Three colleagues listened to each instance of *aso/also* in two lessons. To exclude that distinction is dependent on the teacher, one lesson was from T1 (20150504_1a) and the other from T2 (20150512_1f2). Each instance had to be put in one of three categories: *aso* (Swiss German variant), *also* (Standard German variant) or *a(l)so* (unclear which variant). With all three colleagues, coder agreement above 90% was established. About 30% of instances were collectively identified as unclear (*a(l)so*), but the other 70% could reliably be assigned to either the Swiss German or the Standard German variant. Keeping this in mind, for the purpose of this project the *aso/also* distinction was considered reliable. The rest of the *aso/also* instances was coded individually by the author. *Aso/also* is the only case in the data that created problems of distinction and therefore needed coder agreement (other cases are either clearly or not at all distinguishable).

In Table 13, the detailed codebook for the category of ASSIGNED LANGUAGE is provided.

Table 13: Codebook for category 4—ASSIGNED LANGUAGE (AL) of translanguaging

AL_swiss german		
Definition	**Example**	**Comments**
The translanguaging instance is assigned to Swiss German.	**CLIL_1b_20150528** S: *Wie e Pfyffebutzer.*	Only instances that are clearly distinguishable as Swiss German (by spelling or pronunciation) are coded as Swiss German.
AL_standard german		
Definition	**Example**	**Comments**
The translanguaging instance is assigned to Standard German.	**CLIL_1e_20150521** T:that there must be nutrients, *Nährstoffe*	Not applicable in non-CLIL lessons unless → TYPE_translation _creative or TYPE_integration
AL_english		
Definition	**Example**	**Comments**
The translanguaging instance is assigned to English.	**Non-CLIL_1f1_20150512** T:wo wir nicht nur so ein paar Dinge, *Facts*, auswendig lehren	Not applicable in CLIL lessons unless → TYPE_translation_creative or TYPE_integration
AL_french		
Definition	**Example**	**Comments**
The translanguaging instance is assigned to French.	**Non-CLIL_1f1_20150526** T:*Et voilà.* Deshalb ist die Stärke aufgebraucht	If the source is unclear, i.e. one cannot say for sure whether the term comes from/entered via French or Latin → marked as AL_unclear.

AL_italian		
Definition	**Example**	**Comments**
The translanguaging instance is assigned to Italian.	**CLIL_1b_20150518** T:*Cuore di palma.* No proper language I'm afraid.	If the source is unclear, i.e. one cannot say for sure whether the term comes from/entered via Italian or Latin → marked as AL_unclear.
AL_greek		
Definition	**Example**	**Comments**
The translanguaging instance is assigned to Greek.	**CLIL_1b_20150518** T:could you know the word *dendro?*	If the source is unclear, i.e. one cannot say for sure whether the source language is Greek or Latin → marked as AL_unclear.
AL_latin		
Definition	**Example**	**Comments**
The translanguaging instance is assigned to Latin.	**Non-CLIL_2d_20150521** T: *Medulla oblongata*	If the source is unclear, i.e. one cannot say for sure whether the source language is Greek or Latin → marked as AL_unclear.
AL_unclear		
Definition	**Example**	**Comments**
The translanguaging instance in question cannot be definitely assigned to any of the above-mentioned languages.	**CLIL_2e_20150521** S:to give a lot of *educt* T:Substrate, yeah.	Reasons for unclear cases: could be assigned to multiple languages, or to none in particular

8.2.4 Coder Agreement

Validity and reliability of all of the above-mentioned categories was tested by means of establishing intercoder agreement. Intercoder agreement was necessary as the categories are all based on qualitative assessment of text in context. This means, a qualitative interpretation process is involved and that an automatic and unambiguous assigning of categories is not possible. Intercoder agreement was done on two levels: The first level included the identification of a translanguaging instance based on the description in the codebook, and the second its categorization according to the four categories TYPE, SOURCE, FORM and ASSIGNED LANGUAGE.

A second coder, fluent in English, Standard German and Swiss German, coded a subsample of the data consisting of 44 episodes. Episodes refer to excerpts from the transcript that stretch over several lines or turns (Ø 67.6 words per episode). The selection was designed such that it contained episodes with one or more instances of translanguaging; for control, episodes with no translanguaging at all were included as well. The first 12 episodes served as training for the second coder. The training consisted of two phases: First, identify all translanguaging instances, and then, categorize them. Minor revisions to the codebook seemed necessary as a result of the training. For one, the original name "TYPE_translation_literal" seemed to be misleading and was consequently changed to "TYPE_translation_equivalent"[60]. Second, the initial subcategories of "FORM_word", *adjective* and *adverb* were deleted, since a distinction into these two categories proved inconsistent and unhelpful[61]. The remaining 32 episodes were

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[60] The second coder interpreted "literal translations" literally, i.e. in that for instance a *Marienkäfer* is not a literal translation of a lady bug, since a literal translation would be something like "Mary's bug".

[61] The bottom-approach to the data revealed that single-word instances of translanguaging often consist of nouns, and to a lesser extent of verbs, adjectives, adverbs and some other single words. Thus, I originally

then individually coded by the second coder and myself according to the revised codebook.

Of a total of 85 translanguaging instances, the second coder identified 82 correctly. An additional three instances were coded as translanguaging instances when they were not. The three episodes that did not contain any translanguaging were identified correctly. This corresponds to a coder agreement of 93% with regard to the identification of translanguaging instances. Each of the correctly identified translanguaging instances (n=82) had to be categorized according to four main categories, resulting in a total of 82 x 4 = 328 categorizations. Of these, 12 were not in agreement. They were, however, equally distributed over the four categories, therefore coder agreement for each individual category was over 93% (TYPE: 79/82=96.3%, SOURCE: 78/8 =95.1%, FORM: 77/82=93.9%, AL: 82/82=100%). All disagreements regarding translanguaging instances and coding were discussed and agreed on in a final discussion. After establishing the validity and reliability of the codes, the author coded the entire corpus independently.

8.3 Translanguaging: Analysis and Results

In this section, the analysis of translanguaging instances in the EG_BIO corpus is presented. First, the quantitative overview of translanguaging instances in the EG_BIO corpus according to their categories is shown (Section 8.3.1). This is followed by the quantitative overviews of translanguaging instances according to the variable of lesson type (Section 8.3.2), thereby paying specific attention to the differences

distinguished between more than just the three categories (nouns, verbs and else). However, discussions with the second coder showed that it was not always clear from context whether a word was an adjective, adverb or else. It was therefore decided to distinguish classes that can be clearly recognized, which resulted in the three categories “nouns”, “verbs” and “other”.

regarding translanguaging instances in CLIL and non-CLIL lessons. After this, the quantitative overviews regarding the other variables of speaker (Section 8.3.3) and classroom register (Section 8.3.4) are discussed. In addition to this, Section 8.3.5 deals with the special case of *aso*. Following the overall quantitative overviews, a close analysis of one specific episode (*Harasse*) is presented in Section 8.3.6.

Aso is a special case because of the total of 851 translanguaging instances in the EG_BIO corpus, 288 are instances of *aso* [that is, therefore]. In Section 8.2.3.4, the decision to include *aso* as a translanguaging instance is explained in terms of it being a Swiss German variant that can be reliably distinguished from the Standard German variant *also.* In addition, *also* in Standard German can have many functions, from being an adverb and connector to being used as a discourse marker (see e.g. Deppermann & Helmer, 2013; Dittmar, 2002), and even though there are not yet any particular studies on this, one can assume that the Swiss German variant *aso* is used similarly in interaction. This would explain the high frequency (n=288) in the EG_BIO corpus and its use by all speakers (T1, T2 and their students). However, taking up a third of all translanguaging instances (n=288; 33.8%), it cannot be excluded that the cases of *aso* skew the quantitative results in general as well as the subsequent overviews to a considerable extent, since they are all coded the same (integration, single word, Swiss German). For instance, comparing translanguaging instances in CLIL and non-CLIL lessons this way yields several statistically significant results between these two subcorpora, most of which, come down to instances of *aso* (only four of the 288 instances of *aso* occur in CLIL lessons). Therefore, in this analysis section, the decision is taken to remove the cases of *aso* for the subsequent discussions of translanguaging in order to gain a clearer picture of the distribution of translanguaging instances within the EG_BIO corpus, excluding the possibility of them being skewed due to the high frequency of *aso*. Instead, the cases of *aso* are separately discussed in Section 8.3.5.

8.3.1 Quantitative Overview of Translanguaging Instances in the EG_BIO Corpus

The original 851 translanguaging instances (1203 words) correspond to 1% of the EG_BIO corpus (n=119’337 words). Removing instances of *aso,* the EG_BIO corpus contains 563 translanguaging instances ranging from one to 17 words each (915 words in total). These 915 words that make up the 563 instances of translanguaging correspond to 0.77% of the words in the EG_BIO corpus (n=119’337 words). Consequently, translanguaging is actually a rare occurrence in the teacher-led whole class interaction examined for the present study. Figures 20 to 23 present the general overview of translanguaging instances according to the four main categories of TYPE, SOURCE, FORM and ASSIGNED LANGUAGE as they occur in the EG_BIO corpus.

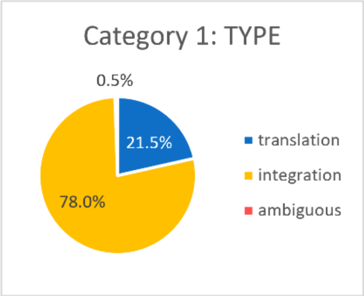

Figure 20: Translanguaging instances in the EG_BIO corpus according to type

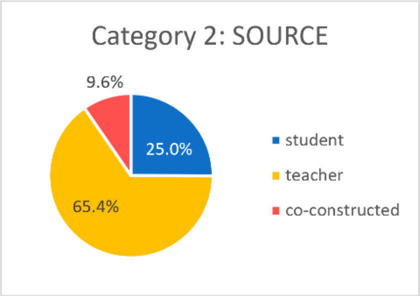

Figure 21: Translanguaging instances in the EG_BIO corpus according to source

With regard to TYPE of translanguaging instances occurring in the corpus, one can see in Figure 20 that about three fourths of translanguaging instances (78%, n=439) are integrations, followed by translations (21.5%, n=121) and three ambiguous instances (0.5%). With regard to the SOURCE of translanguaging, Figure 21 shows that 65.4% (n=368) of the translanguaging instances are produced by the teacher, 25% (n=141) are used by students, and 10% (n=54) are co-constructed.

Regarding the FORM of translanguaging instances, Figure 22 shows that a majority of the 563 translanguaging instances consist of single words (60.9%, n=343), followed by affixes (15.3%, n=86) and clauses (14.6%, n=82), then phrases (5.5%, n=31) and other (3.6%, n=21). When looking at the ASSIGNED LANGUAGE of translanguaging instances in the EG_BIO corpus, Figure 23 reveals that 41.2% (n=232) are uttered in Swiss German, 33% (n=186) in Standard German, followed by Greek (9.9%, n=56). 5.9% (n=33) of the translanguaging instances are unclear, meaning no single language could assertively be assigned to them.

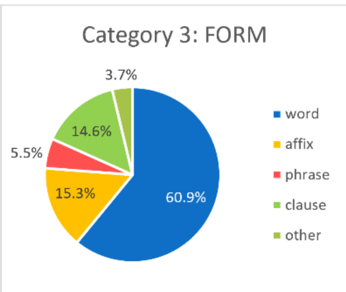

Figure 22: Translanguaging instances in the EG_BIO corpus according to form

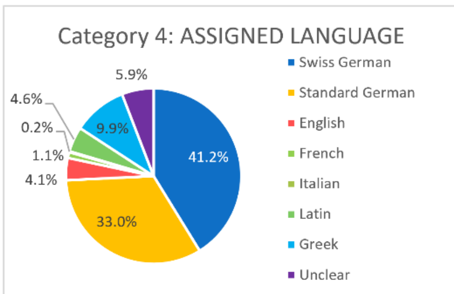

Figure 23: Translanguaging instances in the EG_BIO corpus according to assigned language

26 instances (4.6%) correspond to Latin, 23 (4.1%) to English, six (1.1%) to French and one single instance (0.2%) to Italian. Consequently, Figures 20 to 23 show that in the EG_BIO corpus the most frequent type of translanguaging is integration, with the teacher as the most common source. It typically occurs in the form of a single word and is most often assigned to Swiss German. The corresponding table is available in App. V.

Three of the four main categories (TYPE, SOURCE and FORM), have additional subcategories, the results of which are shown in Tables 14 to 16. For instance, within TYPE of translation, the category of translation is further divided into equivalent translations, explanations, and creative translations. Of the 121 instances of translation found in the EG_BIO corpus, 94 (77.7%) are equivalent translations, 15 (12.4%) are explanations and 12 (9.9%) are creative translations (see Table 14). With regard to the SOURCE category of translanguaging, co-constructed instances are further classified into whether they are initiated by the teacher (t-initiated) or by the student(s) (s-initiated). Of the 54 co-constructed instances occurring in the EG_BIO corpus, more than half (57.4%, n=31) are initiated by the teacher, and the rest (42.6%, n=23) by students (see Table 15).

Table 14: Overview of translations

TRANSLATION-TYPE	N=121	
- equivalent	94	77.69%
- explanation	15	12.40%
- creative	12	9.92%

Table 15: Overview of co-constructed instances

CO-CONSTRUCTED-TYPE	N=54	
- t-initiated	31	57.41%
- s-initiated	23	42.59%

Table 16: Overview of single word instances

WORD-TYPE	N=343	
- noun	133	38.78%
- verb	20	5.83%
- else	190	55.39%

Lastly, with regard to the FORM of translanguaging, instances consisting of single words are further categorized into nouns, verbs or else. In the EG_BIO corpus, of the 631 translanguaging instances that consist of single words, 133 (21.1%) are nouns or compound nouns, 20 (3.2%) are verbs and a three-fourths majority (75.7%, n=478) belong to word classes other than nouns or verbs (see Table 16). Thus, with regard to the subcategories, translations occur most often as equivalent translations, co-constructed instances are more often initiated by the teacher and single word instances most frequently occur as nouns.

8.3.2 Overview of Translanguaging Instances According to Lesson Type

In this section, an overview of translanguaging instances in the EG_BIO corpus according to the different categories of the lesson type variable as presented in Section 7.2.1 is given. First, with regard to type of instruction (CLIL vs. non-CLIL), then teacher (lessons taught by T1 vs. T2), and lastly regarding grade (10 vs. 11). The first overview (CLIL vs. non-CLIL) is very detailed and rather extensive with regard to analysis, since this comparison is not only the most important one regarding the descriptive variables, but is also used to illustrate and detail the basic patterns of translations and integrations occurring in the EG_BIO corpus in an effort to answer the first research question of the translanguaging analysis ("What translanguaging practices can be found in the EG_BIO corpus?"). In the subsequent sections (T1 vs. T2 and 10 vs. 11), therefore, only the major similarities and differences between the respective contexts are reported on.

8.3.2.1 Type of Instruction: CLIL vs. Non-CLIL

Excluding instances of *aso,* which results in a total of 563 translanguaging instances, the 15 CLIL lessons contain overall slightly more translanguaging instances (n=291, 51.7%) compared to the 16 non-CLIL lessons (n=272, 48.3%). This difference becomes more relevant considering the fact that the CLIL subcorpus has less teacher-led whole class interaction (n=51'585) than the non-CLIL subcorpus (n=67'752), but at the same time contains more translanguaging instances. It follows that the relative frequency of translanguaging instances is higher in the CLIL lessons (rf=0.56%) than in the non-CLIL lessons (rf=0.4%). This confirms the expectation raised in Section 7.2.1 in regards to CLIL lessons containing overall more translanguaging instances than non-CLIL lessons. Even though the pilot studies showed that non-CLIL lessons also contained translanguaging instances, the difference between the two subcorpora is smaller than expected, as it was assumed that in CLIL lessons still contained considerably more translanguaging instances than non-CLIL lessons.

As for the TYPE of translanguaging, Table 17 shows that of the 291 translanguaging instances found in the CLIL lessons, 72 (24.7%) are translations, 216 (74.2%) integrations and three (1%) ambiguous. Regarding the non-CLIL lessons, of the total 274 translanguaging instances, 49 (18%) are translations and 223 (82%) integrations. There are no ambiguous cases in the non-CLIL subcorpus. Thus, overall integrations are the most frequent in both, but there are more translations and less integrations occurring in the CLIL lessons compared to the non-CLIL lessons.

Table 17: Comparison of type of translanguaging in CLIL and non-CLIL subcorpora of the EG_BIO corpus

	clil		non-clil	
Feature	N	Percent	N	Percent
Total Units	291		272	
TYPE	N=291		N=272	
- translation	72	24.74%	49	18.01%
- integration	216	74.23%	223	81.99%
- ambiguous	3	1.03%	0	0.00%

The overall higher frequency of translations in CLIL compared to non-CLIL lessons is not surprising, since in CLIL lessons the language of instruction is English, a language foreign to both teachers and students, therefore occasional translations from English to Standard German are to be expected. However, it is interesting to see that even in the non-CLIL lessons translations are occurring as well, therefore the next section will deal with translations in CLIL and non-CLIL lessons in more detail.

8.3.2.1.1 Translations

Translations are instances of translanguaging that have a corresponding unit (CU), which might be equivalent, an explanation or creative. There are overall more translations occurring in the CLIL than in the non-CLIL subcorpus, in absolute numbers as well as in relative terms (CLIL: rf=0.14%; non-CLIL: rf=0.07%).With regard to these subtypes of translations, Table 18 shows that of the 72 instances of translation in the CLIL lessons, 56 (77.8%) are equivalent translations, 12 (16.7%) are explanations and four (5.6%) are creative translations. Compared to the non-CLIL lessons, of the 49 translations, the majority (77.6%, n=38) are equivalent translations, three instances (6.1%) are explanations and eight (16.3%) are creative translations. Thus, the CLIL lessons have overall more equivalent and explanatory translations, but less creative translations than the non-CLIL lessons. Another finding is that all these translations (equivalent, explanation, creative) in both the CLIL and non-CLIL lessons, are either made by the teacher or co-constructed, but never made by the students themselves (see Table 18). In the remainder of this section, translations are examined by type, beginning with equivalent translations, explanations and creative translations in the CLIL lessons, followed by a step-by-step comparing with the non-CLIL lessons.

Table 18: Comparison of translations in CLIL vs. non-CLIL with regard to type and source

	clil		non-clil	
Feature	N	Percent	N	Percent
Total Units	72		49	
TRANSLATION-TYPE	N=72		N=49	
- equivalent	56	77.78%	38	77.55%
- explanation	12	16.67%	3	6.12%
- creative	4	5.56%	8	16.33%
SOURCE	N=72		N=49	
- student	0	0.00%	0	0.00%
- teacher	41	56.94%	32	65.31%
- co-constructed	31	43.06%	17	34.69%

Translations in CLIL lessons

Starting with equivalent translations in the CLIL subcorpus according to assigned languages (see Table 19), 40 of the 56 equivalent translations are indeed translations into Standard German, which is expected in CLIL lessons.

Of these 40 equivalent translations, 25 are teacher translations such as in extract 8.8, and 15 are co-constructed, six initiated by the teacher as in extract 8.9 and nine initiated by students shown in extract 8.10.

Table 19: Assigned languages of equivalent translations in the CLIL subcorpus

ASSIGNED_LANGUAGE	N=56	
- swiss_german	1	1.79%
- standard_german	40	71.43%
- english	0	0.00%
- french	0	0.00%
- italian	0	0.00%
- latin	5	8.93%
- greek	6	10.71%
- unclear	4	7.14%

Extract 8.8: CLIL_1b_20150507

```
01    T2:    Uhm the comparison they make here, that to
             reinforced concrete[62], that's Stahlbeton in
             German
```

Extract 8.9: CLIL_1e_20150511

```
01    T1:    Chickpeas. What are chickpeas?
02    S:     Kichererbsen
```

Extract 8.10: CLIL_2b_20150505

```
01    S:     And Malpighian tubules?
02    T2:    Malpighische Gefässe
```

38 of the 40 equivalent translations in Standard German in the CLIL subcorpus are single words, and of these, most (n=32) are nouns as exemplified in extracts 8.8 and 8.9. There are three instances with verbs

[62] As noted in the transcription conventions (App. I), underlining represents the CU of a translation.

(*keimen* [germinate], *verschwindet* [disappears] and *zusammenfassen* [summarize]) and three in the "else" category, which are all instances of teacher turns with "yes, *ja"*. The other two equivalent translations in Standard German which are not single words are one affix (*Erd-,* [earth]) and one noun phrase exemplified in extract 8.10 above. This means all equivalent translations in CLIL lessons using Standard German (except for the "yes, *ja*" cases) concern clarifying lexis and content teaching.

Of the remaining 16 equivalent translations in CLIL lessons, all but one use source languages (Greek, Latin and unclear[63]), often to translate affixes or nouns, either by the teacher or in co-construction. For example, in extract 8.11 the teacher translates the Greek affix *xylo* into English, a strategy that is also encountered with Latin affixes (e.g. *manu* is hand).

Extract 8.11: CLIL_1b_20150518

```
01    T2:   Xylo is wood.
```

In the 15 equivalent translations in the CLIL lesson using source languages for translanguaging, six are uttered by the teacher (as in extract 8.11), and nine are co-constructed as displayed in extract 8.12. Extract 8.12 is also a good illustration of the "unclear" cases with regard to assigned language: While the components *blasto* and *derm* can be clearly attributed to Greek, the origin of the combined form *blastoderm* is not that straight-forward and is therefore labelled as "unclear". Further, the following extract 8.13 shows that translations using Latin can also be used to translate the proper names of species.

[63] In all of the four equivalent translations labelled "unclear" in the CLIL lessons (*blastoderm, peristome* and *dermis* (2x)), it was not clear whether the term entered English via Greek or Latin, which is why these cases are subsumed under source languages here as well.

Extract 8.12: CLIL_2b_20150526

01 T2: What is a *blastoderm*?

02 S: *Blasto* means germ and *derm* skin.

03 T2: Exactly. So germ skin, skin germ.

Extract 8.13: CLIL_1b_20150528

01 T2: Here. German Iris. *Iris germanica.*

Thus, the 56 cases of equivalent translations in the CLIL lessons contain 40 instances with Standard German and 15 with either Greek, Latin or unclear assigned languages. This leaves one instance of equivalent translations assigned to Swiss German, which is shown in extract 8.14:

Extract 8.14: CLIL_1b_20150507

01 S1: The upper (end) is in general yeah just yeah it's uhm, *was heisst zusammenfassen*?

02 S2: Mh? *Zämmefasse*? Ah *was heisst scho wiedr*?

03 T2: Summarize

04 S1: Yeah summarize please

Extract 8.14 shows an exchange involving two intersecting translations: S1 starts in English and then switches mid-sentence to Standard German to ask for the English word of *zusammenfassen* [summarize] (line 01). This is a common strategy known in code-switching literature as intra-sentential code-switching (see e.g. Bullock & Toribio, 2009; Poplack, 1980). In line 02, a second student chimes in to repeat or brainstorm about the English word, and does so in Swiss German: "*Zämmefasse? Ah was heisst scho wiedr?* [Summarize? Ah what is it again?]". In line 03, the teacher then provides the students with the English equivalent, which is immediately incorporated in the student's turn in line 04. There are two instances of equivalent translations in this extract, which both have two corresponding units (CUs): For one, the Standard German *zusammenfassen* corresponds to the Swiss German *zämmefasse* and the English *summarize,* and vice versa with the Swiss German *zämmefasse*. The Swiss German *zämmefasse* is, in fact, the only instance of Swiss German used for a translation in the whole CLIL subcorpus. To conclude, over two thirds (n=40, 71.4%) of equivalent translations in CLIL lessons are translations from English to Standard German (or vice versa) mostly in form of single words and either uttered by the teacher or co-constructed and exclusively used for clarifying key lexis. The rest (n=16, 28.6%) consists of translanguaging with source languages of technical vocabulary mostly in form of affixes, plus one instance of Swiss German explained above.

With regard to the other two types of translation, there are 12 instances of explanations and four creative translations in the CLIL lessons. All of these come from the same teacher, T2. As for the explanations, 10 of these are uttered by the teacher and two are co-constructed. Of the 10 teacher explanations, three are from the same lesson and deal with the Greek affix *epi* as exemplified in extract 8.15, similarly another instance deals with the Greek affix *meso* (example not shown here). In extract 8.16, an example of a teacher explanation in Standard German is illustrated. Interestingly, in this extract the teacher emphasizes the pronoun "we" when translanguaging to *Muskelkater* [literally: muscle tomcat[64]=sore muscles], indicating that "we who speak German" call it that way, implying that there seems to be no equivalent or adequate expression for that term in English.

---

[64] Muscle tomcat is one possible literal translation of the German *Muskelkater*, as *Muskel* corresponds to "muscle" and *Kater* to "tomcat". However, the most probable origin of *Kater* in *Muskelkater* has nothing to do with a male cat, but instead with *Kater* as in "hangover", which itself is probably a Germanized version of Latin *Katarrh* describing mucosa irritation (DWDS, 2021). Thus one could translate *Muskelkater* as "muscle hangover" or simply its equivalent in English, "sore muscles".

Extract 8.15: CLIL_1b_20150504

01	T2:	*Epi* is <u>something above the center</u>

Extract 8.16: CLIL_1e_20150518

01	T1:	We call it s- uhm *Muskelkater* that <u>your muscles actually hurt after an exercise</u> and maybe for two or three days

Another interesting phenomenon with regard to explanatory translations in CLIL lessons concerns species' names: As already seen in extract 8.12 with the German Iris, the teacher sometimes uses equivalent translations to translate the species' name (often in Latin) into its English common name. Two of the 10 teacher explanations also have to do with explanations of Latin species' names, as shown in extract 8.17.

Extract 8.17: CLIL_2b_20150505

01	T2:	*diadematus* is the the of uh I think, I think <u>the diamond shape</u>

The last three instances of teacher translations in form of explanations all come from the same lesson about palm trees (see extract 8.18).

Extract 8.18: CLIL_1b_20150518

01	T2:	And indeed, what I have here, that's the inner part, *Palmherzen, cours de panier, cuore di palma.* No proper language I'm afraid. Uh, that's <u>the inner part</u>, that's what would have been inside there of palm trees.

This extract is interesting with regard to the following aspects: First, there are three translations of palm hearts into three different languages: *Palmherzen* (Standard German), *cours de panier* (French), *cuore di* *palma* (Italian). They are labelled as explanations because the CU in English is “the inner part” and not palm hearts, which is the equivalent in English. Second, the teacher comments on his use of translanguaging with “no proper language I’m afraid”, almost to apologize for not being able to think of the English term in that moment and for having to use languages other than the TL. This is actually something this teacher (T2) does occasionally in his CLIL lessons whenever languages other than the TL English are spoken. Including the example above, there are a total of eight references in T2’s CLIL lessons where T2 or his students comment on this by referring to languages other than English as “strange languages”, implying a negative connotation towards the use of languages other than the TL English.

As for the two instances of co-constructed explanations, one comes from the same lesson as extract 8.15 above and consists of the teacher asking what *epi* means and the student giving the explanation “more in the middle than outside”. The other co-constructed explanation is initiated by the student and deals with *Mark* [pith cavity] as “the inner part of many stems is hollow”.

Having a closer look at the four instances of creative translations in CLIL lessons, three of these come from the same lesson and are shown in extracts 8.19 and 8.20:

Extract 8.19: CLIL_1b_20150528

```
01   T2:  But we have talked about uh, uh, ugh, what's it
          called. With flowers. Searose, it's not Seerosen
```

Extract 8.20: CLIL_1b_20150528

```
01   S:   So, peanuts in German should actually (be)
          called Erd-, Erd-,

02   T2:  Erderbsen. Ja. Something like that or Erdbohnen.
```

In extract 8.19, the teacher is talking about water plants, and tries to find the English name for *Seerosen* [water lily]. In his attempt he creates the English word *searose* (pronounced siːrəʊz) which is a literal translation of the Standard German word *Seerose.* In extract 8.20 the creative translations of *Erderbsen* [literally earthpeas] and *Erdbohnen* [literall*y earthbeans]* are co-constructed. Peanuts are called *Erdnüsse* [literally earthnuts] in Standard German, and the teacher points out that in a botanical sense, peanuts are not nuts, but would rather belong to the family of peas or beans. This prompts the student's initiation in line 01, followed by the teacher's creative translations of peanuts as *Erderbsen* and *Erdbohnen* in line 02.

The last creative translation found in the CLIL subcorpus follows a similar pattern as illustrated in extract 8.19 with *searose* for water lily, but this time it is co-constructed. It is similar in that the teacher creates an English word by anglicizing the Standard German word for it. In this case *Harasse* [crate] (pronounced haːʁasə in German) becomes *harass* (pronounced ˈhærəs in its Anglicized form), which is later translated by the student (line 06) into its English equivalent (which is why it is coded as co-constructed, see extract 8.21).

Extract 8.21: CLIL_2b_20150526

```
01   T2:  Harasse, how is it in English Harasse
          ((T looking at class))
02   T2:  It's not a harass, no
          ((Ss discussing))
03   T2:  It's a
04   S:   (xx)
05   T2:  Sorry
06   S:   Crate
07   T2:  Crate
```

The creative translation in extract 8.21 is only one aspect making this is a highly interesting episode with regard to the concept of translanguaging. This is why this particular episode is discussed separately in its wider context in Section 8.3.6. In sum, translations in CLIL lessons are overwhelmingly used to discuss key lexis and technical vocabulary, and are most often used in form of an equivalent translation with the AL Standard German.

Translations in non-CLIL lessons

Moving from the CLIL to the non-CLIL lessons, there is a total of 49 translations, of which 38 (77.6%) are equivalent translations, three (6.1%) are explanatory and eight (16.3%) creative translations (see Table 18, Section 8.3.2.1.1). Taking a closer look at the assigned languages of the 38 instances of equivalent translations, a different picture to the CLIL lessons arises in that there is no single language predominantly used for equivalent translations but a diversity of languages (see Table 20).

Going through the equivalent translations by language, the six instances of Swiss German translations are all uttered by the teacher, and follow the same pattern: Something is uttered in Swiss German, and followed by the same word or phrase in Standard German (extracts 8.22 and 8.23).

Table 20: Assigned languages of equivalent translations in the non-CLIL subcorpus

ASSIGNED_LANGUAGE	N=38	
- swiss_german	6	15.79%
- standard_german	2	5.26%
- english	4	10.53%
- french	0	0.00%
- italian	0	0.00%
- latin	8	21.05%
- greek	13	34.21%
- unclear	5	13.16%

Extract 8.22: Non-CLIL_1a_20150521

01 T1: Sie *gsehn*, Sie <u>sehen</u> das übrigens bei der Glukose

[You *see*, you <u>see</u> that in Glucose by the way]

Extract 8.23: Non-CLIL_1f2_20150526

01 T2: ein Foto, *es Föteli i dr Hang ha*<u>, ein Foto in der Hand halten</u>

[a picture, *to hold a picture in your hand*, <u>to hold a picture in your hand</u>]

In extract 8.22 for instance, the teacher uses the Swiss German verb form of "see", and immediately self-repairs to the Standard German variant *sehen.* There are two other instances involving verbs, and two involving discourse markers ("*Do,* da" [here] and "ja, *jo*" [yes]). The last equivalent translation involving Swiss German in the non-CLIL subcorpus consists of a verb phrase shown in extract 8.23. Since Swiss German is the spoken L1 of the teacher but Standard German the language of instruction, one could argue that these instances of translanguaging illustrate the teachers' self-repairs with regard to the language variety used in that very moment (cf. Lehti-Eklund, 2012 who observed this strategy in students).

Switching from Swiss German to Standard German, Table 20 shows that there are also two instances of equivalent translations in Standard German. They both deal with translations of the affix *un-* (extracts 8.24 and 8.25).

Extract 8.24: Non-CLIL_1f2_20150526

01 T2: im English wird sehr die, die Vorsilbe <u>*dis-*</u> sehr oft verwendet für <u>*un-*</u>

[in English the prefix <u>*dis-*</u> is often used for <u>*un-*</u>]

Extract 8.25: Non-CLIL_1f2_20150526

```
01    T2:   A- ist eine Vorsilbe die ma- die manchmal
            un- bedeutet
            [A- is a prefix that so- that sometimes means
            un-]
```

The affix *un-* is used in Standard German but cannot stand on its own (since it is an affix), but in both cases (8.24 and 8.25), the teacher explicitly foregrounds this by mentioning its function ("is a prefix") and then translating them into Standard German. Having a look at equivalent translations in non-CLIL lessons using English as assigned language, there is a total of four instances, three of which are uttered by the teacher (extracts 8.26–8.28) and one is co-constructed (extract 8.29).

Extract 8.26: Non-CLIL_1a_20150507

```
01    T1:   A(l)so die, diese true and false, richtig oder
            falsch Aufgaben
            [So the, these true and false, true or false
            tasks]
```

Extract 8.27: Non-CLIL_2h_20150507

```
01    T2:   Deshalb sind ja auch die uh Herzsehnen hier heart
            strings
            [This is why there are the heart strings here
            heart strings]
```

In extract 8.26, the English expression *true and false* is used by the teacher and is immediately followed by its translation into Standard German. In extract 8.27, there is a translanguaging practice frequently observed in the CLIL lessons, namely the translation of key terminology, which is used here the other way around from Standard German to English. In this case, the explicit use of translanguaging can be explained by the teacher showing a transparency with English labels, therefore this translation makes sense in so far that it ensures the students know that the *heart strings* in the picture are the "Herzsehnen".

Same as in the CLIL lessons, another strategy to explain key lexis consists of the teacher translating components of a technical term to make the link explicit to students, as shown in extract 8.28, where the teacher translates part of the technical term aerenchym *air* into Standard German in order to explain the concept of aerenchyma (spongy tissue in plants with large air-filled spaces) as a whole.

Extract 8.28: Non-CLIL_1f2_20150505

01	T2:	*Air* ist <u>Luft</u> huh. Aerenchym da das sind Luft wie Luftröhrchen drin
		[*Air* is <u>air</u> huh. Aerenchyma there are air like little airways in it]

This can also happen in co-construction as illustrated in extract 8.29:

Extract 8.29: Non-CLIL_1f2_20150526

01	T2:	Französisch oder Englisch *similar* heisst was? Ja
		[French or English *similar* means what? Yes]
02	S:	<u>Gleich</u> und <u>gleichwertig</u>
		[<u>Same</u> and <u>equivalent</u>]
03	T2:	Gleich, ja.
		[Same, yes]

In this lesson, the teacher is trying to explain the concept of assimilation, and makes a link to a component of the word the students might already be familiar with: *similar*. He then reconstructs the meaning of the technical term assimilation using students' knowledge of the word *similar,* something that is discussed more deeply in

Research Focus 3 focusing on the use of translanguaging to negotiate technicality (see Chapter 10).

Continuing with equivalent translations but using Latin as a resource, five of the total eight instances are used with affixes, such as the *dis-* explained in extract 8.24 above, or with *re-* in co-construction (see extract 8.30). In extract 8.30, the teacher explicitly mentions *re-* as a prefix, a practice already observed with *un-* in examples 8.24 and 8.25. In extract 8.30, however, the teacher asks the students for the meaning of the prefix in question, and thus co-constructs the translation.

Extract 8.30: Non-CLIL_1f2_20150526

01	T2:	Vorsilbe, die immer wieder vorkommt. Was heist *re-*? Ja [Prefix that occurs again and again. What does *re-* mean? Yes
02	S:	<u>Zurück</u> [<u>Back</u>]
03	T2:	Genau, zurück. (...) Und *Reflektion, -flekt* oder *-flex* manchmal, das *-flekt* oder *-flex* ist <u>biegen</u> [Exactly, back. (...) And *reflection, -flekt* or *-flex* sometimes, the *-flekt* or *-flex* means <u>to bend</u>]

Extract 8.30 also shows the use of the other two instances of Latin affixes in equivalent translations, namely *flekt* and *flex* with the CU "biegen" [to bend][65]. The three equivalent translations in Latin including nouns and not affixes are presented in the following two extracts 8.31 and 8.32; both have to do with Latin naming (as already seen in the Latin equivalent translations in the CLIL lessons, see

[65] The previous instances of *Reflektion, flekt* and *flex* are integrations (see Section 8.3.2.1.2 for more details).

extracts 8.11–8.13). In extract 8.31 the student first initiates the translation by simply mentioning the term *homo,* which the teacher then translates as “Mensch” [human] (line 02), repeating the translation himself one more time as clarification or confirmation of the student’s contribution. There are thus two translations of *homo* in extract 8.31*,* one co-constructed and one uttered by the teacher himself.

Extract 8.31: Non-CLIL_2h_20150528

01	S:	*Homo*
02	T2:	(Aso) <u>Mensch</u>. *Homo* ist <u>Mensch</u>, ja
		[(So) <u>human</u>. *Homo* is a <u>human</u>, yes]

The next extract 8.32 shows the co-constructed instance of the technical term *medulla oblongata*. First, the student tries to name what he sees on the transparency, using a creative translation combining the first part of its Latin name *medulla* with Swiss German *irgendöpis* [something] (line 01)[66]. The teacher then provides the full scientific Latin name *medulla oblongata* in line 02, which the student translates back to Standard German (line 05), resulting in the equivalent translation.

Extract 8.32: Non-CLIL_2d_20150521

01	S:	Das ist diese <u>*medulla irgendöpis*</u>
		[This is this <u>*medulla something*</u>]
02	T1:	<u>*Medulla oblongata*</u>
03	S:	Mhm

[66] Here one could argue that the insertion of *irgendöpis* in extract 8.32 functions more like a placeholder (similar to *whatchamacallit*, see Amiridze, Davis, & Maclagan, 2010) and would thus not be considered a translation at all. However, according to the codebook used in this study, this is considered a special case of creative translation because the compound noun *medulla irgendöpis* combines two source languages creatively (Latin and Swiss German).

04 T1: Ja
[Yes]
05 S: Das ist der Hirnstamm
[This is the brainstem]

Moving from one source language to the other: Most equivalent translations in the non-CLIL subcorpus are assigned to Greek (n=13, 34.2%), all of which are uttered by T2. Of these 13 instances, 11 deal with Greek affixes, of which six are teacher contributions like in extract 8.33 and five are teacher-initiated co-constructed equivalent translations illustrated in extract 8.34.

Extract 8.33: Non-CLIL_1f2_20150526

01 T2: Und *ergon*, das ist die Arbeit
02 S: [And *ergon*, that's the work]

Extract 8.34: Non-CLIL_1f2_20150526

01 T2: *Hemi* heisst
[*Hemi* means]
02 Ss: Halb
[Half]
03 T2: Halb. Ja das ist wunderbar
[Half. Yes this is wonderful]

As for the two instances of translations involving Greek nouns and not affixes, they belong to the word *Eugenik [eugenics],* translated literally as *Echterzeugung [truth-genesis],* as illustrated in the following extracts 8.35 and 8.36.

Extract 8.35: Non-CLIL_2h_20150528

```
01   T2:   Was ist die wörtliche Bedeutung von Eugenik?
           [What is the literal meaning of eugenics?]
02   S:    Echterzeugung. Echterzeugung?
           [truth-genesis. Truth-genesis?]
03   T2:   Echterzeugung, wenn mans zusammenhängt, genau
           [Truth-genesis, if you put it together, exactly]
```

In extract 8.35, the teacher asks for the literal meaning of eugenics (line 01). The student then replies with a creative translation, combining the literal meanings of the Greek components *eu,* which generally means good or well, but in this case also true (*echt* in Standard German) and Greek *gen-,* which corresponds to produce or generate (*erzeugen* in Standard German) to form the compound noun *Echterzeugung [truth-genesis].* The repetition of this word with a rising intonation by the student in line 02 indicates that he himself is not too sure about this creation, but the teacher affirms his creative translation in line 03 by explicitly describing the process behind the word. Therefore, in extract 8.35, a Greek equivalent translation (*Eugenik*) appears with its CU being a Standard German creative translation (*Echterzeugung)* and vice versa. Later in this lesson, the teacher summarizes the meaning of eugenics again (extract 8.36), using an equivalent translation with the CU of a verb "echt erzeugen" [to truly generate/produce].

Extract 8.36: Non-CLIL_2h_20150528

```
01   T2:   Das ist Eugenik. Ja. Und der Name Sie S- S- Sie
           verstehen der Name ist echt erzeugen
           [That's eugenics. Ja. And the name you y- y- you
           understand the name is to truly generate]
```

Transitioning to equivalent translations where the AL is unclear, there is a total of five instances in the non-CLIL lessons, one of which is co-

constructed and the others uttered by the teacher. One of these is an affix that cannot be traced back to a single language (the prefix *a-,* see extract 8.25, p. 166) translated by the teacher. The other four are, same as in the CLIL lessons, instances of compounds where the origin of the individual components might be clear, but not the origin of the compound word such as such (e.g. *Hemihydrat* [hemihydrate], *abiotisch* [abiotic] and twice *Chlorophyll* [chlorophyll][67]). With regard to the three explanations occurring in the non-CLIL subcorpus, they all come from a single episode in one of T2's lessons, displayed in extract 8.37.

Extract 8.37: Non-CLIL_1f2_20150526

01 T2: *ease*, das bedeutet wohl, dass es einem wohl ist. Man ist *at ease*, dann ist es einem wohl und *disease*, das heisst eigentlich unwohl, unwohl sein.

[*ease*, that means comfortable, that you feel at ease. You are *at ease*, then you are feeling at ease and *disease*, that actually means unwell, feeling unwell.]

In extract 8.37, the teacher is explaining the concept of the prefix *dis*-, as in dissimilation or in this case, *disease*. He explains what *ease, at ease* and *disease* mean. This is an excellent example of how translanguaging can be used to deconstruct and reconstruct technicality, which is why this is further discussed in the analysis of Research Focus 3 (Chapter 10).

Lastly, looking at the creative translations occurring in the non-CLIL lessons (n=8), apart from one instance (*medulla irgendöpis*, extract 8.32), they are all uttered by T2 and result from literal

[67] For instance, *chloro* and *phyll* come both from Greek, but the term *chlorophyll* itself seems, at least in English, to have entered the language via French. Therefore, *chlorophyll* has multiple origins (Merriam-Webster, 2021).

translations of technical terminology into Standard German, as exemplified above with *Echterzeugung* (extract 8.35). Other examples of this are *Hemihydrat* [hemihydrate] translated as *Halbwasser* [half-water], *Chlorophyll* as *Grünblatt* [green-leaf] or *abiotisch* [abiotic] as *unbiotisch* [unbiotic].

This section has presented a detailed look into the similarities and differences regarding the types of translations occurring in the CLIL and non-CLIL subcorpora of the EG_BIO corpus, providing a first answer to the research question ("What translanguaging practices can be found in the EG_BIO corpus?"). All types of translations in both contexts are either made by the teacher or co-constructed. Overall, there are generally more equivalent and explanatory, but less creative translations in CLIL than in non-CLIL classes. In both, CLIL and non-CLIL lessons, equivalent translations are most frequent, but their use is different in the respective context. In CLIL lessons, equivalent translations are most frequently used with Standard German to clarify key terminology or other vocabulary needed to converse in English. Second are equivalent translations with source languages (Greek, Latin, unclear), mostly in form of affixes in order to help construct the meaning of (parts of) technical terms. In non-CLIL lessons, Greek and Latin affixes are used similarly to CLIL lessons in order to clarify components of technical vocabulary. However, what stands out in the non-CLIL subcorpus are instances of equivalent translations in Swiss German, which mainly consist of the teacher translating or self-repairing instances of Swiss German into Standard German.

With regard to explanations, in the non-CLIL context all three instances come from the same lesson while in the CLIL subcorpus there are not only more explanations, but they also vary in their form and usage, from explaining Greek affixes to species' names and concepts that have seemingly no equivalent in the TL. Creative translations in the CLIL lessons are either attempts by the teacher to translate literally from Standard German to English, or conscious creations to prove a point. In the non-CLIL lessons, however, the creative translations are almost exclusively the result of literal translations of technical vocabulary. In both contexts, all explanatory and creative translations are (with one exception) exclusively made by T2.

A last interesting observation regarding translations concerns student-initiated co-constructions: While both CLIL and non-CLIL lessons have the same amount of teacher-initiated co-constructed translations (n=14), the CLIL subcorpus contains overall more (n=16) student-initiated translations than the non-CLIL subcorpus (n=3). This could be an indication that students are generally more active or less anxious to ask questions and to draw on diverse linguistic resources in CLIL compared to non-CLIL lessons, a claim that has often been reiterated in CLIL literature (see e.g. Dalton-Puffer & Smit, 2007a, p. 9). Having compared and described in detail the instances of translation occurring in CLIL and non-CLIL classes, the findings for the second type of translanguaging, integration, are presented in the following section.

8.3.2.1.2 Integrations

Integrations are cases where languages other than the language of instruction are directly incorporated into the speech without a corresponding unit (CU). Even with the exclusion of *aso,* integrations make up the largest part of translanguaging instances (n=439, 78%) in the EG_BIO corpus. They are almost equally distributed between CLIL (n=216, 49.2%) and non-CLIL (n=223, 50.8%) lessons (see Table 21). The relative frequencies show that integrations occur more frequently in the CLIL lessons (CLIL: rf=0.42; non-CLIL: rf=0.33). Integrations are rather equally distributed with regard to SOURCE and FORM of translanguaging, as can be seen in Table 21.

Table 21: Comparison of integrations in the CLIL vs. non-CLIL subcorpora with regard to source, form and assigned language

	clil		non-clil	
Feature	N	Percent	N	Percent
Total Units	216		223	
SOURCE	N=216		N=223	
- student	77	35.65%	64	28.70%
- teacher	135	62.50%	158	70.85%
- co-constructed	4	1.85%	1	0.45%
FORM	N=216		N=223	
- word	128	59.26%	128	57.40%
- affix	30	13.89%	24	10.76%
- phrase	6	2.78%	20	8.97%
- clause	39	18.06%	43	19.28%
- other	13	6.02%	8	3.59%
ASSIGNED_LANGUAGE	N=216		N=223	
- swiss_german	55	25.46%	170	76.23%
- standard_german	114	52.78%	18	8.07%
- english	5	2.31%	10	4.48%
- french	2	0.93%	3	1.35%
- italian	0	0.00%	0	0.00%
- latin	2	0.93%	9	4.04%
- greek	19	8.80%	13	5.83%
- unclear	19	8.80%	0	0.00%

In both contexts, the teacher utters roughly two thirds of the integrations (n=135, 62.5% in CLIL and n=158, 70.9% in non-CLIL); the rest is used by students. A mere five instances of all integrations are co-constructed. With regard to FORM, in both contexts almost 60% are single word contributions (n=128, 59.3% in CLIL and n=128, 57.4% in non-CLIL). The rest are, in both subcorpora, made up mainly of clauses, followed by affixes and phrases, and a few instances in the "other" category (see Table 21 for the exact numbers). The two contexts differ most in regards to assigned language, with CLIL lessons having Standard German (n=114, 52.8%) as the dominating language, and non-CLIL lessons Swiss German (n=170, 76.2%), respectively.

Due to the role of assigned language in the use of integrations, the next section then first reports on student and teacher integrations according to assigned language in the CLIL context. This is followed by an analysis of student and teacher integrations in the non-CLIL context. Finally, the five instances of co-constructed integrations are briefly discussed, and the main similarities and differences of integrations across the two subcorpora are summarized.

Integrations in the CLIL lessons

Of the 77 student integrations in the CLIL lessons, 50 (64.9%) are assigned to Swiss German, 18 (23.4%) to Standard German, four (5.2%) are unclear cases, three (3.9%) are assigned to Greek, and one (1.3%) each to French and English (see Table 22). Of the 50 student integrations that are in Swiss German, 33 occur in the form of clause, a clause being defined as consisting of at least a subject and a finite verb. Some examples of such clauses are shown in extracts 8.38 to 8.42.

Table 22: Student integrations in the CLIL subcorpus according to assigned language

ASSIGNED_LANGUAGE	N=77	
- swiss_german	50	64.94%
- standard_german	18	23.38%
- english	1	1.30%
- french	1	1.30%
- italian	0	0.00%
- latin	0	0.00%
- greek	3	3.90%
- unclear	4	5.19%

Extract 8.38: CLIL_1b_20150507

```
01    T2:   So why would trees want to grow that tall?
02    S:    Ah i weisses [I know it]
03    T2:   Yeah
04    S:    Because they want to get more sunlight
```

In extract 3.38, the teacher asks his class in English why trees grow that tall, to which the student in line 02 replies in Swiss German “Ah *i weisses* [Ah *I know it*]”. After the teacher confirms (line 03), the student goes on (line 04), giving the answer to the teacher’s question in English. In fact, 22 of the 33 Swiss German clauses uttered by students are preceded by utterances in English by their teacher (as shown in extract 3.38), another one is preceded by a teacher turn in Standard German and one by an unintelligible teacher turn. The other nine of the 33 Swiss German clauses are preceded by student turns as illustrated in extracts 3.39 and 3.40. Thus, student switch to Swiss German

Extract 3.39 below is taken from a lab class, where students had to look through the microscope to detect certain specialized cells, and S1 inquires in English whether she had actually found such a cell, to which S2 replies in Swiss German that there are no such cells in their sample (which is later confirmed by the teacher).

Extract 8.39: CLIL_1b_20150504

```
01    S1:   Is that one there right in the middle?
02    S2:   Ah es het gar keini dörte inne [there are none
            in there]?
```

Extract 3.40 shows another example of student integrations in Swiss German, this time claiming they do not have the worksheet the teacher is referring to in class. This extract is interesting with regard to two aspects: First, they are talking not about the content of the class, but about organizational affairs (regulative register), which is why they might feel comfortable to switch back to Swiss German to discuss these matters. Second, while in the previous extracts (8.38 and 8.39) the preceding turns were always in English, meaning it was the students' decision to switch languages, in extract 8.40 S2 continues to talk in Swiss German only after the previous student had done so.

Extract 8.40: CLIL_2b_20150528

```
01    S1:   Ha das gar nit [I do not even have that]
02    S2:   Ich au nit [me neither]
```

The switching of S2 in extract 8.40 might have something to do with what Moore and Nikula (2016, p. 227) assumed to be translanguaging strategies signaling alignment to participants. In this case, S2 would signal alignment with the first student by sticking to Swiss German. Another reason might be the classroom register, in that similarly to group and pair work, there are just areas within a lesson where translanguaging seems more accepted, such as in this case discussing organizational matters (see Gierlinger, 2015). Another interesting example with regard to student clauses in Swiss German is extract 8.41:

Extract 8.41: CLIL_1b_20150521

```
01    S1:   Ah okay, but we can still improve it.
02    T2:   Yes, yes of course, of course, of course.
03    S2:   Het er e neui ine to [did he put in a new one]?
04    T2:   I haven't changed, I haven't changed it recently
05    S3:   Aha ich weiss nit, ich has [I don't know, I have]
            (xx)
```

Here the class is also discussing organizational matters (regulative register), namely the calculation of their grades. One can see that the conversation starts in English (lines 01 and 02), then in line 03 S2 switches to Swiss German to inquire whether the teacher already updated the grades on their school network. Interestingly, S2 uses the third person (*er [he]*) to refer to the teacher, thus it can be assumed that the student's contribution was not aimed directly at the teacher, which based on my field notes happened often in parallel talk and therefore might be one reason the student uses Swiss German. Nevertheless, the teacher seems to have heard the students' input and reacts accordingly in his turn in line 04, but does so again in English, not aligning himself with the student language-wise. S3 in line 05 then also replies to S2's inquiry, sticking to Swiss German and thus aligning herself with the previous student.

Last but not least, looking at Swiss German integrations in form of clauses by CLIL students, there are two instances worth mentioning because they are structurally different from the others in that the choice of language switches mid-sentence, as illustrated in extract 8.42. Here the student starts off with his answer in English, and then switches to Swiss German in the last clause.

Extract 8.42: CLIL_1e_2015007

01	S:	Because of the pyruvate decarboxylation and the Krebs cycle and uh *was isches gsy [what was it]?*
02	T1:	I think I think he said that already

Interestingly, all 33 examples of student integrations in form of clauses in the CLIL subcorpus seem either to refer to understanding the content (e.g. *Ich weisses* [I know it], *jetzt tscheggis* [now I get it], *ich tscheggs nit* [I don't get it]) commenting on the task at hand in some form (e.g. *esch jo mega klei* [this is indeed really tiny], *gohts no schnäller?* [does it go any faster?]) or discussing organizational matters (e.g. *het er e neui ine to?* [has he added a new one?], *das han ich nit* [I haven't got this one]). The analysis of translanguaging instances with regard to classroom register (Section 8.3.4) might shed some more light on whether certain registers (e.g. the regulative register_general or regulative register_specific content) are more prone to this type of translanguaging.

As for the remaining 17 instances of student integrations assigned to Swiss German that are not clauses, nine of them consist of single word instances, all but one occurring in the same class (1b). Two of the nine single word integrations are nouns both exemplified in extract 8.43 (*Pfyffer [piper]* and *Pfyffebutzer [bottlebrush]*). One instance is a verb (*isch [is]*) and six are cases subsumed in the "else" category not shown here (*nei [no]* (2x), *jä [yes], eso [that way], wügli [really], jöö [cute]*).

Extract 8.43: CLIL_1b_20150507

01	S:	Wueh it's a *dings do e [thing here a]* (xx) *Pfyffer [piper]* (xx) *Pfyffebutzer [bottlebrush]*
02	T2:	It could remind you of
03	S:	*Wie e Pfyffebutzer [Like a bottlebrush plant]*

Of the other eight student integrations in Swiss German, four occur in the form of phrases (see e.g. line 03 in extract 8.43, other examples include *nu no ei Stund* [only one more lesson], *denn Wuchenänd* [then weekend] and *20 ab* [20 past]), and another four in the "other" category consisting of strings of words that do not build a phrase or clause (see e.g. *dings do e* [thing here a], line 01 extract 8.43; other examples include *jä scho abr* [yes indeed but], *nei abr abr* [no but but] and *hei nomol* [damn][68]).

In contrast to the 50 CLIL student integrations in Swiss German, CLIL student integrations using Standard German occur 18 times, the majority are not phrases but single word contributions (n=13). Eight of

[68] *Hei nomol* is an idiomatic expression used in some Swiss German dialects and has no direct or equivalent translation in English. It can be used similarly to "damn!".

these single word contributions are nouns and five belong to the category “else” (*was* [what] (3x) and *ja* [yes] (2x)). Two of the nouns are instances of a student calling the teacher’s name in combination with title, but instead of the English *Sir* or *Mister,* the student uses the Standard German equivalent *Herr*. One instance concerns organizational matters (as shown in the extract 8.44), and I argued elsewhere (Bieri, 2018b, p. 98) that such instances often occur in the CLIL subcorpus with regard to specific administrative terms in Standard German that are highly contextualized to the school system and therefore do not have an exact equivalent. For instance, in extract 8.44 the teacher and the students know that *Berufswahltag* refers to a specific event held every year at this school, during which students can learn about professional choices.

Extract 8.44: CLIL_2b_20150505

```
01   S:   (xx) we already we've already saw when we were
          there like Berufswahltag [career choice day]?
```

The other five instances of student integrations consisting of nouns all concern the instructional register as shown in extract 8.45 with the example of *Seitenstechen* [stich]. The others include *Hundekurs* [dog school], *Gänseblümchen* [daisy], *Liane* [vine] and *Pflug* [plough]. In all of these cases, the students do not seem to know the English equivalent, and thus translanguage. And maybe because it is the instructional register, they use Standard German for translanguaging rather than Swiss German (as Standard German is the official ML). Interestingly, in extract 8.45, after the student uses *Seitenstechen,* the teacher in line 02 employs the same translanguaging practice, namely integrating the term *Seitenstechen* in his otherwise English reply, maybe because he himself does not know the equivalent in English on the spot.

Extract 8.45 CLIL_2e_20150528

```
01    S:    Well they try, they they they exhale not enough
            and then there's too much CO2 left and then you
            have something like Seitenstechen [stitch]? But
            if your brain did know that why

02    T1:   Okay, so you heard that that's the reason for
            getting Seitenstechen [stitch]? Okay.
```

The remaining five instances of student integrations that are not single word contributions consist of one phrase (*mega unheimlich* [really uncanny]), one clause (*was heisst zusammenfassen?* [what does summarize mean?]) one "other" (*ja ja ja* [yes yes yes]) and two affixes (*Erd-* [earth-] (2x); both were illustrated in the previous Section 8.3.2.1.1 in extract 8.20).

Then there are four unclear cases with regard to assigned language: One consists of the word *zschokkei,* which is a Latinized version of a person's name (the class is talking about the rules for the naming of species). The other three instances are all connected to a discussion about the correct spelling of *bronchio* (see extract 8.46).

Extract 8.46 CLIL_2e_20150507

```
01    S1:   Is it bra or bro?

02    T1:   Here?

03    S1:   Yeah

04    T1:   Bra.

((several lines omitted))

11    S1:   Uhm, you wrote there, uhm, uh branchio. Uhm and
            in the script it says, uh it says bronchio with
            a 'o' but (xx)
```

In this extract, the student asks whether the writing on the blackboard spells *branchio* or *bronchio,* to which the teacher affirms the *bra* spelling (line 04). Later the same student remarks that in the book it is spelled *bronchio* instead of *branchio.* While *bronchio* is the correct affix stemming from Greek, and can thus be assertively assigned to that language, its other versions cannot, since they are either partial affixes (*bra, bro*) or misspellings of the original (*branchio*). Accordingly, the use of *bronchio* in the extract above (line 11) is an example of a Greek student integration in form of an affix. The two other student integrations also assigned to Greek also concern affixes (*exo, logy*). There is one student integration assigned to French, which shown in extract 8.47. It is the opening of a lesson, where the student switches to French to ask the teacher how he is doing. Interestingly here, the teacher, maybe because it is an opening, signals alignment and replies in French as well.

Extract 8.47: CLIL_2b_20150505

01	S:	*Ça va monsieur [how are you Mister]* (T2's NAME) uh?
02	T2:	*Qu'est-ce qu'il y a [What is it]*?

Lastly, there is one case of student integration in a CLIL lessons assigned to English. According to the codebook, English integrations in CLIL lessons and Standard German ones in the non-CLIL lesson are mainly creative insertions due to error or creativity, similar to creative translations but without the CU. In the case at hand, the student simply uses *transportened*[69] instead of transported.

[69] One could argue that this is an inflection and therefore not a translanguaging instance at all, but here it is considered a translanguaging instance since the inflection (-ed for simple past tense) is actually correct, but the stem or the word itself is not (transporten instead of transport). Therefore, it is considered a translanguaging instance, more specifically a creative integration probably caused by error.

In summary, those CLIL student integrations assigned to Swiss German mostly consist of phrases, and seem to be tied to the regulative register, while CLIL student integrations in Standard German and source languages mostly occur in form of single word contributions during the instructional register. Section 8.3.4 will show whether this correlation with classroom registers holds true.

Changing from student integrations to teacher integrations in CLIL (n=135), the greatest difference between the two is evident in assigned language: While most student integrations are assigned to Swiss German (n=50 of 77, 64.9%), most of the teacher integrations are assigned to Standard German (n=92 of 135, 68.2%), followed by 16 instances assigned to Greek, 15 unclear cases, five Swiss German ones, four assigned to English, two to Latin and one French integration (see Table 23). Of the 92 teacher integrations in Standard German, the majority (n=81, 88%) are single word contributions. Of these, 15 are instances of nouns, and 66 are subsumed in the category of "else". Almost all instances of CLIL teacher integrations in the category "else" (n=63) refer to the word *ja* [yes], as shown in extracts 8.48 and 8.49. The other three instances are the use of *genau* [exactly], *oder* [or] and *noch* [still]. Thus, out of all the CLIL teacher integrations (n=135, see Table 23), 46.7% (n=63) are instances of *ja* [yes]. This might be due to *ja* [yes] having various functions in German (see e.g. Imo & Lanwer, 2019, pp. 159–193) that might be transferred to English here; from being used as a discourse and hesitation marker or modal particle to signaling the end of a turn. Most of the teacher's use of *ja* [yes] in the CLIL lessons occur

Table 23: Teacher integrations in the CLIL subcorpus according to assigned language

ASSIGNED_LANGUAGE	N=135	
- swiss_german	5	3.70%
- standard_german	92	68.15%
- english	4	2.96%
- french	1	0.74%
- italian	0	0.00%
- latin	2	1.48%
- greek	16	11.85%
- unclear	15	11.11%

in the form of extract 8.48 or 8.49. In extract 8.48 the teacher uses *ja* [yes] as a positive assessment of the student's content. This also often occurs as a single turn, meaning that unlike in extract 8.48, where the teacher continues to hold the floor in English, the student would continue talking.

Extract 8.48: CLIL_2b_20150526

01	S:	They're very flat so the oxygen in the environment can diffuse through the whole body.
02	T2:	*Ja [yes].* That's the whole story. *Ja [yes].* Flatworms.

Extract 8.49: CLIL_2e_20150507

01	T1:	Other argument? Start with the anti- *ja [yes]*?
02	S:	(xx) father has the blood group B

Extract 8.49 illustrates a very specific use of the particle *ja* [yes]: with rising intonation it functions as other-selection to give students the floor. In this case, the teacher sees that a student raised his hand, and interrupts his own talk to give the floor to the student. Of the 63 uses of *ja [yes],* a total of five are used in this manner.

As for CLIL teacher integrations with AL Standard German consisting of nouns (n=15), they contain administrative terms (*Schulnetz* [school network], *Arbeitswoche* [project week], *Urlaubsgesuch* [application for leave]*, Gymnasium* [upper-secondary school]*, Pfingstmontag* [Pentecost Monday]), content teaching (*Pflug* [plough], *Muskelkater* [sore muscles], *Seitenstechen* [stitch], see line 02 in extract 8.45), or words connected to the episode on *Harasse* [crate] discussed separately in Section 8.3.6.

Of the remaining 11 instances of CLIL teacher integrations, eight belong to the category "other" and are simply repetitions of *ja* [yes], as in *ja ja ja.* One is a clause and one is a phrase used by the teacher[70] when reading from a German pamphlet to advertise an optional course in biology offered at a local pharmaceutical company. The last one concerns the affix *Erd-* [earth] as in *Erdnüsse* [peanuts].

Apart from the 92 integrations assigned to Standard German, in the CLIL lesson there are 16 instances of teacher integrations assigned to Greek (see Table 23). All 16 instances are affixes and used exclusively by T2 (classes 1b and 2b), as for instance shown in extract 8.50.

Extract 8.50: CLIL_1b_20150518

```
01   T2:  which is related to the word xylo and you're
          probably aware of other words starting with xylo
```

In extract 8.50, unlike the teacher translations of affixes discussed in the previous section (e.g. "*Xylo* is wood", extract 8.11), the teacher simply integrates the affix without a CU. Other examples of affixes integrated this way are *epi*, *exo*, *endo*, *dendro-* (4x), *chronos*, *logy* (2x), *bronchio* and *hemo.* In addition to the instances in Greek, there are a total of 15 CLIL teacher integrations with unclear AL. Four of these are affixes related to the *bronchio* example shown previously in extract 8.46. Similar to the students' use of various versions of the *bronchio* affix, the teacher does so too, using *bra, brancheo, branchus* and *branchio.* The other 11 instances with unclear assigned languages all concern two scientific names of species: *Philates zschokkei* and

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[70] The clause in question reads as follows: "*Informationen zu den einzelnen Themen und zum Anmeldeverfahren können über die Fachschaft Biologie und Chemie bezogen werden [Information on the individual topics and the registration procedure can be obtained from the Biology and Chemistry Department]"*
The phrase in question reads as follows: "*Einblicke in die Welt eines (xx) Biopharmazeutischen Unternehmens [Insights into the world of a (xx) biopharmaceutical company]"*

Stenaelurillus. Scientific naming, though often still based on Latin, can have various origins or rules on how these names come about. For instance, in extract 8.51, the teacher talks about a specific spider, *Stenaelurillus albus.* The second part *albus* clearly stems from Latin, meaning white, because this particular jumping spider has a whitish covering (Sebastian, Sankaran, Malamel, & Joseph, 2015). However, together *Stenaelurillus albus* cannot be assigned solely to Latin as the the etymological origin of *Stenaelurillus* is unknown.

Extract 8.51: CLIL_2b_20150505

01	T2:	It's the Sebastian et al. is it (Früh) ah *I muess no einisch go luege [I have to look it up again].* It is probably this one here S- S- *Stenaelurillus albus* Sebastian and al. 2015.

There are also two teacher integrations assigned to Latin—one where only the last name of a species is mentioned (*grammicus [geometrical]*) and the other one where the teacher integrates the affix *pulmo* into his explanation of alveoli, the pulmonary capillaries in our lungs.

Moving on to CLIL teacher integrations in Swiss German (n=5), there is a variety of forms: three single word instances, of which one is a noun (*Pfyffebutzer,* shown in extract 8.43), and the other two are subsumed in the category "else" (*jo [yes]* and *mol [indeed]*). The remaining two instances are clauses and particularly interesting to look at. One of them is exemplified in extract 8.51 above. I argued elsewhere (Bieri, 2018b, p. 98) that the teacher switches back to Swiss German because he makes a meta-comment about his own actions, a translanguaging strategy previously observed by Moore and Nikula (2016, p. 229). The second instance of a teacher clause in Swiss German is illustrated in extract 8.52:

Extract 8.52: CLIL_2b_20150505

01	T2:	How many marks do we have?
02	S1:	One and a half
03	S2:	Two
04	S3:	Two
05	S4	*No hämmer zwei? Mer händ doch nur eine [do we have two? But we have only one]*
06	T2:	*Mer händ [we have]* a full mark and then (what do we get) another lab and then another lab, that's enough.

In extract 8.52, the students are discussing their grades with the teacher, and whether or not they need to schedule an additional exam. The teacher inquires about the number of grades they already have (line 01), whereupon the students give various answers. S4 (line 05) then asks in Swiss German whether they actually have one or two grades. In response to this, the teacher in line 06 starts his sentence in Swiss German ("*Mer händ* [we have]*"*) but then switches mid-sentence back to English. This could be an example of a situation where the teacher unconsciously aligns himself with the student before realizing that he should stick to the TL English.

Then there are four instances of teacher integrations assigned to English in the CLIL subcorpus, all erroneous derivations by the teachers (*denaturate, unefficient, air suckage,* and *trustworth*). Lastly, there is one instance assigned to French, and it corresponds to the student integration assigned to French since it is the same opening already shown previously (see extract 8.47). In summary, CLIL teacher integrations occur most frequently in Standard German, most often in the form of *ja [yes],* otherwise in the form of single nouns. A substantial amount of CLIL teacher integrations are used with source languages connected technical terminology.

Integrations in non-CLIL lessons

Table 24: Student integrations in the Non-CLIL subcorpus according to assigned language

ASSIGNED_LANGUAGE	N=64	
- swiss_german	60	93.75%
- standard_german	3	4.69%
- english	0	0.00%
- french	0	0.00%
- italian	0	0.00%
- latin	0	0.00%
- greek	1	1.56%
- unclear	0	0.00%

Transitioning from CLIL to the non-CLIL subcorpus, there are a total of 64 student integrations occurring in the non-CLIL lessons. Language-wise, the distribution is rather simple (see Table 24): A majority (n=60, 93.9%) are uttered in Swiss German, three (4.6%) in Standard German and only one instance (1.5%) is assigned to Greek. Starting with the 60 student integrations in Swiss German, 25 are clauses, 24 single word contributions, eight phrases, two affixes and two are in the "other" category. With the 25 clauses in Swiss German, 22 of the 25 clauses are preceded by a teacher turn in Standard German, two are preceded by unintelligible teacher turns and only one clause is preceded by a student turn in Standard German. Thus, in contrast to the CLIL lessons (see extracts 8.38–8.47), there are no student clauses preceded by other students using Swiss German in the non-CLIL lessons, meaning that students did not translanguage to signal alignment with a previous student. Connected to this, there is a difference with regard to the students' structural use of Swiss German clauses: Whereas in CLIL lessons all but two instances of Swiss German clauses by students occur in single turns, i.e. the whole turn consists of a clause in Swiss German, in non-CLIL lessons only 15 of 25 clauses constitute single turns, all others are embedded as shown in extract 8.53:

Extract 8.53: Non-CLIL_1a_20150507

```
01   S:   Ja aso, uhm, die Energie ist ja in der Glukose
          drin. Cha mes so sage, nein

          [Yeah so, uhm, the energy is inside the glucose.
          Can one say it like that, no]
```

The higher number of Swiss German clauses embedded in otherwise Standard German replies might be an indication that switching from Standard German to Swiss German is not as conscious a process as switching from English to Swiss German. There are also similar patterns regarding the use of Swiss German clauses observed in the non-CLIL lessons compared to the CLIL lessons: They are also used to refer to understanding of the content material (e.g. *Das kenni alles* [I know all of this]), commenting on the task at hand (e.g. *söll ichs Ihne hebe?* [Should I hold it for you?]) or organizational matters (e.g. *Dr (NAME) fehlt au* [the (NAME) is also missing]).

Transitioning from clauses to single word contributions, of the 24 single word contributions, one is a noun (*Akündigti* [announced exam]), five instances are verbs (*isch* [is] (3x), *het* [has], *bunde* [bound]) and 18 integrations are in the category "else". The 18 integrations in the category "else" are instances of Swiss German variants *jä* and *jo* for *yes* (9x) or *nei* [no] (6x), *tschuldigung* [sorry], *do* [here] and *bitz* [a bit].

There are eight student phrases in Swiss German, two concerning openings (*guete Morge* [good morning]), and six other phrases (*kei Ahnig* [no idea], *einglech scho* [actually yes], *ned do* [not here], *vo wo* [from where], *en Überraschig* [a surprise], *putzt bechunnt* [gotten an electric shock]). There are two affixes by students in Swiss German, both connected to different pronunciations of these affixes in Swiss

German compared to Standard German[71]. There is one case in the "other" category, and it is simply a repetition of the Swiss German variant for *yes—jä jä* [yes yes].

Moving to the three student instances assigned to Standard German, which are all creative integrations (since Standard German is the language of instruction in non-CLIL lessons). They all concern creative or erroneous derivations from Swiss German to Standard German (*Apparatschaften [apparatus-ship]*, *einte [one]*[72] and *unreaktiv [unreactive]*).

There is one single student integration assigned to Greek, and as most Greek integrations it concerns the use of an affix and content teaching, in this case the student uses the affix *glyko* to refer to glucose (see extract 8.54):

Extract 8.54: Non-CLIL_1a_20150528

```
01     S:     Aso zwei pro uh glyko
              [So two per uh glyco]
```

To summarize student integrations in the non-CLIL lessons, they are heavily dominated by Swiss German, most of which occur in the form of clauses or as single word contributions and are used in a variety of different ways, ranging from commenting on content to organizational matters.

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[71] Swiss German *a-* [ʌ] for *an-*[ʌn], as in *anziehen [to tighten]*, or *uf-* [ʊ̯f] instead of Standard German *auf-* [ˈaʊ̯f] in the word *aufpassen [to pay attention]*.

[72] *Einte* is probably a combination of Swiss German and Standard German, since *dr Eint* or *dr Einti* are Swiss German variants, but the correct version in Standard German would be *der Eine [the one]*.

Table 25: Teacher integrations in the Non-CLIL subcorpus according to assigned language

ASSIGNED_LANGUAGE	N=158	
- swiss_german	110	69.62%
- standard_german	15	9.49%
- english	9	5.70%
- french	3	1.90%
- italian	0	0.00%
- latin	9	5.70%
- greek	12	7.59%
- unclear	0	0.00%

Moving on to teacher integrations in non-CLIL lessons, in contrast to teacher integrations in the CLIL lesson, where Standard German was the dominant assigned language, Table 25 shows that of the 158 teacher integrations in the non-CLIL lessons, the majority (n=110, 69.6%) are assigned to Swiss German, followed by Standard German (n=15, 9.5%), Greek (n=12, 7.6%), English and Latin (each n=9, 5.7%), and French (n=3, 1.9%). Of teacher integrations in Swiss German (n=110), 77 (70%) are single word contributions, a majority (n=69) of which belong to the category "else"[73]. Within these 69 instances, 21 integrations are cases of *tschuldigung,* the Swiss German equivalent of *sorry* or *apologies.* 16 consist of *guet* [well, good], 10 are cases of *jo/jä* [yes] and six of *nei* [no], three instances of *do* [here], two of each *mitenand* [together], *gummig* [elastic] and *Gsundheit* [bless you][74], and several other single instances of Swiss German teacher integrations[75].

[73] The other instances are five nouns (*Morge* [morning] (2x), *Bispiel* [example], *Wurscht* [sausage] and *Zetteli* [paper slips]) and three verbs (*isch* [is] (3x)).
[74] The Swiss German term *Gsundheit* is actually a noun literally translating as *health.* However, in Standard German and Swiss German the term is often also used as an interjection meaning *bless you.* In both cases in the EG_BIO corpus, *Gsundheit* is used in the latter sense, which is why it was categorized as "else". The same applies for *Tschuldigung,* which is technically a noun but used here as an interjection meaning *sorry.*
[75] These are: *ecklig* [irksome], *före* [forward], *öpe* [approximately], *drab* [away], *mol* [indeed], *villicht* [maybe], *usser* [except].

The remaining teacher integrations in Swiss German not consisting of single words constitute 18 clauses, 10 phrases and five in the "other" category. With regard to the 18 clauses, they are all uttered by T2 and seem to concern either meta-comments about his own actions (e.g. *das muess i no uffschriebe dass es richtig gsy isch* [I have to still write down that this has been correct] or specific instructions to tasks and experiments (e.g. *chömed mal före* [you all come to the front]). What is interesting here is that in three of the total 18 clauses, the teacher responds in Swiss German only after the student had previously done so (see extract 8.55).

Extract 8.55: Non-CLIL_2h_20150507

01	S:	Links haben wir die Vene die aus der Lungenvene so (x) *hän Sie e Stock?*
		[On the left we have the vein which from the pulmonary vein so (x) *do you have a stick?*]
02	T2:	Uh ja *dört äne, dört äne ischer*
		[Uh yes *over there, it is over there*]

In extract 8.55, the student presents the circulatory system of an animal to the class by means of a PowerPoint, and switches mid-sentence to Swiss German to ask the teacher for a stick so he can better display the flow of blood stream to his classmates. In response to this, the teacher replies in Swiss German (line 02), maybe signaling alignment with the student because it is not the subject content that is talked about but an immediate organizational matter.

The 10 teacher phrases in Swiss German refer to openings (*Guete Morge* [good morning] (4x)) or closings (*E Guete!* [Enjoy your meal][76]), or comments on tasks (*gar nid so schlimm* [not that bad], *nid schwerig* [not difficult] (3x) and *dört äne* [over there] exemplified in

[76] There is no direct translation of *E Guete* to English. Literally it means "a good one" and is used in the sense of "enjoy your meal".

the extract above). Lastly, teacher integrations in the "other" category (n=5), include counting students for group work or attendance, one repetition (*nei nei* [no no]) and strings of words (*jä da tschuldigung* [yes here sorry]).

Continuing with teacher integrations in the non-CLIL lessons, there are 15 instances in Standard German; these are all creative integrations (by error or creativity) that do not occur as such in a German dictionary. Most of them are nouns (n=8), which makes sense considering Standard German is a language that allows for long compound words.

Examples for such creative integrations are *Einatemreflex* [Inhale-reflex], *Energieumwandel* [energy-trans-change], *Apparatschaften* [apparatus-ship] (2x), *Enzymatik* [enzymology][77] and *Reflektion* [reflection](3x). In my opinion, there are several reasons why content experts such as the teachers in this study would use creative integrations like these. For one, Standard German is not the L1, but Swiss German is. For instance, *Apparatschaften* might derive from Swiss German, where one would use such a word (*Apparatschafte*). Or it could also just be by error: For instance, the correct term for *Einatemreflex* is *Atemreflex*, but they were talking before about *einatmen [inhaling]*, so the teacher might just have combined all of that and used a creative integration. Similarly, the teacher's use of *Reflektion* might be due to error or transfer from Swiss German, because in Standard German it is simply spelled and pronounced differently *(Reflexion* [reflɛˈksioːn], whereas in Swiss German it is *Reflektion* [reflɛˈktsioːn]).

The other five instances of creative integrations concern two creative verb participles (*eingefältelt* [folded in] and *verschlaucht*

[77] *Enzymatik* is a term that is used more and more in scientific discourse, but not yet codified in neither the Duden (2021) nor the technical dictionary used for the determination of technical terms (Cole, 2015, see Chapter 9).

[tubed]), a verb phrase (*auswendig lehren* [to learn by heart][78]), three adjectives (*UHB-lische* [UHB-lic], *sigmoidale* [sigmoidal] and *unreaktiv* [unreactive]) and one adverb (*dinnen* [inside][79]). Interestingly, in the cases of *Apparatschaften* and *unreaktiv*, it is always the student who uses the word first, which is then adopted by the teacher as shown in extract 8.56:

Extract 8.56: Non-CLIL_1f2_20150512

01	S:	*Aso* es gibt ja diese NADP und wenn diese Träger macht das, dass H, uhm, *unreaktiv* wird.
		[*So* there are these NADP and if these carriers then they make that H, uhm, becomes *unreactive*.]
02	T2:	Genau. Der Wasserstoff ist an NADP gebunden. Und ist dadurch *unreaktiv*.
		[Exactly. Hydrogen is bound to NADP. And becomes *unreactive* due to this.]

Then there are 12 Greek integrations all in form of affixes (*phyll*, *chloro* (2x), *ex* (4x), *exo* (2x), *endo* (2x), *end-*) and nine Latin affixes (*dis* (4x), *flekt* (2x), *flex* (2x), *re-*) all uttered by the same teacher, T2 and concern subject lexis. The perceived difference in T2's use of translanguaging instances in Latin and Greek compared to T1 is something that is looked at more closely in the next section (8.3.2.2).

The nine teacher integrations in English consist of six (compound) nouns (*concept map*, *facts*, *air*, *disease* (2x) and *outdoor*

[78] Standard German makes a difference between *lehren* [to teach] and *lernen* [to learn], whereas Swiss German does not but uses *lehren* for both, *to teach* and *to learn*. Therefore, even though *lehren* as such exists in Standard German, the verb phrase *auswendig lehren* does not make sense in Standard German *[to teach by heart]* but is rather a transfer from Swiss German where this expression is used in the sense of *to learn by heart.*

[79] This again might be a combination of Swiss German *dinne* [dɪnə] and Standard German *drinnen* [drɪnən].

equipment), an adjective (*similar*), a noun phrase (*fifty fifty joker*) and one "other" (*or or*). Following English integrations, there are also three in French, one is the use of the expression *et violà* [and that is], the other two are instances of the adjective *similaire* [similar] (2x) used in T2's explanation of *assimilation* and *dissimilation* already explained in extracts 8.29 and 8.37 in Section 8.3.2.1.1.

In summary, teachers use integrations in the non-CLIL lessons predominately in Swiss German, and for various purposes and in various forms, ranging from discourse markers to meta-comments and classroom management. Creative integrations tied to Standard German are mostly due to transfer from the L1, and integrations with source languages and some with English and French revolve around content teaching.

Co-constructed integrations

Having had a closer look at integrations used by students and teachers in the CLIL and non-CLIL subcorpora, these last few paragraphs discuss the co-constructed integrations in the EG_BIO corpus. Co-constructed integrations are cases where one speaker finishes the other speaker's sentence using translanguaging, but there is no CU. In the EG_BIO corpus, all co-constructed integrations occur in only two lessons, presented and discussed in the following.

Extract 8.57: CLIL_1f2_20150526

01	T2:	Englisch wird sehr die, die Vorsilbe *dis-* sehr oft verwendet für *un-* [In English the prefix *dis-* is often used for *un-*]
02	S:	(x)
03	T2:	*Disease*

Line 01 of this extract was already shown in the previous section to illustrate the teacher translation of the affix *un-* (extract 8.24). It is shown again including lines 02 and 03 in order to display the co-constructed integration that follows after line 01. In line 01 the teacher is looking for a word starting with *dis-* to illustrate his point that it often stands for German *un-*. Unfortunately, the student's contribution in line 02 is unintelligible, but assuming the teacher is taking up the student's cue by repeating the word, the student suggested *disease* as an example for a word starting with *dis-*. Hence, the student (if it were intelligible) seems to be translanguaging, using an integration. Since this integration is originally prompted by the teacher, and then repeated by him (line 03), this is considered a co-constructed integration. It is also considered student-initiated, since it is the student who initiates the translanguaging. Two clearer examples of co-constructed integrations are demonstrated in extract 8.58.

Extract 8.58: CLIL_2b_20150526

01	T2:	I think the only person who do it are those who buy it the whole, uh
02	S:	*Harasse [crate]*
03	T2:	*Harasse [crate]*
((several lines omitted))		
14	S:	It's just a Swiss German word.
15	T2:	*Harass [crate]?*
16	S:	*Harasse [crate]*, yes

In extract 8.58, there are a total of four co-constructed integrations, one student-initiated (lines 02 and 03) and one teacher-initiated (lines 15 and 16). In line 01, the teacher is apparently looking for the right word in English to describe crates, but does not seem to find it as indicated by the hesitation marker *uh* at the end of his turn (line 01). Instead, the student jumps in using the word *Harasse* to fill in the blank, which is then repeated by the teacher (line 03). The integrations are co-constructed and initiated by the student, since he is the one translanguaging.

In the second part of extract 8.58, after an explanation on recycling by the teacher, the student makes a remark with regard to the assigned language of the word *Harasse,* without mentioning the word itself (line 14). To be certain, the teacher translanguages (line 02) to make sure it actually is *Harasse* the student is referring to, which is confirmed by the student's repetition of the word (line 03). This time the co-construction is teacher-initiated. Co-constructed integrations with only five instances are rare in the EG_BIO corpus, but they can be a strategy to help fill a lexical gap (extract 8.57 and the first part of extract 8.58) as well as ensuring mutual understanding (the second part of extract 8.58). The co-constructed integrations in extract 8.58 are another reason why the *Harasse* episode is a highly interesting one to look at more thoroughly with regard to translanguaging, which is therefore discussed in a separate section (Section 8.3.6).

The main findings of integrations across the CLIL and non-CLIL subcorpora indicate that the relative distributions of integrations by SOURCE and FORM are similar in both subcorpora. Teachers account for nearly two-thirds of integrations, while single-word instances comprise almost 60%. As will be seen in Section 8.3.3, relative to the overall word count the teachers do not use more integrations than students. Integrations differ most in assigned language with CLIL lessons having Standard German as the dominant language and non-CLIL lessons Swiss German.

A closer examination of integrations in the CLIL subcorpus reveals that nearly all integrations assigned to Standard German are produced by the teacher, while the majority of Swiss German integrations are made by students. The high frequency of teacher integrations in Standard German is largely due to the teachers' recurrent use of *ja [yes]* in their turns. The most common form of student integrations in Swiss German consists of clauses constituting a single turn, and which are often preceded by teacher turns in English. They deal with comments about understanding the content, tasks at hand or organizational matters. In non-CLIL lessons, both student and teacher integrations have Swiss German as the prevalent assigned language, the former almost exclusively (93.8% of all student integrations). Non-CLIL students, similar to CLIL students, also use clauses in Swiss German to make comments on their understanding of the content material, instructions of tasks or organizational matters. In contrast to CLIL students, non-CLIL students embed their Swiss German clauses more often directly within Standard German in a single turn. Teacher integrations in non-CLIL lessons, most of which are assigned to Swiss German, consist largely of single word contributions, and similar to the *ja* [yes] teacher integrations in CLIL, they are composed of particles that can have various functions (*jä/jo* [yes], *nei* [no], *guet* [good/well). Teachers also use the interjection *tschuldigung* [sorry] frequently, in the non-CLIL lessons, but not in the CLIL lessons. Integrations with source languages (Greek, Latin, unclear) occur in both, CLIL and non-CLIL lessons, mostly in form of affixes dealing with technical terminology. T2 uses most of these integrations in CLIL and non-CLIL, to a lesser extent, students in CLIL do that as well, but in non-CLIL lessons students only use one integration assigned to Greek. Creative integrations (English in CLIL and Standard German in non-CLIL), either due to error or creativity, are present in both, yet to a lesser extent in CLIL lessons. Lastly, co-constructed integrations are rare in the EG_BIO corpus, but in the instances occurring it serves either to fill a lexical gap or ensure mutual understanding.

Overall, the sections on translations and integrations in CLIL and non-CLIL lessons have illustrated the great variety of translanguaging practices used in these context, and therefore provided an answer to the research question of what translanguaging practices can be found, as well as how they are distributed according to type of instruction. To gain a more nuanced understanding of the distribution of translanguaging practices within the EG_BIO corpus, the main similarities and differences related to the other two subsets of the lesson type variable—teacher (8.3.2.2) and grade (8.3.2.3)—are briefly addressed.

8.3.2.2 Lessons Taught by T1 vs. T2

As can be seen in Table 26, the main finding regarding translanguaging instances in lessons taught by T1 and T2 is that in absolute numbers there are considerably more translanguaging instances occurring in

Table 26: Comparison of translanguaging instances in T1 compared to T2's lessons

	t1		t2	
Feature	N	Percent	N	Percent
Total Units	100		463	
TYPE	N=100		N=463	
- translation	21	21.00%	100	21.60%
- integration	77	77.00%	362	78.19%
- ambiguous	2	2.00%	1	0.22%
SOURCE	N=100		N=463	
- student	30	30.00%	111	23.97%
- teacher	61	61.00%	307	66.31%
- co-constructed	9	9.00%	45	9.72%
FORM	N=100		N=463	
- word	66	66.00%	277	59.83%
- affix	12	12.00%	74	15.98%
- phrase	9	9.00%	22	4.75%
- clause	12	12.00%	70	15.12%
- other	1	1.00%	20	4.32%
ASSIGNED_LANGUAGE	N=100		N=463	
- swiss_german	50	50.00%	182	39.31%
- standard_german	28	28.00%	158	34.13%
- english	7	7.00%	16	3.46%
- french	0	0.00%	6	1.30%
- italian	0	0.00%	1	0.22%
- latin	2	2.00%	24	5.18%
- greek	4	4.00%	52	11.23%
- unclear	9	9.00%	24	5.18%

T2's lessons (n=463) compared to T1's lessons (n=100). Considering T2 teaches one fewer lesson than T1, but there is overall more teacher-led whole class interaction happening in T2's lessons (n=62'523 in T2's lessons compared to n=56'814 in T1's lessons), the relative frequency of translanguaging instances still shows a difference (T2: rf=0.74%; T1: rf=0.18%).

Having a closer look at the distributions according to the categories, one can see that with regard to TYPE of translanguaging, however, the relative distribution is almost the same with translation taking up 21% (T1) and 21.6% (T2), respectively, and integrations 77% (T1) and 78.2% (T2), respectively, meaning that in T1's as well as T2's lessons integration is the most frequent translanguaging type taking up more than three quarters. One could argue that the higher number of translanguaging instances in T2's lesson compared to T1's is indicative of a certain teaching style which includes more translanguaging. This is, to a certain extent, confirmed by a result already reported on in Section 8.3.2.1.1 on translations, namely that with one exception, all explanatory and creative translations come from T2, which is certainly suggestive of a particular teaching style.

In addition to that, the SOURCE category in Table 26 tells us that indeed, T2 himself uses more translanguaging instances (n=307) compared to T1 (n=61), but so do T2's students (n=111 compared to T1's students n=33). There are also more co-constructed translanguaging instances in T2's lessons (n=45) than in T1's lessons (n=9). That is, even though the relative distribution with regard to source is similar in that both teachers take up more than 60% of translanguaging instances, it is evident that T2 not only uses more translanguaging himself but that he also creates a space where more translanguaging is allowed, since his students translanguage comparatively more as well.

This could, of course, also be due to outliers, namely that only certain lessons by T2 contain a very high number of translanguaging instances, and others contain a similar amount of translanguaging instances compared to T1's lessons. In fact, there are two lessons by T2 that contain more than 60 instances of translanguaging[80]. However, looking at the mean, median, and range, the following picture emerges: In T1's lessons, the mean of translanguaging instances is 6.25, the median is 5.5 and the range is 16 (from min. one to max. 17 instances per lesson). In T2's lessons, the mean of translanguaging instances is 30.9, the median 29 and the range 55 (from min. seven to max. 62 per lesson). Chapter 7 has shown that not all lessons contain the same amount of teacher-led whole class interaction, but even when looking at translanguaging instances relative to teacher-led whole class interaction in these lessons, it confirms the overall picture that in T2's lessons there is continuously more translanguaging going on.

One explanation for T2's lessons containing more translanguaging might be the fact that his two CLIL classes (1b and 2b) are half-classes, meaning they only contain eight to 10 students per class instead of the 18–24 students in the other classes. There are no studies yet on how class size might affect translanguaging behavior, but it is known that group work and peer talk is prone to translanguaging (Dalton-Puffer, 2007, p. 31; Hancock, 1997; Moore & Nikula, 2016; Nikula & Moore, 2019, p. 244; Storch & Wigglesworth, 2003), therefore it might be hypothesized that smaller classes also allow for more translanguaging.

Further, with regard to the form of translanguaging, in both T1 and T2's lessons, single word contributions are the most frequent form of translanguaging, followed by affixes and clauses, then phrases and "other". With regard to affixes and clauses, they are used more frequently in T2's lessons compared to T1's (see Table 26). Looking at the dominant assigned languages, it is in both contexts Swiss German

[80] CLIL_2b_20150526 and Non-CLIL_1f2_20150526 both contain 62 translanguaging instances. Both contain exam discussions which might explain the frequent use of translanguaging instances.

followed by Standard German. What is particularly striking to see in Table 26 is the higher use of translanguaging practices assigned to Greek (n=52, 11.2%) and Latin (n=24, 5.2%) in T2's lessons, compared to only four instances in Greek (4%) and two in Latin (2%) in T1's lessons. This can be attributed to a specific pedagogical strategy that T2 employs, as he explains in the interview:

Excerpt 3: Interview T2[81]

01	T2:	What I have is a foreign word list. (...). This foreign word list that I do, I do it with the German-speaking classes as well. That is not I don't do it
02	I:	This has to do with Latin, Latin
03	T2:	Simply Latin Greek terms, that is uh parts of words which I write down afterwards.

In this excerpt, the teacher describes the principle of the foreign word list, which is a list consisting of foreign, mostly Latin and Greek affixes that he keeps and regularly updates with both his CLIL and non-CLIL classes, an example of which is provided in extract 8.59:

Extract 8.59: Non-CLIL_1f2_20150526

01	T2:	das *ex* von exergon ist das wie *exo,* was haben wir damals geschrieben? [the *ex* of *exergonic* that's like *exo,* what did we write down last time?]
02	S:	<u>Aussen</u> [Outside]
03	T2:	Aussen, ja, oder heraus. Genau, beide ja, und *ergon* das ist *Arbeit*. Ex-ergon

[81] This and all subsequent excerpts of the teacher interviews were translated from Swiss German into English by the author herself.

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[Outside, yes, or out. Exactly, both yes, and
ergon that is work. Ex-ergonic]
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T2 keeps this foreign word list on a transparency and every once in a while takes it up in class again. In extract 8.59 above, T2 discusses exergonic reactions, and asks how they have translated *ex/exo* the last time, to which a student (line 02) replies “aussen [outside]”. This is confirmed by T2, and in line 03 he shows how the term exergonic is put together by using the prefix *ex-* and adding *ergon,* which means “work”. This is one strategy T2 employs purposefully and throughout in both his CLIL and non-CLIL lessons, and it explains the higher number of translanguaging instances related to Greek and Latin in T2’s lessons.

To conclude, T2’s lessons contain considerably more translanguaging instances across all categories—on the one hand, T2 himself translanguages more, generally but also specifically with the foreign word list, on the other hand, T2’s students also translanguage more, maybe due to smaller class sizes or a general climate allowing for more translanguaging behavior.

8.3.2.3 Translanguaging Instances According to Grade

As mentioned in Section 7.2.1, the EG_BIO corpus is made up of 22 lessons in grade 10 (n=79’164, 66.3%) and nine lessons in grade 11 (n=40’173, 34.7%). Table 27 shows that grade 10 contains 341 translanguaging instances and grade 11 contains 222. Normalized results reveal that grade 10 has a relative frequency of 0.04%, while the lessons in grade 11 have a relative frequency of 0.55%, an almost 14-fold increase compared to grade 10. In other words, grade 10 has 0.4 translanguaging instances per 1000 words, and grade 11 contains 5.5 translanguaging instances per 1000 words. Consequently, students and teachers in grade 11 translanguage more than in grade 10.

Table 27: Overview of translanguaging instances in the EG_BIO corpus according to grade

	10		11	
Feature	N	Percent	N	Percent
Total Units	341		222	
TYPE	N=341		N=222	
- translation	75	21.99%	46	20.72%
- integration	264	77.42%	175	78.83%
- ambiguous	2	0.59%	1	0.45%
SOURCE	N=341		N=222	
- student	91	26.69%	50	22.52%
- teacher	227	66.57%	141	63.51%
- co-constructed	23	6.74%	31	13.96%
FORM	N=341		N=222	
- word	196	57.48%	147	66.22%
- affix	64	18.77%	22	9.91%
- phrase	21	6.16%	10	4.50%
- clause	46	13.49%	36	16.22%
- other	14	4.11%	7	3.15%
ASSIGNED_LANGUAGE	N=341		N=222	
- swiss_german	151	44.28%	81	36.49%
- standard_german	100	29.33%	86	38.74%
- english	19	5.57%	4	1.80%
- french	4	1.17%	2	0.90%
- italian	1	0.29%	0	0.00%
- latin	16	4.69%	10	4.50%
- greek	45	13.20%	11	4.95%
- unclear	5	1.47%	28	12.61%

In addition to this, of the 341 translanguaging instances in grade 10, 161 (47.2%) occur in the CLIL lessons, and 180 (52.8%) in the non-CLIL lessons. Compared to grade 11, of the 222 translanguaging instances, 130 (59%) are found in the CLIL subcorpus and 92 (41%) in the non-CLIL subcorpus. Consequently, the overall expectation that there is more translanguaging in grade 10 CLIL lessons due to them being first-year students (see Section 7.2.1) does not hold true for the EG_BIO corpus.

With regard to TYPE of translanguaging, Table 27 shows that the relative distribution is similar in both grades, with integrations taking up between 77–79% and translation between 20–22% of the translanguaging instances. With regard to SOURCE, in both grades it is the teacher who utters more than 60% of the translanguaging instances, followed by the students and then co-constructed instances. Striking is that out of the 222 translanguaging instances occurring in grade 11, 31 (14%) are co-constructed, compared to only 23 out of 341 (6.7%) in grade 10. In other words, co-constructed instances are more frequent in grade 11 (rf=0.08%) than in grade 10 (rf=0.03%). Students in grade 11 may be less anxious to ask for words that they do not know, particularly in the CLIL lessons, because they are older and already familiar with the teacher. The co-constructed instances do not support this theory as most co-constructed instances (n=20) in grade 11 are t-initiated. This might mean that the teachers' more frequent use of translanguaging in grade 11 creates an atmosphere where, in response to teachers, students also translanguage more. Another explanation might be that the difference simply stems from the respective topics covered in grade 11, which might have yielded more translanguaging.

Looking at FORM of translanguaging, in both grades the most frequent translanguaging instance comes in form of a single word. The most notable difference with regard to form is the use of translanguaging in form of affixes (grade 10: n=64, 18.8%; grade 11: n=22, 9.9%, see Table 27). This might be explained by examining the next category, ASSIGNED LANGUAGE, where 13.2% (n=45, rf=0.06) of instances in grade 10 are assigned to Greek, compared to only 5% (n=11, rf=0.03) in grade 11. As detailed in the exploration of translanguaging instances in CLIL and non-CLIL lessons (see Section

8.3.2.1), instances assigned to Greek and Latin in the EG_BIO corpus[82] often take the form of affixes. Additionally, the previous section highlights that this type of translanguaging is predominantly employed by T2. Thus, one can assume that the higher use of translanguaging practices assigned to Greek and Latin is indeed due to T2's use of that particular translanguaging practice. Indeed, a closer look at the 45 Greek translanguaging instances occurring in grade 10 reveals that all but one are uttered by T2, and of the 16 Latin translanguaging instances all are used by T2. This pattern also emerges, though to a lesser extent, in grade 11[83]. This might indicate that T2 uses the foreign word list primarily with his classes in grade 10, as in grade 11 they already have a greater knowledge of these terms and affixes. Then again, only five of T2's total of 15 lessons recorded for this study come from grade 11, so it might well be that the topic in these classes did not require him to employ this particular pedagogic strategy.

What can further be said with regard to assigned language and grade is that there is more use of Swiss German in grade 10 (n=151, 44.3%) than Standard German (n=100, 29.3%), while in grade 11 both languages are used to an equal extent, (Swiss German: n=81, 36.5%; Standard German n=86, 38.7%). Also, there are considerably more unclear instances in grade 11 (n=28) than in grade 10 (n=5), most of which (n=23) occur in the CLIL classes and concern specific episodes discussing scientific names of either species (*Stenaelurillus* and *Philates* in class 2b) or organs (the correct spelling of *Bronchio-/Bronchus* in class 2e), or refer to nouns where the origin or entry into the English language can be traced to multiple languages (e.g. *blastoderm* or *chlorophyll*).

[82] In fact, only two out of the total 56 instances assigned to Greek in the EG_BIO corpus are not affixes; and with regard to Latin, 10 out of 26 instances assigned to Latin are not affixes.
[83] With regard to the 11 instances of Greek in grade 11, T2 utters eight of them, T1 three. With regard to the 10 Latin instances, T2 again uses eight of them, and T1 two.

In sum, grade 10 contains considerably less translanguaging instances than grade 11, in both, CLIL and non-CLIL lessons. Distributions within categories are similar with regard to type and form. An interesting finding is that there are more co-constructed instances in grade 11, which might indicate that either the older students are less anxious to ask for the meaning or teachers engage more in this type of translanguaging. Another interesting finding concerns assigned language, in that there is more translanguaging with source languages in grade 10, almost all of it occurring in T2s lessons, indicating that T2 might be using this pedagogic strategy more often with grade 10 students. Overall, these difference have to be interpreted with caution, since the EG_BIO corpus is most unbalanced in regards to grade, with only nine of the total 31 lessons pertaining to grade 11.

8.3.3 Overview of Translanguaging Instances According to Speaker

Speaker distribution has, to a certain extent, already been discussed in relation to the lessons taught by T1 vs. T2 (Section 8.3.2.2). However, in this section the focus lies on the translanguaging practices specifically used by the teacher as compared to the students. Table 28 shows that 400 (71%) of the total of 563 translanguaging instances are produced by the teachers, and 161 (28.6%) by students (and only two instances by multiple students not shown in Table 28). Thus, the teachers use overall more translanguaging instances. However, considering that in teacher-led whole class interaction the teacher talks considerably more than his students (87%, see Section 7.2.2), the frequency of translanguaging instances relative to the overall word count paints a different picture: The teachers have a relative frequency of 0.38%, whereas the students yield a relative frequency of 1.09%. Hence, students actually translanguage more than their teachers.

This confirms the expectations mentioned in Section 7.2.2 where it was speculated that teachers have overall more translanguaging instances than students, but not necessarily in regards to relative frequency.

Table 28: Overview of translanguaging instances in the EG_BIO corpus according to speaker

	teacher		student	
Feature	N	Percent	N	Percent
Total Units	400		161	
TYPE	N=400		N=161	
- translation	102	25.50%	19	11.80%
- integration	296	74.00%	141	87.58%
- ambiguous	2	0.50%	1	0.62%
FORM	N=400		N=161	
- word	273	68.25%	69	42.86%
- affix	72	18.00%	14	8.70%
- phrase	18	4.50%	12	7.45%
- clause	22	5.50%	60	37.27%
- other	15	3.75%	6	3.73%
ASSIGNED_LANGUAGE	N=400		N=161	
- swiss_german	121	30.25%	109	67.70%
- standard_german	151	37.75%	35	21.74%
- english	22	5.50%	1	0.62%
- french	5	1.25%	1	0.62%
- italian	1	0.25%	0	0.00%
- latin	25	6.25%	1	0.62%
- greek	49	12.25%	7	4.35%
- unclear	26	6.50%	7	4.35%

Starting with the first category, TYPE of translanguaging, Table 28 reveals that integration is the dominant type of translanguaging for both, teachers (74%) as well as students (87.6%). However, there is a noticeable difference with regard to translations: While the teachers use a total of 102 translations in their lessons, which represents 25.5% of all their translanguaging instances, students only use 19 translations (11.8%). This is not unexpected, given that it is the teacher's role to be the expert on content and has to make sure students understand the concepts and the key lexis. In CLIL contexts, where the language of instruction is different to the L1/ML of students and teachers, translanguaging has been shown to be a frequent strategy to clarify lexis (e.g. Moore & Nikula, 2016; Nikula & Moore, 2019). However, of the 102 teacher translations, only a bit more than half (n=58, 56.9%) are occurring in the CLIL subcorpus, with 44 instances (43.1%) occurring in the non-CLIL subcorpus, which would suggest that CLIL lessons, even though they are taught in a language other than the L1/ML, are not per se more prone to the use of translations compared to non-CLIL lessons.

The section on lessons taught by T1 vs. T2 (see Section 8.3.2.2) has further shown how T2 uses more translanguaging practices overall, as well as a specific strategy of translanguaging with source languages of scientific terminology, and he does so in CLIL as well as non-CLIL lessons. This is also what is observed in the non-CLIL subcorpus, since most of the translations found there (n=40 of 44) are uttered by T2 and a majority of them (n=25, 62.5%) are indeed concerned with translations assigned to source languages. In contrast to this, the 19 student translations seem unusual, since there is usually no need for students to translate unless the teacher asks them to and in Section 8.3.2.1.1 it was noted that all translations are either done by the teacher or in co-construction. Since the SPEAKER variable only records who is doing the actual translanguaging in contrast to the SOURCE category where co-constructed instances are considered, it follows that these 19 student translations must all be co-constructed. And indeed, they are all co-constructed: teacher-initiated to ask for the meaning of a specific word, or student-initiated along the lines of extract 8.60, where the student is asking for confirmation of a proposed translation.

Extract 8.60: CLIL_1b_20150504

01	S:	Uh doesn’t uhm *exo* mean outside?
02	T2:	Yes

Looking at the FORM of teacher vs. student translanguaging instances, the most frequent form in both is single word contributions (teacher: n=273, 68.3%; student: n=69, 42.9%, see Table 28). Striking in this category is the relatively high use of clauses by students (n=60, 37.3%) compared to teachers (n=22, 5.5%). All of the 60 student clauses are integrations, and most of them are uttered in Swiss German (n=58)[84], so are most of the teacher integrations in form of clauses (n=20 of 22)[85], the diverse uses of which have been discussed previously (see Section 8.3.2.1.2).

With regard to the last category, ASSIGNED LANGUAGE, the results show that Standard German is the dominating language assigned to translanguaging practices used by teachers—largely responsible for that are translanguaging practices used in the CLIL subcorpus (n=131, 86.8%), compared to the 20 instances (13.2%) of creative translations and integrations in Standard German in the non-CLIL subcorpus. Swiss German is popular with both, teachers (n=121) and students (n=109), however, relative frequency shows that students use Swiss German translanguaging practices more (rf=0.72) compared to teachers (rf=0.11). This confirms the expectation raised in 7.2.2 in regards to students using more Swiss German than their teachers. Apart from this, the higher use of translanguaging practices by teachers assigned Greek, Latin and unclear has again to do with T2's strategy of translanguaging with source languages.

In conclusion, students translanguage relatively more than teachers, and the type of translanguaging differs considerably between teachers and students, in that teachers are responsible for all translations, uttered by them or in co-constructions with students.

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[84] The two other clauses by students are from CLIL classes: once a clause in Standard German, and once one in French.

[85] Same as with the student clauses, there are two other clauses by teachers in CLIL classes not assigned to Swiss German: once a clause in Standard German, and once one in French.

Interestingly though, teachers use more translations in the CLIL lessons than in the non-CLIL lessons, however, the difference is less than expected and indicates that either CLIL classrooms are not per se prone to using translations, or that science classrooms in general require the use of translations no matter the medium of instruction. Further, Standard German is the teachers' dominant language, but mainly because of its use in the CLIL lessons, and Swiss German is the dominant assigned language of student translanguaging.

8.3.4 Overview of Translanguaging Instances According to Classroom Register

Classroom register, as explained in Section 7.2.3, concerns the types of registers prevalent in classroom discourse. There is the instructional register concerned with content instruction, the regulative register dealing with organizational matters and task management, and social talk, referring to teacher-led whole class interaction that is neither fitting into the instructional nor the regulative register. As illustrated in Section 7.2.3, a three-quarter majority (73%) of teacher-led whole class interaction in the EG_BIO corpus occurs in the instructional register and is thus focused on content teaching, while 26% are made up of the regulative register. The regulative register itself is comprised of 16% regulative register_specific content (management of tasks particular to the field of biology) and 10% regulative register_general (general classroom management). Furthermore, 1% of the EG_BIO corpus is social talk.

An overview of translanguaging instances occurring in the EG_BIO corpus according to classroom registers is provided in Table 29.

Table 29: Overview of translanguaging instances in the EG_BIO corpus according to classroom register

	general		specific_cont		instructional		social_talk	
Feature	N	Percent	N	Percent	N	Percent	N	Percent
Total Units	110		72		368		11	
TYPE	N=110		N=72		N=368		N=11	
- translation	5	4.55%	13	18.06%	100	27.17%	3	27.27%
- integration	105	95.45%	59	81.94%	265	72.01%	8	72.73%
- ambiguous	0	0.00%	0	0.00%	3	0.82%	0	0.00%
SOURCE	N=110		N=72		N=368		N=11	
- student	38	34.55%	9	12.50%	90	24.46%	3	27.27%
- teacher	69	62.73%	60	83.33%	235	63.86%	3	27.27%
- co-constructed	3	2.73%	3	4.17%	43	11.68%	5	45.45%
FORM	N=110		N=72		N=368		N=11	
- word	52	47.27%	36	50.00%	247	67.12%	7	63.64%
- affix	0	0.00%	28	38.89%	58	15.76%	0	0.00%
- phrase	19	17.27%	0	0.00%	11	2.99%	0	0.00%
- clause	33	30.00%	8	11.11%	37	10.05%	4	36.36%
- other	6	5.45%	0	0.00%	15	4.08%	0	0.00%
ASSIGNED_LANGUAGE	N=110		N=72		N=368		N=11	
- swiss_german	82	74.55%	24	33.33%	123	33.42%	2	18.18%
- standard_german	25	22.73%	16	22.22%	137	37.23%	7	63.64%
- english	3	2.73%	1	1.39%	19	5.16%	0	0.00%
- french	0	0.00%	0	0.00%	4	1.09%	2	18.18%
- italian	0	0.00%	0	0.00%	1	0.27%	0	0.00%
- latin	0	0.00%	3	4.17%	23	6.25%	0	0.00%
- greek	0	0.00%	25	34.72%	31	8.42%	0	0.00%
- unclear	0	0.00%	3	4.17%	30	8.15%	0	0.00%

Of the total of 563 instances of translanguaging, 368 (65.4%) occur in the instructional register, 182 (32.3%) in the regulative register and 11 (2%) in social talk. Within the regulative register, 110 (19.5%) translanguaging instances occur in the regulative register_general, and 72 (12.8%) in the regulative register_specific content.[86]

[86] Not included in the overview in Table 29 are the parts coded as unclear because it only makes up 0.1% of the corpus (n=127 words) and only contains two instances of translanguaging.

With regard to translanguaging instances and classroom register, it was speculated in Section 7.2.3 that social talk might be prone to the use of translanguaging because it is off topic, neither content-related nor task- or organization-related. Considering the relative frequency of translanguaging instances, the following picture emerges: 0.42% for instructional register, 0.38% for regulative register_specific content, 0.89% for regulative register_general and 1.7% for social talk. Considering only the relative frequencies, it seems true that social talk is most prone to the use of translanguaging, followed by the regulative register_general, then the instructional register and lastly the regulative register_specific content. However, the overall amount of social talk in teacher-led whole class interaction in the EG_BIO corpus is very low (n=217, 0.5%). Indeed, having a closer look at translanguaging in social talk, it turns out that seven of the 11 instances can be tied back to one episode (see discussion of "Harasse" episode in Section 8.3.6); two others concern the greeting in French illustrated in extract 8.47 (Section 8.3.2.1.2), and the other two are Swiss German comments made by students[87]. The whole register of "social talk" can thus be reduced to a few scenes and therefore represents not enough data to accurately reflect translanguaging practices therein.

Another hypothesis mentioned in Section 7.2.3 suggested that there are different types of translanguaging prevalent in the respective registers, for instance translations should be more frequent in the instructional and regulative register_specific content, since they are often used in connection with technical terms. Indeed, looking at Table 29, of the total of 121 translations found in the EG_BIO corpus, 100 occur in the instructional register, 13 in the regulative register_specific content, five in the regulative register_general and three in social talk.

[87] In one CLIL lesson a student remarks "*Dasch e Stuehl* [this is a chair]", in another a student comments on another student's potential whereabouts "*Jo wohrschienlich isch sie wiedr e Stock obedra* [yeah she's probably one floor up again]".

In addition, all but four translations[88] in the instructional register concern vocabulary directly connected to subject content, most of which occur in form of nouns (n=56) or in form of affixes (n=29). The same applies for the 13 translations in the regulative register_specific content, where all but two[89] concern translations with subject-specific vocabulary. In contrast to this, the five translations in the regulative register_general all deal with the translation of words such as *zusammenfassen* [to summarize] (2x), *Drucker* [printer], *do* [here] and *richtig und falsch* [true and false], and the three translations in social talk all refer to the word *Harasse* [crate]. This means that at least in regards to translations, they are used differently in the respective registers.

With regard to integrations, Table 29 shows that the majority of the total 439 integrations in the EG_BIO corpus occurs in the instructional register (n=265), followed by the regulative register_general (n=105), the regulative register_specific content (n=59) and social talk (n=8). What stands out here is that half of the 265 integrations (n=130) in the instructional register are integrations in the category "else", i.e. single word contributions that are neither nouns nor verbs. With a few exceptions, most of these 130 instances concern the use of particles such as *ja/jo* [yes], *nei* [no], *guet* [good/well], or the injection *tschuldigung* [sorry]. These also occur in the other registers, but to a lower degree (n=35 of 105 in regulative register_general and n=23 of 59 in regulative register_specific content). This type of

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[88] These four translations are three instances of Standard German *ja* in CLIL or Swiss German *jo* in non-CLIL lessons, and once the teacher remarking *Sie gsehn,* <u>Sie sehen</u> [you see], first in Swiss German and then in Standard German.

[89] Similar to the four translations before, the two translations not concerned with content vocabulary in the regulative register_specific content involves one instance of *yes, ja* in a CLIL lesson and one instance of a verb first used in Swiss German, and then translated/repeated in Standard German in a non-CLIL lesson (*behandlet, behandelt* [dealt with]).

integration is particularly frequently used in the instructional register, maybe as discourse markers to structure complex content teaching.

With regard to SOURCE of translanguaging, the teacher takes up more than 60% of translanguaging instances in each the regulative register_general and the instructional register, and more than 80% in the regulative register_specific content, suggesting that specific task instructions might require more translanguaging from the teachers' side or simply less interaction from the student's perspective. However, the 60 instances of teacher translanguaging in the regulative register_specific content do not indicate whether either of these trends is more likely. Interesting with regard to source are the co-constructed instances, which almost exclusively occur in the instructional register. This is not surprising as most of the co-constructed instances are in fact translations (see Section 8.3.2.1) and translations, as seen above, predominately occur in the instructional register.

With regard to the FORM of translanguaging, there are several interesting aspects one can observe in Table 29. Most of the translanguaging instances in the instructional register take the form of single word contributions, which makes sense in that there are more translations (which are often one-worded) but also a substantial number of single-word integrations in the category "else" in the instructional register. Furthermore, Table 29 shows that there are no translanguaging instances in form of affixes in the regulative register_general, which again makes sense considering that this strategy of translating and integrating affixes is strictly tied to content teaching by T2.

Another interesting aspect concerns the fact that there are few (instructional n=11, 3%) or no (regulative_specific content) phrases compared to the regulative register_general (n=19; 17.3%). This can, however, be easily explained in that half of the cases (n=9) in the regulative register_general concern openings (*guete Morge* [good morning]) and closings (e.g. *E Guete!* [enjoy your meal!]), while the other cases deal with organizational matters such as checking attendance. This also plays into the next and last aspect discussed here with regard to form, because relatively the regulative register_general also contains more clauses (n=33, 30%) than the instructional register (n=37, 10.1%) or the regulative register_specific content (n=8, 11.1%), all but two uttered in Swiss German. Same as with phrases, the clauses in the regulative register_general deal primarily with organizational affairs such as checking students' attendance, general task instructions or scheduling an exam, while in the regulative register_specific content it is all connected to specific task instructions such as clarifications of an ongoing an experiment. The Swiss German clauses in the instructional register mainly concern meta-comments by teachers or students, or comprehension questions and clarification of content.

Connected to this, another hypothesis regarding translanguaging practices and classroom registers proposed in Section 7.2.3 concerned assigned languages, namely that there will be a prevalence of Swiss German in social talk as well as in both subsets of the regulative register (general and specific content), because teachers as well as students seem to translanguage more easily when it comes to organizational matters or task instruction. Table 29 shows that this is only true for the regulative register_general, where 74.6% of all translanguaging instances are uttered in Swiss German. In the regulative register_specific content, most instances (n=25, 34.7%) are assigned to Greek closely followed by Swiss German (n=24, 33.3%). In the instructional register, Standard German is the dominant language mainly due to its use in the CLIL lessons, closely followed by Swiss German. Interestingly, with regard to social talk, only two of the instances are assigned to Swiss German, seven to Standard German and two to French. The discussion around assigned languages specifically with the episode on *Harasse* is further elaborated on in Section 8.3.6.

Lastly, comparing CLIL and non-CLIL across classroom register, Table 30 shows that the instructional register has more translanguaging instances in CLIL lessons than in non-CLIL lessons, and the regulative registers (specific content and general) both more in the non-CLIL lesson.

Table 30: Number of translanguaging instances according to classroom register in the CLIL and non-CLIL subcorpora

	CLIL	**Non-CLIL**
Instructional	205	163
Regulative_specific content	46	64
Regulative_general	27	45

This increased use of translanguaging in the instructional register is mainly due to the frequent translations in CLIL surrounding technical terminology. Other than that, the translanguaging instances in the CLIL and non-CLIL lessons are similarly distributed according to the categories of TYPE, SOURCE and FORM in each classroom register. They differ of course in regards to AL, as has been thoroughly discussed in Section 8.3.2.1. Interestingly, the differences regarding AL vary here depending on register. Almost all translations occur in the instructional register (see Table 29), therefore the difference in AL between CLIL and non-CLIL is that in CLIL Standard German is followed by source languages, whereas in the non-CLIL lessons it is Swiss German followed by source languages. In the regulative register_specific content, in both CLIL and non-CLIL lessons, the source languages take up about half of the instances. Lastly, in the regulative register_general, all but four instances in the non-CLIL classroom occur in Swiss German, while in the CLIL lessons Swiss German and Standard German are evenly distributed.

In summary, excluding social talk, translanguaging instances occur, relatively speaking, the most in the regulative register_general, followed by the instructional register and the regulative register_specific content. As expected, translations surrounding subject-specific lexis are particularly prominent in the instructional register, along with one-worded integrations used for structuring discourse. Integrations are most prevalent in the regulative register_general, including phrases and clauses in Swiss German used for organizational matters. In the regulative register_specific content, the teacher takes up more than 80% of translanguaging instances which is more than in any other register and might indicate that specific task instruction requires the teacher to translanguage more. Generally, the analysis shows that translanguaging practices are used differently in each classroom register, i.e. the frequency and use of translanguaging depends on whether the objective is classroom management and organizational matters (regulative register_general), specific task instructions (regulative register_specific content) or content teaching.

Overall, the quantitative analysis of translanguaging practices has painted a detailed picture of the structure and use of translanguaging practices in the EG_BIO corpus according to the variables of lesson type, speaker and classroom registers. Due to the high frequency of the translanguaging instance *aso* (n=288), these were not included in the previous analyses. Therefore, the next section takes a closer look at the use of *aso* as occurring in the EG_BIO corpus.

8.3.5 The Case of *Aso*

Aso is a Swiss German variant of the Standard German *also,* originally a connective adverb meaning *that is*, *so*, or *therefore*. Several studies have shown that *also* can have various functions apart from being used as an adverb, particularly in spoken German discourse (see e.g. Alm, 2007; Deppermann & Helmer, 2013; Dittmar, 2002; Fernández-Villanueva, 2007). There is, so far, no specific research on the use of *aso* in Swiss German, therefore one might assume that the Swiss German variant *aso* occupies similar functions compared to the Standard German variant *also.* The fact is that instances of *aso* make up 33.8% of all translanguaging instances found in the EG_BIO corpus, which might well be due to the various functions and uses of *aso.*

All of the 288 instances of *aso* in the EG_BIO corpus are single-word integrations and assigned to Swiss German. Almost all of them occur in the non-CLIL subcorpus (n=284, 98.6%), leaving only four instances of *aso* in the CLIL subcorpus. In lessons taught by T2 there are more instances of *aso* occurring (n=168, 58.3%) than in those taught by T1 (n=120, 41.7%). In grade 10 there are more instances of *aso* (n=228) than in grade 11 (n=60). Relatively speaking, *aso* is used twice as often in grade 10 (rf=0.29%) than in grade 11 (rf=0.14%). Overall, a bit more than half of all instances of *aso* (n=163, 56.6%) are uttered by students, the rest by the teachers (n=125, 43.4%). Considering the teachers talk much more overall in teacher-led whole class interaction, this means that students use *aso* considerably more than the teachers (students: rf=1.09%; teachers: rf=0.12%). Taking into account that most cases of *aso* occur in non-CLIL lessons, this might be an indication that teachers are more alert to adhering to the norm of teaching Standard German where using the Swiss variant is accepted. A further explanation concerns the potential function of *aso* as a discourse marker. With regard to classroom register, *aso* is, relatively speaking, used most in the instructional register (n=252, rf=0.29%), followed by the regulative register_specific content (n=25, rf=0.14%) and the regulative register_general (n=10, rf=0.08%). There are no instances of *aso* occurring in social talk or unclear register.

One aspect that stood out in the literature concerned with *also* as a discourse marker is that it often occupies the initial position of a turn when functioning as a discourse marker (see e.g. Auer, 1996; Deppermann & Helmer, 2013; Dittmar, 2002; Fernández-Villanueva, 2007).Of the 163 *aso* uttered by students, 50 instances have it in initial position of their turn, and 18 in second position (often preceded by a hesitation marker or another particle such as *ja*). In contrast, the 125 instances of *aso* uttered by teachers contain only nine in initial position, and seven in second position. On the one hand, this might be an indication that *aso* is used as s discourse marker primarily by students, but not necessarily by teachers. On the other hand, having generally longer turns, teachers might use *aso* as a discourse marker in the middle of their speech to structure their discourse. Since there is neither any research on the use of *also* and *aso* in Swiss German[90], nor any research in a school setting where *aso* is still frequently used even if the language of instruction is Standard German, this presents an avenue for further research.

In the next section, drawing on the previous quantitative analyses, one particular episode (*Harasse*) is selected for a close analysis based on its dense use of diverse translanguaging practices which are not specifically connected to technicality (which is the topic of Research Focus 3 in Chapter 10).

8.3.6 Close Analysis of an Episode: *Harasse*

Throughout the previous analyses, references to this episode *Harasse* have been made, and with good reason: It combines a diverse set of translanguaging practices within one episode, from equivalent and creative translations to co-constructed translations and integrations. Translations and co-constructed integrations are usually particularly interesting with regard to how translanguaging is employed in interaction to create or foster understanding of technical terms. For instance, looking at all the translanguaging instances which include co-constructions in the EG_BIO corpus (n=54), most of them (n=41) are indeed dealing with technical terms.

Of the co-constructed instances not involving technical vocabulary (n=13), nine occur in the same episode within 20 turns surrounding the topic of *Harasse* [crate]. These nine co-constructed instances (four translations and five integrations) plus three normal integrations with *Harasse* indicate that in this episode something

[90] In all of the previous sections, *aso* was labelled as the Swiss German variant of Standard German *also*. However, *also* is also an accepted variant used in Swiss German, but it is indistinguishable from its Standard German variant. Further research on *aso* as a discourse marker could therefore also focus on potential differences in function and use of *aso* compared to *also* in Swiss German.

interesting is going on with regard to translanguaging that is further explored here.

A close analysis of this episode sheds light on how translanguaging is used in interaction when it is not about technical terminology. The episode is taken from a CLIL class taught by T2 in grade 11, where the class is discussing the exam results from the previous lesson. The episode in question takes place near the end of the lesson, when a student asks about whether or not it is true that spiders recycle their web (which was a question in the exam) and the teacher starts a discussion on the concept of recycling. For the sake of a close analysis, the episode is split and discussed in two parts:

Episode *Harasse* 1/2: CLIL_2b_20150526

01 T2: But, uh, we could, actually, in a simple way, recycle the bottle and that would be much better. But in reality, it's so complicated. I think the only person who do it are those who buy it the whole, uh

02 S1: *Harasse.*

03 T2: *Harasse*, how is it in English, *Harasse*.

((T looking at class))

04 T2: It's not a *harass*, no.

((Ss discussing))

05 T2: It's a

06 S2: (xx)

07 T2: Sorry

08 S2: Crate

09 T2: Crate. Crate, is it crate? I, I'm not sure. Anyway, uh, we buy the whole *Harass* uh, and then we pay another 5 francs for the *Harass* as deposit and then you bring that back, that makes sense.

10 S3: Bottle crates.

11	T2:	Bottle crates.
12	Ss:	Ah
13	T2:	Okay. Doesn't ring a bell, *ja.* (xx) Nobody used the *Harassen*, yeah

In this episode, T2 in line 01 explains that one simple recycling process is the returning of glass bottles, but laments that only few people actually recycle this way. At the end of his turn he mentions that the only persons who do that are those who buy the whole crates. He struggles to find the English equivalent right away, as indicated by the hesitation marker "uh" right at the end of his turn. A student (line 02) steps in and uses the word *Harasse,* thus creating a co-constructed integration. The teacher repeats the word (line 03), and follows up by asking the class what *Harasse* is called in English. He is looking at the class, but no one immediately answers. The teacher, in line 04, uses a creative translation by simply anglicizing the word *Harasse,* pronouncing it [ˈhærəs]. A brief discussion among students erupts, and in line 05 T2 tries to find an answer by initiating "It's a". The student's first answer is unintelligible (line 06), also to the teacher, so he makes a clarification request ("sorry") in line 07, to which the student assumedly repeats what he had previously said, in this case "crate" (line 08). In line 09, T2 then reacts in an interesting way, first repeating the word, then turning it into a question, thus challenging the correctness of this translation ("Crate. Is it crate? I'm not sure"). Moreover, in his continued elaboration of the recycling process, T2 does not take over the student's suggestion, instead he decides to translanguage and use the word *Harasse* further. This triggers another student (line 10) to insist that the translation of *Harasse* is in fact "bottle crates". This is repeated by the teacher in line 11, but then again, in line 13, the teacher remarks that he is not familiar with this term, and continues to translanguage, using the word *Harasse.* There are several possible explanations as to why the teacher might not have recodnized the students' contributions as valid in this situation. Two potential explanations are discussed here: The first relates to the teacher's position of authority in the classroom, and the second considers the potential influence of a native speaker bias in T2's perspective.

Regarding the first explanation, it is important to acknowledge that CLIL teachers, as discussed in Chapter 3, often come from a content-teaching background and must teach their subjects in a foreign language. This is also the case for the teachers in the present study, who therefore occupy a double role as both content expert and a language expert. In the interviews, both teachers reflect on the challenges they face when using the TL English. T2, in particular, mentions difficulties with the pronunciation of certain English words. Encountering situations where an English term is unfamiliar, and being corrected by students, may momentarily unsettle the teacher's perceived status as a language expert in this situation. In the episode above, T2 indicates uncertainty through comments such as "I'm not sure" (line 09) and "doesn't ring a bell" (line 13), suggesting that he is not entirely confident in the students' suggested translations. His continued use of the integration *Harasse* indicates that, because he is not familiar with "crate", he opts for translanguaging instead of adopting the students' suggestions. In this context, T2's choice to translanguage appears to be a strategy that allows him to maintain his role as a language guide while navigating is own uncertainties.

A second possible explanation for the teacher's hesitation in adopting the students' contributions may be related to the concept of native speaker fallacy (Phillipson, 1992), which posits that nativeness is often equated with language proficiency in said language. This notion is still prevalent in English as a Foreign Language (EFL) and CLIL teaching (see e.g. Colmenero & Lasagabaster, 2020; Relaño Pastor & Fernández-Barrera, 2019; Relaño Pastor & Poveda, 2020). In this particular class (2b), the CLIL student survey indicates that none of the students are native speakers of English, which might explain why T2 did not place as much weight on their suggested translations. In the interviews, the other teacher, T1, also reveals a tendency to defer to native speakers, viewing them as more authoritative in matters of language. He even mentions consulting native speakrs for English terms when he encounters unfamiliar vocabulary.

Although T2 does not explicitly state the use of such a strategy, certain comments in his interview suggest that he may also be influenced by this idea. He notes that a native-speaking guest teacher who observed his CLIL classes praised his English proficiency, and he recounts with pride that his first CLIL class initially thought he was a native speaker due to his exclusive use of English in class. While T2's comments do not indicate a direct bias, they suggest that the perceived authority associated with being a native speaker may play a role in his classroom decisions. Although it is unclear whether T2 would have accepted a translation from a native speaker in this instance, his anecdotes imply that he might have been more receptive. These two explanations (which are not mutually exclusive) provide some context as to why T2 might not have adopted the students' suggestions in this episode and opted for translanguaging instead.

Continuing with part two of the same episode that follows immediately after the first part, another student remarks that *Harasse* is actually a Swiss German word (line 14) upon which T2 then turns to the class and asks for the equivalent of *Harasse* in Standard German (line 17).

Episode *Harasse* 2/2: CLIL_2b_20150526

14 S1: It's just a Swiss German word.

15 T2: *Harass*?

16 S1: *Harasse*, yes

17 T2: How is it called in Ger- German, Germany?

18 S2: *Bierkasten*

19 S3: *Palette*

20 T2: *Bierkasten. Kasten, ja.* Okay, uh, what I would like you to do, now let's start it this way

Two students then reply giving two possible translations, in line 18 with *Bierkasten [beer crate]* and line 19 with *Palette [pallet* or *wooden box],* of which T2 takes up the first one in line 20 *Bierkasten.* By adding "*Kasten, ja [crate, yes]"* he seemingly seems to accept that translation, before moving on to another task. What is especially noteworthy here in this episode is the discussion of assigning a language to the word *Harasse.* The fourth category of the codebook used to analyze the translanguaging practices occurring in the EG_BIO corpus was purposefully labeled "assigned language". As previously explained (Section 8.2.3.4), this has to do with the fact that according to translanguaging theory (see Chapter 4), the external view on someone's language use (e.g. "she clearly used an English word while speaking Spanish") does not necessarily aling with the internal perception of that individual on their own language use (cf. Otheguy et al., 2015, 2018). Therefore, the fourth category is labeled "assigned language", in that I as a researcher assign a named language to the linguistic resources used by the participants in this study.

The episode above clearly shows that my systematic assigning of language not always overlaps with the participants' own view on the language they use. To briefly explain: Standard German in this study is referenced as the codified version of Standard German as present in the Duden (2021) as well as the Duden's Swiss Standard German addition *Schweizerhochdeutsch* (Bickel & Landolt, 2018). *Harasse* is a codified word in Landolt and Bickel's (2018) Swiss Standard German dictionary, and is therefore, in the analysis, coded as Standard German. The student in line 14 clearly points out that in his own view *Harasse* is not a Standard German but a Swiss German word. By asking the students for the Standard German version of that word and accepting the students' replies in this regard, the teacher aligns himself with the student's internal view that *Harasse* is indeed a Swiss German and not a Standard German word. This example shows how my own perception of assigned language use does not correspond to the participants' own view of the language they used, a point that will be further taken up in the following discussion section.

Concluding this section, the close analysis of the episode *Harasse* has illustrated that, on the one hand, translanguaging practices (integrations in this case) can be used by the CLIL teacher to assert authority as a language expert, even in case of struggling with said language. On the other hand, this episode has pointedly shown that participants' internal perspectives on their own language use do not have to coincide with the researcher's external perspective. Therefore, translanguaging researchers have to constantly be aware that when they are using named languages to describe other individuals' language use, they use their own external view influenced by sociopolitical labels of languages.

8.4 Discussion

In this section, I want to comment on and critically discuss the main findings of the extensive analyses regarding translanguaging. The first research question the translanguaging analysis sought to answer is the following:

1. What translanguaging practices are present in the EG_BIO corpus?

The analysis has shown that there are two main types of translanguaging present in the EG_BIO corpus, translations and integrations. Of the 851 translanguaging instances present, 288 instances concerned the same word *aso,* which were consequently excluded from analysis. Of the remaining 563 translanguaging instances, 78% are integrations, and 21% translations. Apart from type, translanguaging practices were also coded according to SOURCE, FORM and ASSIGNED LANGUAGE. In the EG_BIO corpus, the most frequent source of a translanguaging instance is the teacher; followed by students and co-constructed instances. Translanguaging practices occur in a variety of forms, but most often in form of a single word.

Taking an inclusive approach to translanguaging, the category of ASSIGNED LANGUAGE is particularly interesting, since it shows that translanguaging instances in the EG_BIO corpus occur in at least seven different languages, not counting the translanguaging instances that were coded as unclear because they could not be assigned to a single language. Even though an array of multilingual resources is used, the most frequent AL of a translanguaging instance is still Swiss German, which reflects the geographical context in that the teachers' and students' L1 (Swiss German) is used most often in both, CLIL and non-CLIL lessons. This is followed by translanguaging instances assigned to the ML Standard German, which occur almost exclusively in the CLIL lessons. With a combined percentage of 20.4%, translanguaging with source languages (Greek, Latin and unclear) is also prominent in the EG_BIO corpus. Consequently, translanguaging instances occur in great diversity, but occur most often as integrations, have most frequently the teacher as a source, occur most commonly in form of a single word and are most frequently assigned to Swiss German.

The second research question concerned the distribution of translanguaging practices within the EG_BIO corpus:

2. How are these translanguaging practices distributed within the EG_BIO corpus with regard to

   a. Lesson type, with a specific focus on the comparison of translanguaging practices according to type of instruction (CLIL vs. non-CLIL), and to a lesser extent teacher instruction (T1 vs. T2) and grade (10 vs. 11)

b. Speaker (teacher vs. students)

c. Classroom registers (instructional register, regulative register_specific content and regulative register_general, social talk)

Overall, 1% of the EG_BIO corpus are comprised of translanguaging instances, and 0.77% excluding instances of *aso*. This means, translanguaging is actually rare in both CLIL and non-CLIIL lessons. Looking more closely at the comparison of translanguaging practices in CLIL and non-CLIL lessons, there is, as expected, more translanguaging in the CLIL than in the non-CLIL lessons. But the relative frequencies show that translanguaging is indeed rare in both contexts (CLIL: rf= 0.56; non-CLIL: rf=0.4) and the difference between the two is less than expected. This mainly has to do with the linguistic situation of German-speaking Switzerland and science as the subject that is taught. Due to Swiss German being the L1 of students which differs from the ML Standard German, students and teachers switch back to the L1 also in the non-CLIL lessons. On the other hand, translanguaging with source languages such as Latin and Greek has been shown to be used particularly in connection with technical vocabulary and key lexis, and thus occurs in both, the CLIL and the non-CLIL subcorpora.

The overall low percentage of translanguaging practices in the EG_BIO corpus implies that exposure to the language of instruction is not compromised by the use of translanguaging in teacher-led whole class interaction in CLIL and non-CLIL lessons. This is particularly interesting in the CLIL context, where the use of the L1 and target-language-only policies have long been a controversial issue. Monolingual ideologies are often still prevalent in bilingual programs (Cummins, 2014) and are mainly based on two beliefs: that the L1/ML might interfere with the TL, and that the use of the L1/ML might limit maximum exposure to the TL (Lasagabaster, 2017, p. 252). Monolingual teaching ideologies thus strongly discourage the use of the

L1/ML in favor of TL use only. The present case study demonstrates that exposure to the TL, at least in teacher-led whole class interaction, is not compromised through the use of translanguaging in CLIL lessons, even considering the use of languages other than the L1.

However, the low percentage of translanguaging practices observed in CLIL lessons could be influenced by the teachers' orientation toward a more monolingual approach to language use. Although the school in question does not have an official target-language-only policy, both teachers in the present study emphasize in their interviews that one of the primary objectives in CLIL teaching is to support students' English learning development. While teachers' beliefs play a significant role in shaping their classroom practices (Zhang & Liu, 2013), they do not always align perfectly with what occurs in practice (Bieri, 2018b). Based on the field notes, both teachers actively encourage their students to use English consistently in their CLIL lessons, frequently reminding them to speak English, particularly also during group work. This preference for English is also reflected in teacher-led whole class interaction, as illustrated in the following extract:

Extract 8.61: CLIL_2e_20150528

```
01   T1:  Read at the beginning of the task what it says
          about the causes of hyperventilation. English
          please.
```

In this extract, after his instructions on the reading task, T1 actively reminds his students to speak English with each other ("English please"). Therefore, it cannot be excluded that the low percentage of translanguaging practices in CLIL lessons is at least partly influenced by the teachers' attitude towards the TL. Another contributing factor for the low amount of translanguaging found in the EG_BIO corpus is the focus on teacher-led whole class interaction in the present study. Dalton-Puffer (2007) and other scholars (e.g. Moore & Nikula, 2016;

Nikula & Moore, 2019) have shown that group work is especially prone to switching back to the L1. I have observed this behavior in students' group discussions in the CLIL lessons, but due to the study's research design focusing on quantitative assessment of translanguaging practices, only teacher-led whole class interaction could be taken into account. Consequently, exposure to the TL is not compromised, but the low amount of translanguaging especially in CLIL lessons might be partly due to the teachers' attitudes towards TL and partly due to the study's focus on teacher-led whole class interaction only.

Apart from the overall low occurrence of translanguaging practices, CLIL and non-CLIL lessons differ in their use of translanguaging: In CLIL lessons, integrations as well as translations occur mostly in Standard German, whereas in the non-CLIL lessons translations primarily occur with source languages and integrations in Swiss German. In both contexts, translations are often used to clarify key lexis except for translations from Swiss German into Standard German non-CLIL lessons, which are most likely attributed to teachers' self-repairs. Integrations are, in both contexts, used in a variety of ways, ranging from their use as discourse markers to classroom management and comments on specific tasks.

Another important finding concerns the different teaching styles regarding translanguaging, namely that T2's classes use more translanguaging than those taught by T1. This is particularly interesting considering T2 has a stricter attitude towards the use of the TL in his CLIL lessons and this suggests he would not allow translanguaging in his CLIL lessons at all. However, this has to do with the fact that T2 employs a translanguaging pedagogy (foreign word list) when it comes to the subject-specific terminology of biology. He does this in both his CLIL and non-CLIL lessons, therefore it is not surprising that he translanguages more than T1 in this regard. On the other hand, T2's CLIL classes are half-classes, with eight and 10 students only, which might prompt more informal discourse and thus more translanguaging that is then reflected in the higher use of Swiss German in T2's CLIL classes. T2's approach to pre-planned translanguaging with source languages could be an indication that such a translanguaging pedagogy might be especially fruitful for teaching science, in a CLIL and non-CLIL context. Overall, the quantitative overview shows that translanguaging with source languages is frequently used by T2 in connection with technical vocabulary, a situation that is further analyzed in Chapter 10.

The study further reports that teacher and students in grade 11 use more translanguaging instances than grade 10, which is true for both CLIL and non-CLIL classes. Especially for CLIL classes this was an unexpected result, since it was hypothesized that there is more translanguaging in grade 10 because this is the first year of CLIL instructions for students. Even though one has to be cautious when interpreting these results, since only nine out of the 31 recorded lessons are from grade 11, the differences might have several reasons. First, CLIL students in grade 11 may be less anxious to ask for a word they do not know, although the co-constructed instances do not support this theory. Second, the teachers' more frequent use of translanguaging in grade 11 may create an atmosphere where, in response to teachers, students also translanguage more. Aside from the episode on *Harasse* discussed in Section 8.3.6, no evidence of this was found in grade 11. It may also well be that is simply the diverse range of topics or the exam discussions in the grade 11 lessons that have led to more translanguaging.

This directs attention to the next finding in regards to the speaker variable. Even though most of the 563 translanguaging instances are uttered by the teachers, relative to their overall word count teachers use considerably less translanguaging than their students, and this is the case for both, CLIL and non-CLIL classes. Generally, it can be said that students translanguage more than the teachers, and they do so using integrations mostly in Swiss German. The analysis has shown that there are various uses for student integrations in Swiss German, ranging from commenting on tasks to discussing organizational matters.

Translations, on the other hand, are all either uttered by the teacher or in co-construction with students, but never by the students themselves. This is not surprising giving the power dynamics of the classroom and the fact that most translations are primarily used in the instructional register and in connection with subject-specific terminology. The teacher is thus the content expert (translations with source languages) and in CLIL also the language expert (translations with ML).

Lastly, with regard to the classroom register variable, most translanguaging is found in the regulative registers, followed by the instructional register. but the use of translanguaging varies according to register: Most of the translations are used in the instructional register, consequently translanguaging in the regulative registers is mainly made up of integrations. This is also true for CLIL and non-CLIL classes, yet the assigned language differs depending on classroom register.

The translanguaging analysis has thus shown, on the one hand, that translanguaging practices are rare, but also illustrated how complex and diverse they are with regard to TYPE, SOURCE, FORM and ASSIGNED LANGUAGE. With regard to the special case of *aso,* the Swiss German variant of *also* [that is, therefore] occurs often in the EG_BIO corpus, probably because of its use as a discourse marker, but more research is needed on this. The close analysis of the episode *Harasse* has illustrated in detail how translanguaging by the teacher can be used to assert his authority as a language expert in CLIL, as well as how the external perception of what language is used in a situation does not have to correspond to the participants' internal view on their own language use.

One final aspect I want to address in this discussion section is the apparent paradox of applying translanguaging theory through the use of a codebook. Translanguaging theory posits that the use of a speaker's full repertoire consists of no fixed boundaries or named languages (see Chapter 4). Such an inclusive understanding of translanguaging is difficult to operationalize, as Lin et al. outline:

> What is the nature of the structuring and the ordering in languaging and translanguaging performances? They are not as tightly structured as formal written grammars would dictate, but they are not so loosely structured that any mix is possible. They are something in between. (Lin et al., 2020, p. 44)

This is also why most studies on translanguaging have been of qualitative nature so far. Nevertheless, the current study tried to examine the nature and structuring of translanguaging by establishing a framework that would allow the author to analyze and compare dynamic translanguaging practices quantitatively. The intention behind developing the translanguaging framework in form of a codebook was to empirically document translanguaging instances in their full complexity as accurately as possible in a way that is applicable not only in CLIL, but also in non-CLIL lessons. The fact that of 851 (excluding 563 *aso*) translanguaging instances only three had to be classified as ambiguous is a testimony to the strength of the established framework in capturing all kinds of multilingual translanguaging instances no matter the type, source, form or assigned language.

8.5 Summary of Chapter

This chapter has explored the question of what kind of translanguaging practices occur in the EG_BIO corpus, and how they are distributed in this very corpus. It has introduced the detailed framework that was developed to answer these research questions. By means of a codebook, translanguaging instances were analyzed according to four categories: TYPE, SOURCE, FORM and ASSIGNED LANGUAGE. The quantitative overview of translanguaging instances has documented the complexity and diversity of translanguaging practices occurring in the EG_BIO corpus. Translanguaging practices occur in two types, integrations and translations, of which they most often occur as integrations, uttered by the teacher, in form of single words and in Swiss German. Overall, the EG_BIO corpus contains 0.77% of translanguaging instances excluding *aso.* This means, translanguaging is actually rare in teacher-led whole class interaction in both CLIL and non-CLIL lesson and exposure to the language of instruction is thus not compromised in this particular context. This could, however, be due to the teachers' attitudes towards TL use in CLIL, as well as the study's specific focus on teacher-led whole class interaction. Further, the difference between translanguaging in CLIL and non-CLIL lessons is less than expected, which has to do with the use of the L1 Swiss German and source languages in the non-CLIL subcorpus. Consequently, integrations and translations are most frequently used in Standard German in the CLIL lessons, whereas in the non-CLIL lessons, Swiss German dominates integrations and translations are mainly used in connection with source languages.

Translanguaging practices differ greatly according to teaching style, T2's classes using more translanguaging than T1's, in CLIL as well as non-CLIL lessons. One the one hand, this is due to T2's use of the so-called foreign word list—a translanguaging pedagogy in which he uses translanguaging with source languages to negotiate subject-specific terminology. On the other hand, T2's CLIL classes are smaller in size, which seems to encourage a more informal atmosphere allowing for more translanguaging in CLIL classes. There is no significant difference between CLIL and non-CLIL lessons in the findings regarding grade, speaker and classroom register. For instance, the lessons in grade 11 contain more translanguaging than grade 10 in both CLIL and non-CLIL contexts. Students also translanguage more than their teachers using integrations assigned to Swiss German in both CLIL and non-CLIL lessons, whereas translations are solely used by the teacher or in co-construction with students. And in both CLIL and non-CLIL subcorpora, translanguaging is used most in the regulative registers in form of integrations, and translations are mostly used in the instructional register.

Lastly, in regards to translanguaging theory, the close analysis of the episode *Harasse* has illustrated that external and internal perspectives on language use do not have to coincide, and that it is important to take this into account when doing research using a translanguaging approach. The close analysis has further shown that translanguaging can be used by the CLIL teacher to assert his authority as a language expert. Overall, translanguaging is often used in connection with technical vocabulary, be it in Standard German in CLIL lessons or source languages in the entire EG_BIO corpus, which is thus the topic of the next research focus: technicality.

9 Research Focus 2: Technicality

This chapter addresses the second research focus of the present study: technicality. It begins in Section 9.1 with the research questions, which center on the quantitative overview of technical terms in the EG_BIO corpus and the qualitative analysis of the introduction of new technical terms. Section 9.2 outlines the respective methodology for the quantitative as well as qualitative approaches to technicality in this study. In Section 9.3, the findings of the analyses are presented, starting with the quantitative overview of technical terms in the EG_BIO corpus based on lesson type, speaker and classroom registers (Section 9.3.1), followed by a first discussion of the quantitative results (Section 9.3.2). The chapter then moves to the findings from the qualitative analysis of the introduction of new technical terms (Sections 9.3.3), with a corresponding discussion in Section 9.3.4. The chapter concludes with a summary of the key findings (Section 9.4) and highlights the value of combining quantitative and qualitative approaches to technicality.

9.1 Research Questions

Technicality, according to Wignell et al. (1993), refers to everything that makes language technical in or specific to a particular field. Technicality thus includes vocabulary as much as grammatical resources specific to a certain field. In CLIL research, quantitative comparative studies focused heavily on investigating general vocabulary size as a measurement for learning progress of CLIL students compared to non-CLIL students (e.g. Agustín-Llach, 2014, 2016; Agustín-Llach & Canga Alonso, 2016, 2017; Baten, Van Hiel, & De Cuypere, 2020; Fernández-Fontecha, 2014; Gierlinger & Wagner, 2016; Sylvén & Ohlander, 2014; Tragant, Marsol, Serrano, & Llanes, 2016). These studies showed, among other things, that CLIL students, compared to those attending the regular program, usually outperform their peers with regard to general vocabulary. This is not surprising, since they are not only exposed to a greater vocabulary but also to more varied inputs from the TL.

With regard to the investigation of technical vocabulary specifically, however, there are no quantitative CLIL studies so far. Instead the focus has mostly been on qualitative research, investigating the explanation or negotiation of meaning of terms in the TL (e.g. Evnitskaya, 2012; Lin, 2016; Morton, 2012; Nikula, 2017b). Studies like Bieri (2015), Lin (2016) and Nikula (2017b), which looked at CLIL science lessons, found that the technical terms in English did not always coincide with the technical terms used in the L1 of students, which contributed to difficulties in explaining certain technical concepts. These are important insights with regard to the negotiation of technical terms in CLIL science lessons. However, in science lessons, the language is often marked by a high density of technical terms, a condition that is in itself often problematic in CLIL classes (see e.g. Bieri, 2015). The lexical density of technical terms, however, has not yet been investigated quantitatively nor comparatively (CLIL and non-CLIL). Therefore, the second research focus on technicality follows two main objectives: First, to quantitatively assess, that is taking stock, of the technical terms used in CLIL (English) and in non-CLIL (German) biology lessons and second, to qualitatively look at how new technical terms are introduced depending on mode (spoken vs. written). In other words, the first objective's aim is finding out who uses technical terms (speaker), where they are used in the lesson (classroom register) and whether or not the frequency of technical terms varies according to mode (spoken vs. written). However, even though lexical density is high in science subjects, not every technical term occurring in a lesson is new to the students and has the potential to contribute to difficulties in understanding. Which is why it is essential to investigate the introduction of new technical terms. Therefore, the second objective's aim is finding out how exactly new technical terms are introduced in written teaching materials as well as in the classroom.

More specifically, in order to achieve the first objective, the quantitative analysis focuses on establishing a methodological framework that allows the researcher to get an empirical overview of technical terms used in CLIL and non-CLIL lessons. Combining Wignell et al.'s (1993) theoretical framework of technicality with the use of a technical dictionary (Cole, 2015) is a novel approach to the identification of technical vocabulary that works independently of language, which is why this approach is used in the current study. Hence, with regard to the quantitative analysis, I seek to answer the following research questions:

3. What technical terms can be identified in the EG_BIO corpus and how are they distributed? More specifically, what is the technical density and the relative frequency of technical terms[91] across the variables explained in Section 7.2
    a. Lesson type (CLIL vs non-CLIL; T1 vs. T2; grade 10 vs. 11)
    b. Speaker (teacher vs. students)
    c. Classroom registers (instructional, regulative and social talk)?

Much of the research on identifying and analyzing academic and technical vocabulary has been carried out using written texts (textbooks, student essays etc.), therefore, the next research question focuses on a comparison of modes:

[91] Even though similar, technical density and relative frequency of technical terms refer to different things in this study: Technical density is number of words coded as technical terms divided by the total number of words, whereas the relative frequency of technical terms refers to the number of technical terms divided by the total number of words. More on this follows in the methodology section (9.2.2.1).

4. How does technical density and relative frequency of technical terms in teacher-led whole class interaction compare to a subsample of written text in the teaching materials?

The second, more qualitative part of the research focus on technicality deals with the introduction of new technical terms. New technical terms have to be introduced properly; in Wignell et al. (1993) concept of technicality this happens through a so-called technicalizing process involving highlighting the technical term and assigning it a field-specific meaning. In written texts such as disciplinary textbooks, new technical terms are often highlighted through orthographic means like bold font, followed by a definition of said term. In classroom discourse, the teacher has to draw attention to new technical terms employing other discursive or rhetorical resources. Therefore, in order to achieve the second objective, the resources (linguistic or other) used to highlight and introduce technical terms are closely examined using Wignell et al.'s (1993) concept of the technicalizing process. This technicalizing process is first analyzed in a written subsample of the teaching materials, which is then compared with a subsample of classroom discourse in the EG_BIO corpus. Specifically, the qualitative analysis of technicality seeks to answer the following to questions:

5. How are new technical terms introduced in written vs. spoken mode? More specifically,
    a. how is the second step of Wignell et al.'s (1993) technicalizing process (setting up a term as technical by assigning it a field-specific meaning) realized in a subsample of written teaching materials?
    b. how is the second step of Wignell et al.'s (1993) technicalizing process realized in the corresponding lessons of classroom discourse?

6. Are there any similarities and differences regarding the variable of lesson type (CLIL vs. non-CLIL and T1 vs. T2)?

The corresponding methodologies for the quantitative as well as the qualitative approaches to technicality are presented in the next section.

9.2 Methodology: Technicality

This section first reports on a pilot study, which served as a basis for the development of the actual quantitative and qualitative approaches to technicality (Section 9.2.1). Then it describes in detail the methodology employed for the quantitative analysis of technical terms (Section 9.2.2) as well as the qualitative approach to the introduction of new technical terms (Section 9.2.3).

9.2.1 Pilot Study 3: Analysis of Technical Terms in Two Biology Lessons (Bieri, 2018a)

In 2018, I conducted an exploratory pilot study on technicality with the aim to answer the following two research questions:

(1) Can technical terms as defined by Wignell et al. (1993) be identified reliably and analyzed quantitatively with the UAM CorpusTool in both, CLIL and non-CLIL lessons?

(2) Are there any instances of negotiation of technical terms that shed light on what linguistic resources are used to set terms up as technical in classroom discourse in CLIL vs. non-CLIL lessons?

In order to answer these research questions and compare CLIL and non-CLIL lessons, the data chosen for the pilot study consisted of two lessons from the EG_BIO corpus, one CLIL and one non-CLIL, taught by the same teacher (T1) on the same topic (hemoglobin and oxygen transport, see Table 31).

Table 31: Dataset for pilot analysis of technical terms

Class	Program	Language	Teacher	Topic
2e	CLIL	English	T1	Alveoli, hemoglobin
2d	Non-CLIL	German	T1	Hämoglobin [hemoglobin], Sauerstoff-sättigungskurve [oxygen saturation curve]

The transcripts of the two lessons were coded according to the speaker variable (see Section 7.2.2), and chunked into the activity types “teacher monologue” and “whole class interaction”[92]. Technical terms, in this pilot study, were considered to be nominal group constituents, that is nouns (see Wignell et al., 1993, p. 145). Tree-tagger[93], the integrated Parts-of-Speech (PoS) tagger in the UAM CorpusTool, was used to automatically tag all nouns in the two lessons. Following Wignell et al.’s idea that a term only becomes technical if it has a field-specific meaning assigned to it (see Section 5.1.1), it follows that any term occurring in a dictionary or lexicon of biology is a technical term in the field of biology. In order to identify technical terms, appropriate dictionaries had to be selected for the purpose of this pilot study. The dictionaries had to be freely accessible, up-to-date, roughly comparable in size, as well as include the field of biochemistry (since both lessons selected for the pilot study deal with biochemistry). In the end, the following four dictionaries were selected:

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[92] This was before it was decided to not distinguish teacher monologue from whole-class interaction and instead use *teacher-led whole class interaction* as a term including teacher and student monologue (see Section 6.3.1).

[93] The UAM CorpusTool has two built-in Parts of Speech (PoS) taggers, the Stanford tagger and the tree-tagger. Since the Stanford tagger is only available for English, the tree-tagger was used for tagging nouns in the two selected lessons.

- For English:
    - The Oxford Dictionary of Biology (2016)
    - The Oxford Dictionary of Biochemistry and Molecular Biology (2006)
- For German:
    - Das Lexikon der Biologie (1999–2004)
    - Das Lexikon der Biochemie (1999)

Tagging technical terms in this way, namely first automatically coding for nouns, and then manually checking whether these nouns occur in the above-mentioned dictionaries, the pilot study showed that in both lessons, T1 uses more technical terms than his students, and more technical terms are dealt with in teacher monologue than in whole-class interaction. Interestingly, more technical terms occur overall in the CLIL lesson compared to the non-CLIL lesson: both with regard to teacher and student use, and with regard to teacher monologue and whole-class interaction[94].

The quantitative analysis, however, revealed several issues with regard to methodology: First, a clear distinction between whole-class-interaction and teacher monologue as previously employed by e.g. Dalton-Puffer (2007) was difficult and thus not suitable for quantitative analysis, because even in teacher monologue, interaction with the class is happening, which makes clear boundaries between teacher monologue and whole class interaction impossible. This resulted in the definition of *teacher-led whole class interaction* as a unit for analysis for the transcripts in the current study (see Section 6.3.1 for a detailed explanation). A further issue concerned the identification of technical terms, more specifically, the selection of the respective dictionaries: Even though comparable in size, there were cases where some terms occurred in the English dictionaries, but their German equivalent could not be found in the German dictionary and vice versa. In the pilot study,

[94] For more details on the pilot study see Bieri (2018a).

such cases were handled as follows: If a term did not appear in the respective dictionary (English or German), it was checked whether its equivalent translation would appear in the corresponding dictionary (English or German respectively), and if it did, it was counted as a technical term[95]. However, this way of identifying technical terms checking several dictionaries did not only prove to be very time-consuming, but also not that reliable in that terms that were technical in my opinion, such as e.g. *oxygen saturation,* were not accounted for.

The second goal of the pilot study was to identify instances of negotiation of technical terms in the two lessons. Rather than identifying such instances quantitatively, this was done in the form of two comparative case studies of two technical terms. Even though the lessons roughly dealt with the same content (see Table 31), not all technical terms occurred in both lessons. Therefore, the terms in question had to occur in both lessons, and they had to be new to the students (so the lexico-grammatical resources used to introduce the term in the CLIL and non-CLIL class could be compared). Consequently, the cases of *reaction equilibrium / Reaktionsgleichgewicht* and *affinity / Affinität* were selected for the qualitative analysis in the pilot study. Both technical terms were only briefly introduced in teacher talk in the non-CLIL lesson, but ended up being negotiated over several turns between teacher and students in the CLIL lesson. Furthermore, in the CLIL lessons, T1 was able to negotiate the meaning of the scientific concept *reaction equilibrium* successfully, using the wrong scientific terminology in English though (*equation balance* instead of *reaction equilibrium*). In the case of *affinity,* the opposite was the case: T1 used the correct terminology, but despite the use of translanguaging, they were unable to successfully negotiate the meaning of the scientific concept of *affinity*. The qualitative analysis of the pilot study thus showed that it is worthwhile

[95] Although *Blutkörperchen* does not appear in German dictionaries, it was classified as a technical term due to its English equivalent, *blood cell*, being listed in English dictionaries.

to look at the way teachers introduce technical terms, particularly in CLIL compared to non-CLIL lessons. It also showed that looking at negotiations of technical terms including translanguaging in more depth seems useful, particularly in the CLIL lessons, which is the third research focus of the present study (see Chapter 10).

Overall, the pilot study showed that looking at the distribution of technical terms seems a worthwhile endeavor using Wignell and colleague's definition of technical terms, but in order for it to be successful and reliable, the methodology regarding the identification of technical terms and specifically the selection of dictionaries needs to be revised. It further showed that a more qualitative approach to the negotiation of technical terms seems promising especially in CLIL lessons. Therefore, the detailed methodology for the quantitative analysis is presented in the next section.

9.2.2 Quantitative Analysis of Technical Terms

Much of quantitative analysis depends on the identification of technical terms in the EG_BIO corpus. Therefore, this section is structured as follows: First, after a brief repetition of Wignell et al.'s (1993) definition of a technical term and the parameters for the identification of technical terms in the EG_BIO corpus are presented (Section 9.2.2.1). This is followed by an explanation of the codebook for the categorization of each technical term (Section 9.2.2.2).

9.2.2.1 Identification of Technical Terms

The definition adopted in the present study draws on Wignell et al.'s (1993, p. 144) definition of a technical term as "terms or expressions (but mostly nominal group constituents) with a specialized field-specific meaning". According to them, the technicalizing process—how terms become technical—follows a particular pattern in the natural sciences, consisting of two steps:

1) giving the phenomenon a name
2) making the name technical by assigning it a field-specific meaning

A detailed review of this two-step technicalizing process can be found in Section 5.1.1, but a short summary is provided again in the following. First, a technical term consists of a name, mostly nominal constituents, to describe the phenomenon in question. Second, that name is assigned a field-specific meaning: "[T]he meaning that it will encode whenever it is used again within the context of that field" (Wignell et al., 1993, p. 148). Name-giving can happen in various ways: borrowing names of technical terms from other disciplines or other languages, using existing terms and assigning it a new meaning, or creating newly coined terms within the language (e.g. through nominalization or compounding). Whatever the process of naming a particular phenomenon looks like, it is the second step—assigning a particular field-specific meaning to a term to set it up as technical—that is particularly useful here because it means that technically every term that occurs in a discipline-specific dictionary or lexicon has a field-specific meaning, and can thus be considered a technical term.

In the present study, Cole's (2015) English-German dictionary *Wörterbuch der Biologie / Dictionary of Biology* is used to identify technical terms in the EG_BIO corpus. Cole's biology dictionary contains about 60'000 entries of technical terms in both, German and English. It covers not only technical terms from botany, zoology and microbiology, but also from a range of other fields of study such as biochemistry, physiology, or systematics (see Cole, 2015, p. ix for an overview). This and the fact that it is an English-German dictionary, meaning it focuses exactly on the translation of technical terms from one language into the other, make this dictionary an excellent reference work for the identification of technical terms.

Relying on discipline-specific dictionaries as a way of determining technical vocabulary is neither new nor uncontested. While technical terms can be identified more readily in a smaller scale study or in a qualitative study where there is more time and scope to consider the context of each term, the reliable identification of technical terms especially in big corpora is still a challenge. I therefore review three studies (Chung & Nation, 2003, 2004; Ha & Hyland, 2017; Kwary, 2011) which tested different methods and models to determine technical vocabulary, and cross-reference this to the approach taken in the present study.

For instance, Chung and Nation (2003) identified the rating scale method as a reliable and consistent method for the identification of technical vocabulary. In Chung and Nation (2004) they compared the efficacy of other methods such using a technical dictionary, using clues provided in the text, and using automated term extraction against the rating scale method. Their evaluation showed that using a rating scale provided the most reliable and consistent results while using clues in the text provided the least consistent and reliable results. With regard to using a technical dictionary, they state that the decreased reliability of that approach was in parts dependent on the dictionaries selected for their study, i.e. the fact that there was no technical dictionary available for the topic of the texts they used as sample (Chung & Nation, 2004, p. 261). Since the present study deals with data in two different languages, similar problems concerning the selection and specificity of comparable dictionaries were reported on in the pilot study. This was solved by using a field-specific dictionary in English and German deemed specific and diverse enough for the transcribed lessons (Cole, 2015).

Another approach to the identification of technical vocabulary is presented by Kwary (2011), in what he calls the hybrid method. Similar to Chung and Nation (2004), Kwary carefully reviews the advantages and disadvantages of four methods previously used to determine technical vocabulary in order to then propose a hybrid method. The methods he looks at are vocabulary classifications, keyword analysis, term extraction and systematic classifications. With vocabulary classifications, the text in question is automatically divided into high frequency words, academic words and low-frequency words, assuming that the rest of words constitutes the technical vocabulary. With a keyword analysis, the program (e.g. Wordsmith or AntConc) compares the keyness or frequency of words in the corpus compared to another reference corpus. Term extracting programs (e.g. TermoStat) also focus on keyness but can include multi-word units of up to three words. The last method, systematic classifications requires lexicographers and field experts to select entries for a specific discipline and create a respective word list. While the first three methods “have been able to lighten the burden when determining technical vocabulary by significantly reducing the number of words to be scrutinized” (Kwary, 2011, p. 181), they all have some problems regarding the inclusion of everyday vocabulary and the exclusion of some technical terms. The last method, systematic classifications, proves to be the most reliable and accurate one, but also the most time-consuming (Kwary, 2011, p. 181).

Thus, Kwary proposes a hybrid approach, combining a keyword analysis with the systematic classifications’ method. There is an automatic keyword analysis program available within the UAM CorpusTool, therefore a keyword analysis would technically be possible. However, keyword analyses heavily rely on the respective reference corpora, and because the data in the EG_BIO corpus comes in two languages, there would need to be two comparable reference corpora, one for English and one for German in order not create two completely different word lists for CLIL and non-CLIL lessons. In addition to this, the systematic classifications method which should solve the shortcomings of a keyword analysis is time-consuming and would go beyond the scope of this project. On these grounds, the hybrid method is not considered suitable for determining technical vocabulary in the present study.

Another approach for the identification of technical terms is presented by Ha and Hyland (2017), where they suggest the Technicality Analysis Model (TAM) as a tool for identification and categorization. Thereby, they distinguish five degrees of technicality from words that are *least technical* to words that are *most technical* based on several criteria including the polysemy of a word or its frequency in known corpora such as the Corpus of Contemporary American English (COCA) or the British National Corpus (BNC). The TAM is probably the most comprehensive and precise method for determining and categorizing technical terms by their degree of technicality in a corpus from any discipline. However, its implementation requires a complex process involving multiple general and specialized dictionaries, word lists, and expert input—resources that are unavailable for the current study. Additionally, developing the TAM for both German and English would further complicate the process. As a result, this method of identifying technical terms is not used.

After carefully reviewing different approaches, a field-specific dictionary was chosen as the basis for identifying technical terms. This remains the most reliable method for recognizing technical vocabulary in two languages, while also accommodating both spoken and written data. Since each lesson covers different topics in biology, Cole's (2015) dictionary offers a sufficiently broad and specific reference to encompass these topics. The expanded and revised definition of what constitutes a technical term in this study is as follows:

A **technical term** is a 'token', usually in the form of a noun, compound noun or noun phrase, that is assigned a value, in this case a field-specific meaning. A field-specific meaning thereby refers to the meaning encoded in this term whenever it is used within the context of that field. Technical terms thus occur in a field-specific dictionary, in this case Cole's (2015) bilingual *Wörterbuch der Biologie / Dictionary of Biology*.

Based on this definition and the methodological considerations above, identifying technical terms in the EG_BIO corpus with the UAM CorpusTool works as follows:

1. All common nouns (automatically identified via tree-tagger in UAM CorpusTool) are automatically tagged as technical terms, which results in non-technical terms being included in the list[96].
2. Every noun in the list is then checked manually whether it belongs to a compound noun[97] or not. The single or compound noun is then manually looked up in the Dictionary of Biology (Cole, 2015). If it has an entry in said dictionary, it is confirmed as a technical term. All non-technical nouns are untagged.
3. There are some cases where a pre-modifier forms part of the technical term as well, as is the case with *aufrechter Gang [upright gait]*. In these cases, if there is an entry for said noun phrase in the dictionary (which is the case with *aufrechter Gang*) the whole noun phrase is counted as one technical term.
4. Special rules apply for compound nouns that do not exist as such in the dictionary, but each nominal part of the compound

[96] Roughly 25% (30'017 words) of the EG_BIO corpus are common nouns, a third of which is considered technical following this identification process.
[97] Compound nouns refer to any "combination of two or more words which functions as a single word" (Richards & Schmidt, 2010, p. 108), and that single word takes on the function of a noun.

does. For example, in one lesson, the teacher is talking about *Chitin-Panzer [chitinous armor]*, but in the dictionary it is labeled as *Chitinschale [chitinous shell].* As both *Chitin* and *Panzer* have separate entries in the dictionary, this is counted as one technical term.

5. Wherever applicable, special rules also apply for terms that have a vernacular (everyday) meaning as well as a technical meaning (the one occurring in the dictionary). Even though the dictionary does not include specific definitions of the terms in question, it does sometimes give hints to its contextual meaning by adding synonyms or descriptions. For example, the entry for *ring* in Cole (2015, p. 580) provides a synonym after a slash, including a description in brackets. This is followed by *fung,* meaning this term concerns mycology, the study of fungi. Here, *ring* refers to a specific part of a fungus. In instances like this, the technical meaning is explicit and context is used to determine whether a term is used in this particular technical sense or not. Wherever applicable, only the technical meaning is coded as a technical term. However, when no contextual indication is provided, all occurrences of the term are coded as technical.

6. Derivations of specific technical terms within the same word class, such as from *Elektronentransport [electron transport],* which occurs in the dictionary, to *Elektronentransporter [electron transporters],* which does not occur in the dictionary, are also counted as technical terms.

7. Other terms considered technical by the researcher herself that are not included in the dictionary (e.g. *CO_2, giant redwoods, Ebola*) are providently collected in an additional category.

8. Technical terms that are expressed using translanguaging, that is either a technical term in another language, or an invented/newly coined/unknown word in the language of

instruction (English or Standard German), are not coded as technical terms.

The identification of technical terms in the present study is limited to nouns, compound nouns and the occasional noun phrase. I am fully aware that technical vocabulary also includes technical verbs and adjectives, as well as noun phrases with various pre- and post-modifiers. However, due to the limited scope of this project, the focus here lies on technical terms in form of (compound) nouns and limited noun phrases only. Expanding the analysis towards more complex noun phrases, technical verbs and adjectives using this method might provide another research niche for future endeavors and will be subject to discussion in the conclusion (Section 11.2).

The above-mentioned steps of identification were tested in various self-coding cycles. The steps for identifying technical terms are considered straight-forward and unambiguous, therefore no intercoder agreement was sought. The identification of technical terms allows me to calculate the technical density and relative frequency of technical terms across the EG_BIO corpus. Even though similar, technical density and relative frequency of technical terms refer to different things in this study: Since some technical terms consist of more than one word (e.g. *electron transport chain),* **technical density (td)** is the ratio of the total number of words coded as technical terms to the total number of words occurring in the EG_BIO corpus. That is, technical density calculates the percentage of words belonging to technical vocabulary in reference to the total vocabulary:

$$td = \frac{\text{total nr. of words coded as technical terms}}{\text{total nr. of words}}$$

Relative frequency (rf) of technical terms, on the other hand, refers to the ratio of the number of technical terms (single word or multiword units) to the total number of words occurring in the EG_BIO corpus. Thus, relative frequency calculates how many technical terms occur relative to the overall word count:

$$rf = \frac{\text{total nr. of technical terms}}{\text{total nr. of words}}$$

To illustrate this difference, consider the following example:

(12) In *eukaryotes*, the *electron transport chain* takes place in the *mitochondrion*.

In example (12), there are three technical terms (marked in italics), one of which is a multiword unit (*electron transport chain*). The total word count is ten, of which due to the multiword unit, five belong to technical terms. Hence, the sentence in (12) has a td of 0.5 (5/10) and a rf of 0.3 (3/10). This means, every second word in that sentence (50%) belongs to a (part of a) technical term, and per 10 words there are three technical terms occurring. A text can have a high technical density in that many words out of the total word count belong to the technical vocabulary, but a relatively low frequency of technical terms if those technical terms are all multiword units. This is especially important regarding the structural differences between English and German: German is a more agglutinating language than English, therefore compound nouns are for instance spelled as one word, while in English compound nouns are often spelled in several words. Accordingly, technical terms that are compounds are counted as one word in German, whereas in English they are counted as two or more. For the subsequent quantitative analyses of technical terms (Section 9.3.1), the relative frequency is the standard value reported on. For the comparison of technical terms between CLIL and non-CLIL subcorpora (Section 9.3.1.1) as well as the comparison of technical terms in written teaching materials compared to the EG_BIO corpus (Section 9.3.1.4), the technical density as well as the relative frequency are calculated and reported on.

Two important steps for the quantitative analysis have already been explained so far: the identification process of technical terms as well as the calculation of td and rf. The third step consists of the categorization of the technical terms. In order to get a more detailed overview of the distribution of technical terms in the EG_BIO corpus, they are, once identified through the steps above, coded according to their POSITION in the dictionary and form of the technical term, that is its UNIT (single word or multi-word unit) and its NAME (acronym or other). These categories are presented and explained in more detail in the next section (9.2.2.2).

9.2.2.2 Coding Scheme for the Categorization of Technical Terms

As a result of the considerations described in the previous section, the following coding scheme for the analysis of technical terms emerged (Figure 24).

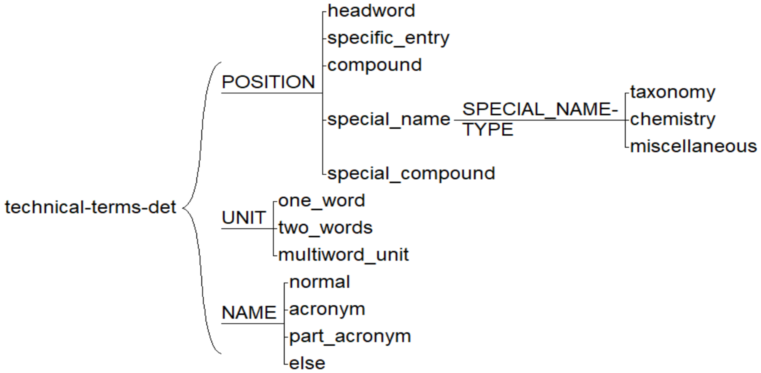

Figure 24: Coding scheme for the analysis of technical terms (taken from UAM CorpusTool)

As can be seen in Figure 24, technical terms are coded according to three categories: POSITION in the dictionary, UNIT and NAME. Each category is explained and followed by the corresponding codebook with definitions, examples and comments.

9.2.2.2.1 Category 1: POSITION of technical terms in the dictionary

Category 1 refers to the position of a term in the dictionary (Cole, 2015). That is, a distinction is made into *headwords*, *specific entries, compounds, special names* and *special compounds.* This has primarily to do with the selection of the dictionary, where certain technical terms are organized in word clusters summarized by a headword: "words are grouped by headwords and topics according to a useful and efficient clustering concept employed in various American biology dictionaries" (Cole, 2015, p. xiv). Thus, the terms *hard water* or *meltwater* are clustered under the keyword *water,* while *maggot* and *tadpole* are under *larva types.* Headwords are often but not always less technical than specific entries, a distinction into headwords and specific entries might therefore give an insight into what the dictionary's editor and his colleagues considered important keywords for the field of biology in English and German. The category *compound* refers to technical terms that are identified according to step 4 (see Section 9.2.2.1), in that the compound noun itself does not have an entry in the dictionary, but each nominal component does. A further subcategory *special names* was added to account for technical terms not included in Cole's dictionary but considered technical by the author of this study[98] (step 7 in the identification list above). Lastly, as a result of the previous two categories *compound* and *special name,* the subcategory of *special*

[98] Having an MA in biology, this category is largely based on my own knowledge of biology. These are terms either too specific to be in Cole's dictionary (e.g. species' scientific names), or terms that belong to a related field and are thus not included in the dictionary (e.g. electrons). It is a subjective and bottom-up category that is further discussed in Section 9.3.2.

compound was added to account for compound nouns where one component exists in the dictionary and the other component is a technical term categorized as *special name.* The codebook used for the various subcategories is presented in Table 32 below.

Table 32: Codebook for category 1—POSITION of technical terms in the dictionary

POS_headword		
Definition	**Example**	**Comments**
Refers to headwords of a word cluster in Cole's (2015) dictionary. Headwords usually represent an overarching term of the more specific technical terms that follow the entry.	*Nutrients, plants, root, water* *Nährstoffe, Pflanzen, Wurzel, Wasser*	If a technical term has multiple entries, e.g. a specific entry but also as a headword (such as *blood cell*), it is coded as a headword.
POS_specific entry		
Definition	**Example**	**Comments**
Refers to all technical terms in Cole's (2015) dictionary that are not headwords.	*Taproot, annual plant, cross section, vascular cylinder* *Pfahlwurzel, Einjährige, Querschnitt, Leitbündel*	If a technical term has multiple entries, e.g. a specific entry but also as a headword (such as *blood cell*), it is coded as a headword.
POS_compound		
Definition	**Example**	**Comments**
Refers to compound nouns which as such do not have an entry in Cole's (2015) dictionary, but each of its nominal components does.	*epidermis layer* *Muskelzellen*	*Epidermis + layer* *Muskel + Zelle*

POS_special name		
Definition		
This category refers to technical terms that are not included in Cole's (2015) dictionary but are considered technical by the researcher.		
POS_special name_taxonomy		
Definition	**Example**	**Comments**
Cole (2015) has entries for "major higher taxa of plants, fungi, and animals" but not for genus and species' names. Thus, this category refers to proper or common names of species, classes, genera, families or phyla not included in the dictionary.	*Iris germanica, common garden cross spider, diplopoda* *Pestwurz, Schwarzkiefer*	Terms that are not common or proper nouns but otherwise related to taxonomy (e.g. *subphylum*) also belong in this category.
POS_special name_chemistry		
Definition	**Example**	**Comments**
Since a considerable part of the lessons deal with biochemistry, this category refers to the proper names of chemical compounds or chemical reactions that are too specific to appear in Cole's (2015) dictionary.	Chemical compounds: CO_2, O_2, H_2O, $NADH^+$ C^5-*Glukose* Chemical reactions: *Decarboxylation, Glykolyse* Other chemical terms: *protons, Atom, ph value*	Terms that are not proper names of chemical compounds or chemical reactions, but otherwise related to the field of chemistry (e.g. *protons*) also belong in this category.
POS_special name_miscellaneous		
Definition	**Example**	**Comments**
This category includes a mixture of technical terms not included in the dictionary that can neither be put in no other category.	*Hepatic artery* *Synthase, amylase* *Ebola* *Lipophore, cytoplast*	Names for specific anatomical features, proper names of enzymes or diseases as well as

POS_special compound		
Definition	**Example**	**Comments**
This category refers to compound nouns where one component has an entry in the dictionary (as either headword or specific entry) and the other is categorized as POS_special name.	*Pyruvate decarboxylation, hydrogen ions, carbon atoms* *CO_2-Austausch, Natriumhydroxid, Nieswurzblatt*	Only works for compound nouns and not noun phrases, i.e. *cervical artery* = coded as POS_special name_miscellaneous and not as POS_special compound.

9.2.2.2.2 Category 2: UNIT of technical terms

This is a rather straight-forward category referring to the structural composition of technical terms, i.e. whether they consist of single words or multi-word units. Due to the different structural and morphological properties of English and German, English has more technical terms separated into several words, and German uses more singular words as technical terms. This category was added to get a more precise overview of how exactly this is distributed in the EG_BIO corpus (see Table 33).

Table 33: Codebook for category 2—UNIT of technical terms

UNIT_one word		
Definition	**Example**	**Comments**
The technical term consists of one word only.	*Roots, mesophyll* *ATP-Synthese* *CO_2, N*	Hyphenated words also belong in this category. Acronyms are also counted as one word, even if they only consist of one letter (e.g. *N* for nitrogen)
UNIT_two words		
Definition	**Example**	**Comments**
The technical term in question consists of two words.	*vascular bundle, oxygen demand* *alkoholische Gärung medulla oblongata*	
UNIT_multi-word unit		
Definition	**Example**	**Comments**
The technical term in question is a multiword unit, meaning it consists of three or more words.	*red blood cells, electron transport chain*	

9.2.2.2.3 Category 3: NAME of technical terms

Because some of the lessons deal with biochemistry, technical terms using acronyms are very common, such as *DNA* for deoxyribonucleic acid or *ATP* for adenosine triphosphate. These can also occur in compound nouns such as *NADH transporter.* There are four subcategories: *full term, acronym, part acronym* and *else,* the detailed definitions of which can be found in Table 34.

Table 34: Codebook for category 3—NAME of technical terms

NAME_full term		
Definition	**Example**	**Comments**
All technical terms that are fully spelled out and do not contain any acronym or other abbreviations.	*carbon atoms, dissimilation, photosynthesis* *Kohlenstoffatome, Dissimilation, Fotosynthese*	
NAME_acronym		
Definition	**Example**	**Comments**
The technical term in question is an acronym. An acronym is defined as an abbreviation or word made up of the initial letters of other words or names and expressions. For instance, *ADP* is an acronym for *adenosindiphosphate.*	*ADP, ATP, NAD, NADPH,* CO_2*, UV*	
NAME_part acronym		
Definition	**Example**	**Comments**
This refers to technical terms which are compound nouns, and one part is comprised of an acronym.	*ATP-Synthese,* CO_2 *molecules*	Only applicable for compound nouns.
NAME_else		
Definition	**Example**	**Comments**
Any technical term that uses some sort of abbreviation or specific label, but is not an acronym.	*Coenzym A,* *Chlorophyll B,* *beta subunit*	

With exception of the additional categories POS_special name and POS_special compound, the categories of POSITION, UNIT and NAME all rely on formal features that do not require context or qualitative interpretation in order to be assigned. Consequently, no intercoder agreement was sought, and all technical terms were coded accordingly. With this type of identification and categorization, a more nuanced picture of technical terms in the EG_BIO corpus emerges. Many of the technical terms coded this way are, however, not new to the students because they already had several years of biology and most technical terms are already familiar. Therefore, because the current study is also interested in the construction of technicality, it is especially worthwhile to look at the introduction, that is, the unpacking of *new* technical terms. This is exactly the objective of the qualitative analysis of technicality: using Wignell et al.'s (1993) technicalizing process to examine how new technical terms are introduced in oral classroom discourse as well as the written teaching materials.

9.2.3 Qualitative Analysis: Introduction of New Technical Terms

Even though the lexical density of scientific discourse might be an obstacle for students and teachers alike, in the L1/ML as well as the TL (see e.g. Drumm, 2016; Langer & Neumann, 2012), many of the technical terms used in class are already known to the students and thus, even though being technical, they form part of the students' general vocabulary. This is particularly valid for the students in the present study: They have already completed compulsory school and have thus received a general education in biology. Consequently, they are already familiar with many technical terms. However, since the objective of any teaching is the learning of new content, it follows that there are new scientific concepts and new technical terms that need to be highlighted, defined and explained. That is, they need to be unpacked. Following Wignell et al.'s (1993) concept of technicality, terms become technical with a two-step process: first, giving the phenomenon a name and second, assigning it a field-specific meaning. It is the second step of the technicalizing process that is particularly interesting here. This second step of the technicalizing process—assigning a field-specific meaning to a name—often happens in two steps as well: first highlighting the term, and then linking it to its meaning. In written texts, teaching materials or textbooks for example, this highlighting of terms is frequently done through orthographic means, such as bold font or color (Wignell et al., 1993, pp. 146–147).

The teaching materials used by the two teachers in the current study also employ this method of marking new or important terms. In the textbook used by T2 for his CLIL classes (Kent, 2000), new or important technical terms are always marked in bold font. This signals to the students that these terms have special importance in this context, i.e. they are set up as technical terms. Further, different colors are used to label the different sections and their corresponding functions, e.g. the red box top-left gives an overview of the objectives, the yellow box adds some trivia information about the topic, and the blue box contains questions. In classroom discourse, all of this has to be done rhetorically by the teacher, from announcing the objectives of the lesson or topic at hand to marking certain words as technical. Whenever a term is highlighted, that is, set up as technical, it needs to be followed by a definition or explanation the first time it is used, so the term can be linked to a field-specific meaning. There are, according to Wignell et al. (1993, pp. 148–149), several grammatical resources used to assign a particular field-specific meaning to the term in question: through projecting and non-projecting naming processes (*we say, we call it, it is called/known as, the common name is* etc.) and through elaboration (i.e. defining, e.g. via an identifying relational clause such as *x is y, x means y* or through listing attributes)[99]. Projecting and non-projecting

[99] Wignell et al. (1993) also list *enhancement* as another grammatical resource to assign a field-specific meaning to a technical term, that is, defining a technical term according to "what caused it to be or happen" (1993, p. 149). In this analysis, however, it is only differentiated between naming processes

naming processes are often used to attach a technical name "to a phenomenon which usually has an existing vernacular name" (Wignell et al., 1993, p. 148), whereas elaboration serves "the translation of common-sense understandings into scientific ones" (Martin, 1993a, p. 172).

Current CLIL research is very much concerned with how Cognitive Discourse Functions (CDFs) such as definitions and elaborations work in specific disciplines (see e.g. Nashaat-Sobhy & Llinares, 2020 on definitions in history). While Wignell et al. (1993, p. 152) state that elaboration in particular is also a common form of defining terms and thus assigning them a particular field-specific meaning in classroom discourse, most of the work on technicality as developed in the SFL tradition focuses on written data (e.g. Halliday & Martin, 1993; Martin & Veel, 1998; Maxwell-Reid & Lau, 2016; Unsworth, 2001). The introduction and thus the initial construction of technicality in a new term is of utmost importance not only in disciplinary textbooks but also in the classroom. In oral classroom discourse, however, one cannot use orthographic means such as font or colors to simply highlight a term as important or technical. Instead, a teacher has to use other (linguistic) means to draw attention to a certain term or expression in oral classroom discourse.

Therefore, the aim of this qualitative analysis is to first compare how technical terms are introduced in the teaching materials compared to oral classroom discourse. Introduction of technical terms hereby refers to the second step of the technicalizing process proposed by Wignell et al. (1993)—setting a term up as technical by assigning it a field-specific meaning. Consequently, the focus lies on the comparison of this second technicalizing step in written teaching materials and oral classroom discourse, in a CLIL and non-CLIL context and between T1 and T2. It was decided to conduct the qualitative analysis only with the

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(which contain specific grammatical structures) and elaboration as an umbrella term which includes enhancement.

teaching materials and lessons from grade 10 (see Table 35) because out of all the recorded lessons for grade 11 (n=9), two contained exam preparations and four exam discussions, focusing on repetition of terms not their introduction. Therefore, in order to look specifically at how new technical terms are introduced, teaching materials from grade 10 and the corresponding lessons were selected for close-analysis. An overview of the selected teaching materials and lessons is provided in Table 35.

Table 35: Selected teaching materials and corresponding lessons for qualitative analysis

Class	**T**	**Teaching materials**	**WC**	**Corresponding lesson/s**
1a (non-CLIL)	T1	Die Gärung [fermentation]	515	1a_20150528
1e (CLIL)	T1	Fermentation solves the problem	537	1e_20150504
1f (non-CLIL)	T2	Fotosynthese [photosynthesis]	518	1f1_20150505 1f1_20150512 1f2_20150512
1b (CLIL)	T2	The root	639	1b_20150528

Key: T= teacher, WC= word count

Thus, in each of the selected teaching materials the highlighted terms are compiled and checked against whether they are also subject of discussion in the corresponding lessons. A compilation of the terms looked at in the written subsamples and the corresponding lessons is given in Tables 36 and 37. Particularly interesting to compare are T1's classes (non-CLIL 1a and CLIL 1e) because they deal with the same topic (fermentation) in the lessons. In addition to this, because T1 compiles the scripts himself, his classes 1a (non-CLIL) and 1e (CLIL) also have similar teaching materials. The terms highlighted in the teaching materials are listed in Table 36. The analysis will first describe how these are introduced in the script, and then examine how T1 deals with these terms in the classroom. This allows for a direct comparison of the introduction of the same technical terms in a CLIL and non-CLIL context in written teaching materials as well as oral classroom discourse.

Table 36: Technical terms highlighted in T1's self-compiled teaching materials[100]

Teaching materials 1a (non-CLIL)	Teaching materials 1e (CLIL)
Gärung	*Fermentation*
Alkoholische Gärung	*Alcoholic fermentation*
Milchsäuregärung	*Lactic acid fermentation*
Hefe	*Yeast*

To complement the qualitative analysis of how new technical terms are introduced in written teaching materials compared to oral classroom discourse, Table 37 shows the technical terms dealt with in the subsample of T2's teaching materials. In T2's case, a direct comparison between his non-CLIL and CLIL class is not possible, since he neither teaches the same content nor uses similar teaching materials. T2 uses two textbooks as main teaching materials, Markl (2010) for his non-CLIL classes, and Kent (2000) for his CLIL classes. It will be particularly interesting to see if there are any similarities and differences in the introduction of technical terms between these two textbooks, as well as how this compares to T2's introduction of these terms in the classroom.

[100] Each text originally contains five highlighted terms, but *anaerobe Bedingungen* and *anaerobic conditions* are not mentioned in any of the recorded lessons, therefore it is not analyzed here.

Table 37: Technical terms highlighted in T2's teaching materials[101]

Teaching materials 1f (non-CLIL) Markl (2010)	**Teaching materials 1b (CLIL) Kent (2000)**
Fotosynthese [photosynthesis]	*Taproot system*
Chloroplasten [chloroplasts]	*Fibrous root system*
Calvinzyklus [Calvin cycle]	*Adventitious roots*

The qualitative approach on technicality thus closely examines the realization of the second step of the technicalizing process (which in itself involves two steps: 1= highlighting name; 2= linking name to field-specific meaning) of a total of 14 technical terms in written and spoken mode, in a CLIL and non-CLIL context, and between T1 and T2. After the explanation of the methodologies employed to investigate technicality quantitatively as well as qualitatively, the next section presents the results and discussions thereof.

9.3 Technicality: Results and Discussion

This section presents the quantitative overview of technical terms in the EG_BIO corpus (Section 9.3.1) as well as the results for the qualitative analysis (Section 9.3.3), each followed by a separate discussion section (Sections 9.3.2 and 9.3.4, respectively). In the first part, the quantitative overview of technical terms in the whole EG_BIO corpus is presented (Section 9.3.1), before reporting in detail the frequency of technical terms according to the variables of lesson type (Section 9.3.1.1), speaker (Section 9.3.1.2) and classroom register (Section 9.3.1.3). In addition to this, Section 9.3.1.4 compares the frequency of technical terms across modes (written vs. spoken). This is followed by a thorough discussion of the quantitative results and the methodology (Section 9.3.2). In the second part, the qualitative analysis of technical terms is

101 The selected text in Markl (2010, pp. 132–133) contains four highlighted terms, but *Fotolyse [photolysis]* is not discussed in any of the recorded lessons. The selected text in Kent (2000, p. 272) contains 11 highlighted terms, which are too many to analyze individually and qualitatively. Therefore, only the first three are selected for qualitative analysis.

presented (Section 9.3.3). More specifically, the introduction and thus the technicalizing processes of 14 technical terms is looked at in the written teaching materials as well as their introduction in the classroom, first in T1's classes (Section 9.3.3.1), then in T2's classes (Section 9.3.3.2). This is followed by a detailed discussion of the results (Section 9.3.4) as well as its implications for teaching pedagogy and teaching materials.

9.3.1 Quantitative Overview

There are 10'793 instances of technical terms from one to four words each (11'738 words in total) in the EG_BIO corpus. These 11'758 words that make up the 10'793 technical terms correspond to 9.9% of the words in the EG_BIO corpus (n=119'337 words). In other words, the technical density[102] in the EG_BIO corpus is 9.9%, that is, out of 119'337 words almost every tenth word is (part of) a technical term. The relative frequency of technical terms[103] in the EG_BIO corpus is 9%, meaning there are, on average, nine instances of technical terms per 100 words. This is similar to the percentage of medical jargon reported in Locher (2017, p. 93), with 11% of the vocabulary accounted for in the Nottingham and expert corpora and 15% for the Basel corpus. It is, however, considerably less than the percentage of technical vocabulary reported in other studies. For instance, Chung and Nation (2003) identify 31.2% of an anatomy text and 20.6% of an applied linguistics text as technical words. Ha and Hyland (2017) also report that 24% of their financial text consists of technical terms identified through the TAM model. The lower technical density and relative frequency is, however, readily explainable: For one, the EG_BIO

[102] Technical density refers to the number of words coded as (part of) technical terms (here n=11'758) divided by the total number of words in the EG_BIO corpus (n=119'337).
[103] The relative frequency of technical terms refers to the instances of technical terms (here n=10'793) divided by the total number of words in the EG_BIO corpus (n=119'337).

corpus consists of transcribed oral data, and spoken interaction has generally a lower lexical density than written texts. Further, the current study only considers (compound) nouns or limited noun phrases as technical terms, whereas Chung and Nation (2003) as well as Ha and Hyland (2017) included word classes other than nouns as technical vocabulary. There are, to my knowledge, no studies to date that have quantitatively investigated the density and frequency of technical vocabulary in classrooms or oral interaction in general. Therefore, the technical density and relative frequency may serve as a first reference value in this respect.

Another way to look at the distribution of technical terms in the EG_BIO corpus consist of looking not at the general density or relative frequency of technical terms, but at the different types of technical terms. Overall, there are 1700 types[104] of technical terms, that is, the 10'793 instances of technical terms correspond to a total of 1700 different technical terms, which equals on average 6.3 token[105] per type.

With regard to the individual categories, POSITION of technical terms within Cole's dictionary reveals, as can be seen in Figure 25, that roughly half of all instances of technical terms are specific entries (49%, n=5284), followed by headwords (36.4%, n=3929), special names (7.5%, n=807), compounds (5.4%, n=585) and special compounds (1.7%, n=188). It follows that a majority, namely 85.4% (n=9213) of instances are found in the dictionary as such, either as headwords or specific entries. 5.4% (n=585) are formed through compounding of two existing entries, and 9.2% of technical terms fall

[104] Type refers to the grouping of terms occurring in singular and plural, in different case forms (e.g. genitive), as well as misspelled versions of technical terms as the same type of technical term. For instance, *Baum, Baumes, Bäume, Bäumen* all belong to the same type of technical term, in this case *Baum [tree].* A complete list of all types of technical terms in the EG_BIO corpus is available on request.

[105] Token and instances are used interchangeably in the present study.

into the additional categories of POS_special name and POS_special compound.

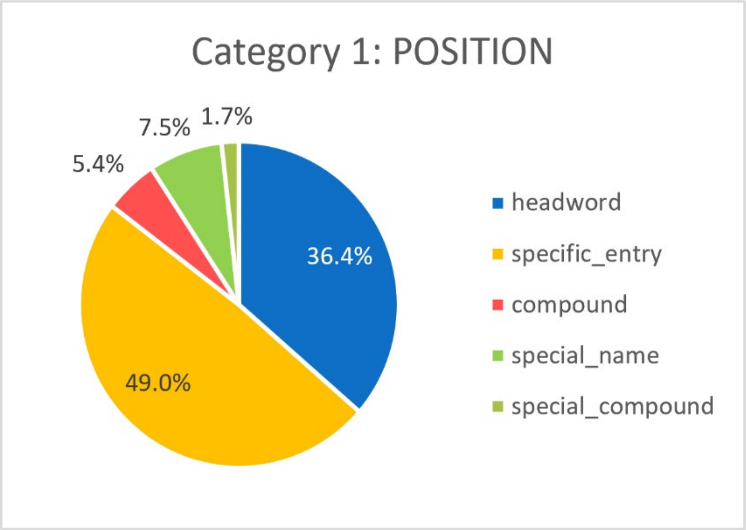

Figure 25: Technical terms in the EG_BIO corpus according to position

Another way to look at these numbers is focusing on the types of technical terms occurring in these categories. Assuming that headwords have a lower type-token ratio[106] compared to specific entries, since they often (but not always) seem to have a more general meaning and thus might be used more often and more generally, the results show that this is indeed true. Headwords have 357 types for 3929 tokens, which accounts for a type-token ratio of 9%, or 11 tokens per type on average. Specific entries contain more types, namely 845 for 5284 tokens, which results in a higher type-token ratio of 16%, or 6.3 tokens per type on average. Thus, headwords have fewer types of technical terms that have

[106] Type-token ratio is calculated by dividing the number of types of technical terms by the total number of tokens/instances of technical terms. The higher the type-token ratio, the more tokens occur per type, i.e. less variation.

on average more instances compared to specific entries. This seems to support the assumption that headwords are more general or at least more often used per type. However, one also has to be careful with the very notion of headwords, as discussed more thoroughly in the conclusion (Section 11.2).

The most frequent headword in the EG_BIO corpus with 198 instances is *Wasser* [water]; the most common specific entry, also with 198 instances, is *Energie* [energy]. The 858 instances of compound nouns correspond to 252 types; thus, compounds have many different types of technical terms with few tokens only (2.3 tokens per type), the most frequent of which is *oxygen concentration* with 24 tokens. Of the 807 tokens of special names the most frequent technical term is *CO_2*, and with 204 instances it is not only the most frequent one in the category special names, but also of the whole EG_BIO corpus. This has to do with the fact that *CO_2* is often used in both, CLIL and non-CLIL lessons, while other terms are language-specific and thus only occur in one of the subcorpora (e.g. the 198 tokens of *Energie* only occur in the non-CLIL subcorpus). Because of the prevalence of *CO_2*, the type-token ratio of special names more or less comparable to the one of specific entries (165 types per 807 tokens; 4.9 token per type). The 188 special compounds then correspond to 81 types, the most common of which is *palm tree/s* (n=38), almost all of which can be traced back to one single lesson (CLIL_1b_20150518).

A closer look at the subcategories of POS_special name in Table 38 reveals that most of these (71.4%, n=576) belong to the realm of chemistry, either denoting chemical compounds (such as *CO_2*) or chemical reactions (e.g. *decarboxylation*). This makes sense as many lessons actually deal with biochemistry. Taxonomical terms make up 20.1% (n=162) of all special names, although taxonomical is understood broadly here, reaching from simple com-

Table 38: Overview of special names

SPECIAL_NAME-TYPE	N=807	
- taxonomy	162	20.07%
- chemistry	576	71.38%
- miscellaneous	69	8.55%

mon names for plants (e.g. *palms*) to proper taxonomical names such as *Philates zschokkei*. The rest (8.6%, n=69) are miscellaneous terms, and as the name of the category implies, it is a mixture of technical terms from different fields within biology that are too specific to be in the dictionary and can neither be grouped with chemistry nor taxonomy in any way, e.g. particular names of blood groups (*A* or *B*), denoting specific anatomical parts (*mesenteric artery*), or terms like *UV* (*Ultraviolettes Licht* [ultraviolet light]). The complete list of types of technical terms and their categorization according to POSITION is available from the author upon request.

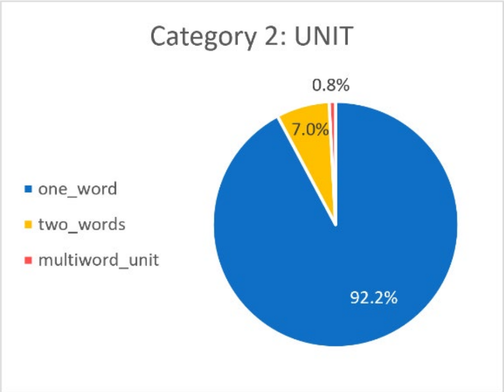

Figure 26: Technical terms in the EG_BIO corpus according to unit

In Figures 26 and 27, the overview of instances technical terms in the EG_BIO corpus according to the categories 2 and 3 of the codebook is presented. With regard to the UNIT of technical terms, one can see in Figure 26 that the overwhelming majority of technical terms consists of one word (92.2%, n=9949), followed by two words (7%, n=753). Only 91 instances are multiword units (0.8%). The most frequent types of one-worded technical terms correspond to what was mentioned previously, namely *CO_2* (n=204), followed by *Wasser* (n=198) and *Energie/n* (n=198). Two-worded units account for 7% of the technical terms in the EG_BIO corpus, the most frequent of which is the previously mentioned special compound *palm tree/s* (n=38). Of the 91 instances of technical terms comprised of more than two words, the most frequent one is the *electron transport chain* with 24 instances.

Looking at the NAME of technical terms in the EG_BIO corpus, Figure 27 reveals that the majority of technical terms (93%, n=10’031) is fully spelled out, the most frequent types are *Wasser* and *Energie/n* with 198 tokens each. 5.4% (n=587) that are acronyms, 1% (n=108) that are partial acronyms and 0.6% (n=62) in the category “else”.

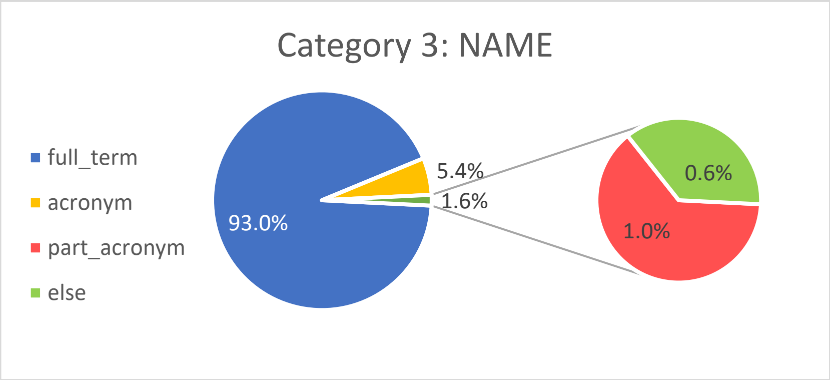

Figure 27: Technical terms in the EG_BIO corpus according to name

In fact, of all the instances of technical terms coded as acronyms in the EG_BIO corpus (n=587, see Table 39), 19 instances are headwords (*DNA, RNA*), 204 are instances of specific entries of which only five do not denote a chemical element or compound: *BOD* for *biological oxygen demand* (four instances) and *BSE* for *Bovine spongiform encephalopathy* (one instance).

The other 199 instances all denote major chemical compounds important for biological processes (*ATP, ADP, NADP, NADH, NADPH, NAD, FAD,*

Table 39: Overview of technical terms in form of acronyms according to category 1: POSITION

Feature	N	Percent
Total Units	587	
POSITION	N=587	
- headword	19	3.24%
- specific_entry	204	34.75%
- compound	0	0.00%
- special_name	364	62.01%
- special_compound	0	0.00%
SPECIAL_NAME-TYPE	N=364	
- taxonomy	0	0.00%
- chemistry	358	98.35%
- miscellaneous	6	1.65%

$FADH_2$, O, N, P). Lastly, the majority of acronyms are special names in the field of chemistry, thus proper names of chemical compounds or chemical reactions that are too specific to appear in Cole's (2015) dictionary. Of 364 instances, 358 (98.4%) belong to the field of chemistry. With 204 instances, CO_2 is the most frequent, followed by O_2 (n=43), *pH* (n=23) and H_2O (n=21). The six instances which are not chemical but "miscellaneous" refer to *UV* (*Ultraviolettes Licht* [ultraviolet light]), pO_2 (partial pressure of oxygen) and *Hb* (hemoglobin).

To summarize the main findings of the general quantitative overview with regard to technical terms: There are a total of 10'793 instances of technical terms (11'758 words) in the EG_BIO corpus, which results in a technical density of 9.9% and a relative frequency of 9%. The most frequent technical term is CO_2. Specific entries take up the most part of technical terms, followed by headwords, special names, compounds and special compounds. The overwhelming majority of instances is spelled normally and consists of one word. In the following, the technical density, relative frequency and distribution of technical terms according to the variable of lesson type is presented.

9.3.1.1 Technical Terms According to Lesson Type

This category is described by three parameters: type of instruction (CLIL vs. non-CLIL), teacher (T1 vs. T2) and grade (10 vs. 11). For type of instruction, it seems worthwhile to look at technical density as well as the relative frequency for each lesson (Figure 28).

In Figure 28, there are several interesting aspects to observe. First, the technical density and relative frequency of technical terms are basically the same in all non-CLIL lessons (the lines overlap, thus one mostly sees blue there in Figure 28), while they differ from each other in the CLIL lessons. As mentioned in the methodology section (9.2.2.1), this is due to the structural differences between English and German. In the non-CLIL classes, all but 17 instances are single-word units, thus technical density and relative frequency are basically the same in non-CLIL lessons. In English, many compound words are spelled as several words, consequently technical density and relative frequency differ. This becomes important when comparing the two subcorpora to each other in that they can be compared regarding the instances of technical terms as well as the number of words coded as (parts of) technical terms.

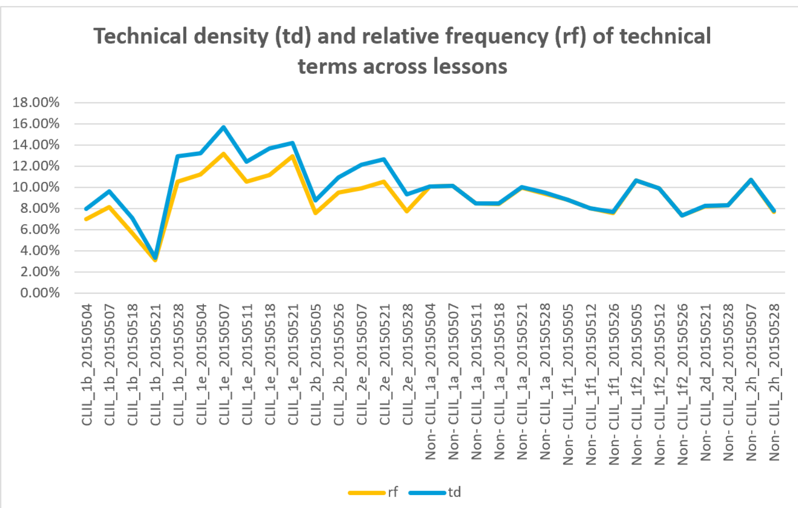

Figure 28: Technical density (td) and relative frequency (rf) of technical terms across the lessons in the EG_BIO corpus. Both lines overlap in the non-CLIL lessons, therefore only one line is seen.

What can also be seen in Figure 28 is that the range of technical density and relative frequency in the CLIL lessons is higher compared to non-

CLIL lessons. Technical density ranges from as low as 3.3% (rf=3.1%; CLIL_1b_20150521) to as high as 15.7% (rf=13.1%; CLIL_1e_20150507). This can be explained by looking at the nature of the lessons themselves: Lesson CLIL_1b_20150521 is a lab class about roots with many hands-on tasks, and contains the least amount of teacher-led whole class interaction out of all lessons (only 962 words). Because it is a lab class, the majority of teacher-led whole class interaction, namely 73.8%, belong to the regulative register, which contains less technical terms (see Section 9.3.1.3 for the analysis of technical terms according to classroom register). On the other end of the spectrum is lesson CLIL_1e_20150507 with the highest technical density (15.7%) and also the highest relative frequency (13.1%). This lesson is focused on the discussion of metabolism, has no hands-on tasks, and includes much frontal teaching. Consequently, in contrast to the previously described lesson, 86.7% of CLIL_1e_20150507 belong to the instructional register (focus on content-teaching) and only 13.3% to the regulative register. Thus, the distribution of classroom register in the individual lessons seems a strong indicator for technical density and relative frequency of technical terms (see Section 9.3.1.3 for the analysis of technical terms according to classroom register). Thus, Figure 28 already reveals some of the differences between the CLIL and non-CLIL subcorpora with regard to technical density and relative frequency.

To be more precise, for type of instruction, CLIL lessons contain altogether 4802 instances of technical terms, which correspond to a relative frequency of 9.2%, while the non-CLIL lessons incorporate 5991 instances of technical terms (rf=8.8%). This means that relatively speaking, the CLIL subcorpus contains slightly more instances of technical terms than the non-CLIL subcorpus. Looking at technical density, the difference becomes naturally greater since English contains more technical terms comprised of several words compared to German. Therefore, the CLIL subcorpus is considerably denser (td=11.1%) than the non-CLIL subcorpus (td=8.9%), meaning 11.1% of the CLIL subcorpus belongs to technical vocabulary, while in the non-CLIL subcorpus it is only 8.9% of words. However, looking at type-token ratio in each subcorpus, the 4802 occurrences of technical terms correspond to 753 different technical terms in the CLIL lessons and the 5991 instances of technical terms to 947 types of technical terms in the non-CLIL lessons. The type-token ratio is thus very similar in both subcorpora (CLIL: 15.7%; non-CLIL: 15.8%), meaning that CLIL and non-CLIL lesson have nearly the same amount of variation of technical vocabulary. The top five most frequent types of technical terms for both subcorpora are presented in Table 40[107].

Table 40: The five most frequent types of technical terms in each subcorpus

	CLIL		**Non-CLIL**	
Nr.	**Technical term (type)**	**Token**	**Technical term (type)**	**Token**
1	Oxygen/s	175	Energie/n	198
2	Cell/s	126	Wasser	198
3	Process/es	116	Sauerstoff/s	185
4	Root/s	112	Blatt/es – Blätter/n	145
5	blood	104	Pflanze/n	138

In the CLIL subcorpus, the term *oxygen* is by far the most frequent term with 175 tokens, followed *by cell, process, root* and *blood*. In the non-CLIL subcorpus, the most frequent terms are *Energie/n* [energy] and *Wasser* [water] with a 198 tokens each, followed by *Sauerstoff* [oxygen], *Blatt* [leaf] and *Pflanze* [plant]. *Oxygen*, *process, Sauerstoff,* and *Energie/n* are specific entries in Cole's dictionary, while the other terms represent headwords. *Cell* for instance subsumes 17 different types of cells in its entry, *root* 36 different types of roots and *blood* four different types of blood. With regard to the non-CLIL subcorpus, *Wasser* subsumes 38 specific entries, *Blatt* has 57 subordinated terms (types of leaves), and *Pflanze* has 95 entries for different types of plants. Thus, a majority of these top five most frequent terms are headwords,

[107] Even though *CO_2* with 204 instances is the most frequent term in the EG_BIO corpus, its distribution over the two subcorpora (CLIL: n=90 non-CLIL: n=114) do not make it part of the top five of each subcorpus.

and the amount of subordinated terms suggests they are very important terms within biology.

An overview of the individual categories and how these technical terms are distributed in the CLIL and non-CLIL subcorpora can be found in Table 41.

Table 41: Distribution of technical terms in the CLIL and non-CLIL subcorpora

	clil		non-clil	
Feature	N	Percent	N	Percent
Total Units	4802		5991	
POSITION	N=4802		N=5991	
- headword	1865	38.84%	2064	34.45%
- specific_entry	2141	44.59%	3143	52.46%
- compound	211	4.39%	374	6.24%
- special_name	456	9.50%	351	5.86%
- special_compound	129	2.69%	59	0.98%
SPECIAL_NAME-TYPE	N=456		N=351	
- taxonomy	110	24.12%	52	14.81%
- chemistry	292	64.04%	284	80.91%
- miscellaneous	54	11.84%	15	4.27%
UNIT	N=4802		N=5991	
- one_word	3975	82.78%	5974	99.72%
- two_words	737	15.35%	16	0.27%
- multiword_unit	90	1.87%	1	0.02%
NAME	N=4802		N=5991	
- full_term	4477	93.23%	5559	92.79%
- acronym	215	4.48%	372	6.21%
- part_acronym	59	1.23%	49	0.82%
- else	51	1.06%	11	0.18%

According to the first category POSITION, the distribution is similar between the subcorpora, in that there are more specific entries than headwords in CLIL and non-CLIL lessons, followed by special names, compounds, and special compounds. They differ most in regards to POSITION in the subcategory of special names. CLIL has, relatively speaking, more special names than non-CLIL lessons, which is mainly due to the higher amount of taxonomical and miscellaneous terms in CLIL than in non-CLIL lessons (see Table 41). This again can be explained by the topics covered in CLIL compared to non-CLIL lessons: While T1 teaches biochemistry in both, his CLIL and non-CLIL lessons, all of T2's CLIL lessons deal with some sort of plant and animal species, whereas his non-CLIL lessons are more diverse (see Section 6.2.1 for the overview).

Going back to the main categories of technical terms, CLIL and non-CLIL lessons differ most in the category of UNIT. Apart from 17 instances (0.3%), German has only one-worded technical terms, whereas English has a total of 794 technical terms (16.7%) which consist of two words or more. This was expected due to the structural differences between the two languages in question—German being a more agglutinating language compared to English allowing for longer word compounds compared with English—consequently, many terms that are spelled as two words or more in English are spelled as one in German. For instance, many of the two-worded technical terms (n=704) in the CLIL-subcorpus are categorized as headwords, such as *blood cells [Blutzellen]*, specific entries such as *annual rings [Jahresringe]*, compounds *phosphate group [Phosphatgruppe]*, special names *water lily [Seerose]* or special compounds *O_2 molecule [O_2-Molekül]*). Even for the multiword units such as *lactic acid fermentation [Milchsäuregärung]* or *electron transport chain [Elektronentransportkette]* German only uses one word. Consequently, the 16 instances of technical terms in German which consist of two words have, in all but four cases, an adjective as a pre-modifier (*alkoholische Gärung* [alcoholic fermentation], *osmotischer Druck* [osmotic pressure], *botanischer Garten* [botanical garden], *Malpighische Gefässe* [Malpighian tubules], *aufrechter Gang* [upright gait] and *morphologische Art* [morphospecies], *indische Elefanten* [Indian Elephant]). The four exceptions are for one *medulla oblongata,* the Latin term for *Hirnstamm* [brainstem] and the three special compounds: *Coenzym A, Chlorophyll A* and *Chlorophyll B.* The one instance of a multiword unit in German is a specific entry *Drei Strich-*

fünf Strich[108]. Thus, all two- and multi-worded technical terms in the non-CLIL lessons have either an adjective as a pre-modifier, come from Latin, or are proper names.

Looking at the last category NAME, Table 41 shows that the distribution is similar in both subcorpora, with an overwhelming majority of 93.2% (n=4477) of technical terms in CLIL and 92.8% (n=5559) in non-CLIL lessons fully spelled out, followed by acronyms (CLIL: 4.5%, n=215; non-CLIL: 6.2%, n=372), partial acronyms (CLIL: 1.2%, n=59; non-CLIL: 0.8%, n=49) and "else" (CLIL: 1.1%, n=51; non-CLIL: 0.2%, n=11). The higher number of technical terms in the subcategory "else" in CLIL lessons compared to non-CLIL lessons can be traced back to one single lesson, CLIL_2e_20150507, where the class is having an exam discussion, among other things about different blood groups. All but six of the 51 instances of technical terms in "else" relate to that lesson, such as *blood type A*, *B antigen* or simply *B* or *Zero* as names for these blood groups, as shown in extract 9.1.

Extract 9.1: CLIL_2e_20150507[109]

```
01   T1:  The father can either have B or Zero.
```

The higher number of instances category "else" in the CLIL subcorpus is thus solely due to that lesson.

Moving on to the main differences in density and distribution of technical terms according to the second subset of lesson type, namely lessons taught by T1 vs. T2. Table 42 shows an overview of the technical terms according to this subset. Considering the relative frequency of technical terms, T1's lessons have, on average, a higher use of technical terms (rf=9.7%) compared to T2's lessons (rf=8.4%),

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[108] *Drei Strich-fünf Strich [three prime five prime]* is a technical term to describe the direction in which DNA is synthesized.

[109] In this and all subsequent extracts of Chapter 9, technical terms are marked in italics.

and they do so to a greater extent in CLIL (T1: rf=10.6%; T2: rf=8.0%) than in the non-CLIL lessons (T1: rf=9.0%; T2: rf=8.7%). This means the overall difference between T1 and T2's lessons stems mainly from the different frequencies of technical terms in their CLIL and non-CLIL lessons.

A contributing factor might also be the fact that the two outliers regarding minimum and maximum td and rf shown in Figure 28 belong to different teachers. That is, the lesson with the highest technical density and relative frequency (CLIL_1e_20150507, td=15.7%, rf=13.1%) is taught by T1, and the lesson with the lowest (CLIL_1b_20150521, td=3.3%, rf=3.1%) is taught by T2. Taking out these two outliers though reduces the difference between T1 and T2's lessons (T1: rf=9.1%; T2: rf=8.4%), but a difference persists nevertheless. The outlier lessons can, therefore, not solely explain the difference in relative frequency of technical terms in T1 and T2's lessons. Another explanation might be the distribution of technical terms according to POSITION, more specifically the fact that T1's classes use almost double the amount of technical terms categorized as special names (see Table 42).

Table 42: Overview of technical terms according to classes taught by T1 vs. T2

	t1		t2	
Feature	N	Percent	N	Percent
Total Units	5531		5262	
POSITION	N=5531		N=5262	
- headword	1772	32.04%	2157	40.99%
- specific_entry	2789	50.42%	2495	47.42%
- compound	303	5.48%	282	5.36%
- special_name	549	9.93%	258	4.90%
- special_compound	118	2.13%	70	1.33%
SPECIAL_NAME-TYPE	N=549		N=258	
- taxonomy	25	4.55%	137	53.10%
- chemistry	465	84.70%	111	43.02%
- miscellaneous	59	10.75%	10	3.88%
UNIT	N=5531		N=5262	
- one_word	5063	91.54%	4886	92.85%
- two_words	395	7.14%	358	6.80%
- multiword_unit	73	1.32%	18	0.34%
NAME	N=5531		N=5262	
- full_term	4920	88.95%	5116	97.23%
- acronym	450	8.14%	137	2.60%
- part_acronym	102	1.84%	6	0.11%
- else	59	1.07%	3	0.06%

A closer examination of the y of POS_special name subcategories reveals notable differences in the distribution of special names across fields: On the one hand, 84.7% (n=465) of T1's special names relate to the field of chemistry, while in T2's classes it only takes up 43% (n=111). On the other hand, T2's classes contain more technical terms that are special names related to the field of taxonomy (T2: n=137; T1: n=25). This is a reflection of the topics the teachers were teaching in class: T1, in all of his classes, taught topics related to biochemistry (cellular respiration and fermentation in his grade 10 classes, hemoglobin and oxygen transport in his grade 11 classes), while T2 covered more diverse topics ranging from plant anatomy and physiology to hearts of vertebrates, the phylum of arthropods and the measuring of blood pressure. Logically, T1's lessons have more instances of technical terms connected to chemistry and T2's lessons more of those connected to taxonomy.

Related to this is the observation that T1's lessons contain considerably more instances of technical terms that are not spelled normally (11%, n=611) compared to T2's lessons (2.8%, n=146). This further reflects the topical focus on biochemistry in T1's lessons, since most names for chemical compounds come in form of acronyms (e.g. O_2), and of all the acronyms in the EG_BIO corpus most are in fact related to the field of chemistry (even if they are not coded as POS_special names_chemistry, see previous Section 9.3.1 on acronyms). The higher number of partial acronyms in T1's lessons is a direct consequence of the high number acronyms, since partial acronyms are compounds of acronyms. T1 talks more about biochemistry in his lessons, therefore his lessons contain more technical terms in form of acronyms and consequently also more compounds in form of partial acronyms (e.g. O_2 *molecule*). Ultimately, T1's focus on biochemistry is the main reasons why his lessons contain more technical terms than T2's lessons.

Moving on to the last subset of the lesson type variable, which is grade. The lessons in grade 10 (n=22) have a total of 7213 instances of technical terms, which results in a relative frequency of 9.1%, whereas the lessons in grade 11 (n=9) have 3580 instances (rf=8.9%). Thus, the lessons in grade 10 contain slightly more instances of technical terms compared to grade 11, but the difference is minimal. This holds true for CLIL and non-CLIL lessons, i.e. grade 10 has overall more technical terms than grade 11 in both CLIL (10: rf=9.5%; 11: rf=9.1%) and non-CLIL lessons (10: rf=8.9%; 11: rf=8.7%). These relative frequencies reinforce again what has been illustrated above, namely that CLIL lessons have overall more technical terms in both, grades 10 and 11, compared to the non-CLIL lessons. The distribution of technical terms according to POSITION, UNIT and NAME does not differ greatly between grades, which is why the corresponding table is not shown here but in App. VI.

Table 43 summarizes the results of technical terms lesson type and shows the overview of relative frequencies across the different subsets of the lesson type variable.

Table 43: Relative frequency across subsets of lesson type variable

Subset 1: Type of instruction	CLIL: rf=9.2%	Non-CLIL: rf=8.8%
Subset 2: Teacher	T1: rf=9.7%	T2: rf=8.4%
Subset 3: Grade	10: rf=9.1%	11: rf=8.9%

In short, the CLIL subcorpus contains more instances of technical terms than the non-CLIL subcorpus, T1's classes have considerably more technical terms than T2's classes and grade 10 is slightly more technical than grade 11. In all of these subsets, the amount of technical terms seems to be tied to the topic that is taught, with lessons relating to biochemistry being particularly dense in terms of technical vocabulary. The subsequent section then reports on the quantitative findings regarding technical terms according to the second variable, speaker.

9.3.1.2 Technical Terms According to Speaker

The previous section showed that T1's classes use more technical terms on average than T2's in the EG_BIO corpus, which, among other things, has to do with the topic that is taught in the lessons. In this section the objective is to first see whether teachers use more technical terms than their students and if so, to what extent. Second, it is to see whether or not there are any quantitative differences between T1 and T2's use of technical terms, as well as their students'.

Both teachers use a total 9090 technical terms, which corresponds to a relative frequency of 8.7%, while students use 1701 technical terms, and thus have a relative frequency of 11.4%[110]. Consequently, and contrary to expectations, students have a considerably higher frequency of technical terms compared to their teachers. One reason for this might be the type of teacher-led whole-class interaction teachers engage in with their students in class: Often, this is still done in the form of display questions (Long & Sato, 1983; Musumeci, 1996), that is questions to which the teacher already knows the answer to, with the sole purpose of displaying the students' knowledge to the teacher (as opposed to referential questions). Even though more recent research records a more balanced ratio of display and referential questions (e.g. Dalton-Puffer, 2007) or even preference for referential (e.g. Smit, 2012), display questions are still very much in use in classrooms today. Additionally, due to the institutionalized character of classroom discourse, interactions are often highly structured according to a three-turn structure called IRF (initiation, response, feedback), whereby the initiation move as well as the feedback move is usually owned by the teacher (see Sinclair & Coulthard, 1975). Scholars such as Long (1983), van Lier (2001) or Seedhouse (2004) have criticized this pattern of IRF sequences as limiting student participation to a minimum, "leaving little space for learners to develop their ideas or engage in extended forms of talks" (Nikula, 2007, p. 181). Thus, combining the prevalence of display questions with the preference for IRF structures, classroom interactions often look like this:

[110] Two technical terms are uttered by multiple students simultaneously in response to a display question from the teacher: *Chromosomen [chromosomes]* and *Quecksilber [mercury]*. That way the numbers of technical terms used by the teacher (n=9090), by students (n=1701) and by multiple students at once (n=2) add up to the total of 10'793 technical terms found in the EG_BIO corpus.

Extract 9.2: CLIL_1e_20150518

01	T1:	What's in the *milk*? Name it except for *water*
02	S:	Uhm *Lactose*
03	T1:	*Lactose*. And? You know *lactose* is only a *carbohydrate* only contains *carbon hydrogen* and *oxygen* that's not enough for growing a growing older *organism*. What does it need in addition?
04	S:	*Proteins*
05	T1:	*Proteins.*

In extract 9.2, the teacher is initiating the exchange by asking a display question, to name the components of milk. The student replies with "Lactose" in line 02, which the teacher evaluates as correct by repeating the word (line 03). After an explanation, he initiates another exchange asking for an additional component of milk, to which the student in line 04 correctly answers "proteins", which is, again, positively evaluated through repetition by the teacher in line 05. For this extract alone, the teacher uses nine technical terms (in italics) per 40 words, resulting in a relative frequency of 22.5%, while the student used two technical terms by uttering only three words (rf=66.7%). While this is an extreme example of how a teacher's display question in an IRF structure can limit a student's answer to only a few technical words, it should nevertheless illustrate why student talk in the EG_BIO corpus contains a considerably higher number of technical terms compared to teacher talk.

An interesting difference can be seen in teacher and students' use of technical terms in regards to type of instruction: While students use more technical terms than their teachers in both contexts, the difference is greater in non-CLIL lessons (T: rf=8.4%, S: rf=12.1%) than in CLIL lessons (T: rf=9.1%; S: rf= 10.5%). This might be an indication that the above-mentioned restrictions regarding display questions and the IRF structure are less applied in the CLIL lessons compared to the non-CLIL lessons.

Looking at potential differences between the two teachers, T1 one uses 4759 technical terms (rf=9.4%), while T2 uses 4331 (rf=8%). Thus, T1 uses overall more technical terms in his lessons than T2. As noted earlier, students in the EG_BIO corpus have a considerably higher frequency of technical terms compared to teachers, consequently the relative frequencies of technical terms for student talk in T1's and T2's classes should be higher as those for their teachers as well. This is indeed the case, with the students' relative frequency of technical terms exceeding their teachers' by more than 2.7% in both instances: 12.1% for T1's students and 10.8% for T2's students. The primary reason for the greater use of technical terms by both T1 and his students relates to the nature of the topics dealt with in class, as previously addressed in Section 9.3.1.1.

9.3.1.3 Technical Terms According to Classroom Register

The variable of classroom register is the one where the clearest differences were expected, in that the instructional register is supposed to have the highest frequency of technical terms since it is by definition focused on the instruction of content, followed by the regulative register_specific content and then the regulative register_general. The results (overview see Table 45) show that at least in absolute frequencies, the instructional register has the highest number of instances (n=9289), followed by the regulative register_specific content (n=1307), the regulative register_general (n=181) and lastly the register of social talk with a total of 14 instances[111]. Considering the relative

[111] There are also two instances of technical terms in the register "unclear", as both are embedded in stretches of either unintelligible talk ("(x) for *sponges* (xx)") or probable talk ("(how many are*) mammals*?") based on which the stretches could not be clearly assigned to a specific register. That way the numbers of technical terms used in the instructional (n=9289), regulative_specific content (n=1307), regulative_general (n=181), social talk

frequencies per register, this sequence holds true (with exception of social talk, see Table 44).

Table 44: Relative frequency of technical terms according to classroom register

Register	INSTR	REG_CONT	REG_GEN	SOCIAL
rf	10.6%	7%	1.5%	2.2%

Key: rf=relative frequency, INSTR=instructional register, REG_CONT=regulative register_specific content, REG_GEN=regulative register_general, SOCIAL=social talk

The instructional register has the highest relative frequency of technical terms (10.6%), followed by regulative register_specific content (7%) and regulative register with only 1.5%. These results confirm that both, the framework established to code classroom registers (see Section 7.2.3) as well as the framework established to identify technical terms (see Section 9.2.2.1) seem to work in a satisfactory manner, in that the instructional register is supposed to contain the most technical terms, and the regulative register_general only a few. There is no difference between CLIL and non-CLIL lessons regarding the amount of technical terms found in each register apart from social talk, which is a special case anyways. The results for the register of social talk should be treated with caution, because its overall word count very small (n=645, 1% of the EG_BIO corpus) and thus not as representative as other registers. This can be further illustrated by looking more closely at the 14 instances of technical terms within social talk: They all stem from two scenes within the same lesson (CLIL_1b_20150518), and both have to do with the teacher's anecdote of how he finally got his own palm tree. Consequently, the technical terms involved in these two scenes reflect that: *palm tree* (6x), *tree/s* (3x), *winter* (2x), *biologist* and *summer.* These, however, are the only technical terms used in all of social talk, therefore the relative frequency of 2.2% in Table 44 is not

(n=14) and unclear (n=2) add up to the total of 10'793 technical terms found in the EG_BIO corpus.

representative. The overview of technical terms across classroom registers can be seen in Table 45 below.

Table 45: Overview of technical terms in the EG_BIO corpus according to classroom register

	general		specific_cont		instructional		social_talk	
Feature	N	Percent	N	Percent	N	Percent	N	Percent
Total Units	181		1307		9289		14	
POSITION	N=181		N=1307		N=9289		N=14	
- headword	88	48.62%	413	31.60%	3422	36.84%	4	28.57%
- specific_entry	79	43.65%	675	51.64%	4526	48.72%	4	28.57%
- compound	10	5.52%	80	6.12%	495	5.33%	0	0.00%
- special_name	3	1.66%	103	7.88%	701	7.55%	0	0.00%
- special_compound	1	0.55%	36	2.75%	145	1.56%	6	42.86%
SPECIAL_NAME-TYPE	N=3		N=103		N=701		N=0	
- taxonomy	1	33.33%	14	13.59%	147	20.97%	0	0.00%
- chemistry	1	33.33%	82	79.61%	493	70.33%	0	0.00%
- miscellaneous	1	33.33%	7	6.80%	61	8.70%	0	0.00%
UNIT	N=181		N=1307		N=9289		N=14	
- one_word	174	96.13%	1192	91.20%	8573	92.29%	8	57.14%
- two_words	7	3.87%	103	7.88%	637	6.86%	6	42.86%
- multiword_unit	0	0.00%	12	0.92%	79	0.85%	0	0.00%
NAME	N=181		N=1307		N=9289		N=14	
- full_term	181	100.00%	1205	92.20%	8634	92.95%	14	100.00%
- acronym	0	0.00%	80	6.12%	507	5.46%	0	0.00%
- part_acronym	0	0.00%	20	1.53%	88	0.95%	0	0.00%
- else	0	0.00%	2	0.15%	60	0.65%	0	0.00%

An interesting aspect to observe in Table 45 concerns the distribution of headwords and specific entries in the different registers. While the instructional as well as the regulative register_specific content are with 31.6% and 36.8% headwords and 51.6% and 48.7% specific entries within the normal distributional range concerning these categories (cf. EG_BIO corpus: 36.4% headwords and 49% specific entries), the regulative register_general is the only subcategory so far containing more headwords than specific entries. Assuming that not always, but more often than not, headwords have a more general technical meaning than specific entries, it would make sense that there are fewer specific entries compared to headwords in the regulative register_general compared to the other registers.

Having shown the results for the relative frequency and technical density of technical terms according to the variables of lesson type, speaker and classroom register, the next subsection illustrates how this differs depending on mode.

9.3.1.4 Technical Terms According to Mode

The written subsample consists of a one-page-text from the teaching materials of each class (see Section 6.2.1 for the complete selection), which results in a corpus of written teaching materials of 4061 words. Of these, 1007 words are (part of) a technical term, which yields in a technical density of 24.8%. This is more than double the percentage in the EG_BIO corpus (td=9.9%, see Section 9.3.1). Thus, the teaching materials are definitely denser in technical terms compared to the oral lessons and is more in line with what other scholars have found to be the case in written texts as well: 31.2% and 20.6% (Chung & Nation, 2003) and 24% (Ha & Hyland, 2017). The 1007 words of technical vocabulary represent 855 technical terms, which results in a relative frequency of 21%. This is still more than double the relative frequency of the EG_BIO corpus (rf=9%). Thus, the written teaching materials all contain considerably more technical terms than the EG_BIO corpus. With regard to types of technical terms, there are 388 different types of the total of 855 technical terms in the written teaching materials, thus there are on average 2.2 tokens per type. This is considerably lower compared to the EG_BIO corpus, where the type-token ratio is 15.8%, which corresponds to 6.3 tokens per type. This means that the technical vocabulary in the written corpus contains, relatively speaking, more different types of technical terms compared to the EG_BIO corpus.

Another hypothesis assumed that there are differences in technical density/relative frequency of technical terms depending on the type of teaching materials, e.g. T1 using his own script in German and English, while T2 is using official textbooks in German (Markl, 2010) and English (Kent, 2000). The assumption was that the self-compiled script by T1 is less technical compared to the professional field-specific textbooks. Figure 29 shows the technical density and relative frequencies of the technical terms across the different teaching materials. Same as with the comparison of CLIL and non-CLIL lessons in the EG_BIO corpus (Section 9.3.1.1). The technical density is here also higher on average in the CLIL teaching materials (td= 27.9%) compared to the non-CLIL teaching materials (td=21.2), but the relative frequency of technical terms is more similar, even though the CLIL teaching materials still contain slightly more technical terms relative to the whole text (CLIL: rf=21.3%, non-CLIL: rf=20.8%). As before, this mainly has to do with English allowing for more multiword units as compounds whereas in German they are spelled as single words. For instance, CLIL_1e's teaching materials have the highest technical density with 33%, but the relative frequency of 22%, a rf which is well in line with the other texts. The reason technical terms make up 33% of the whole vocabulary of text CLIL_1e is because it deals with *lactic acid fermentation* and *electron transport chain,* terms that are repeated throughout the text, and consequently has the highest number of two-worded and multiword units out of all the texts (n=49).

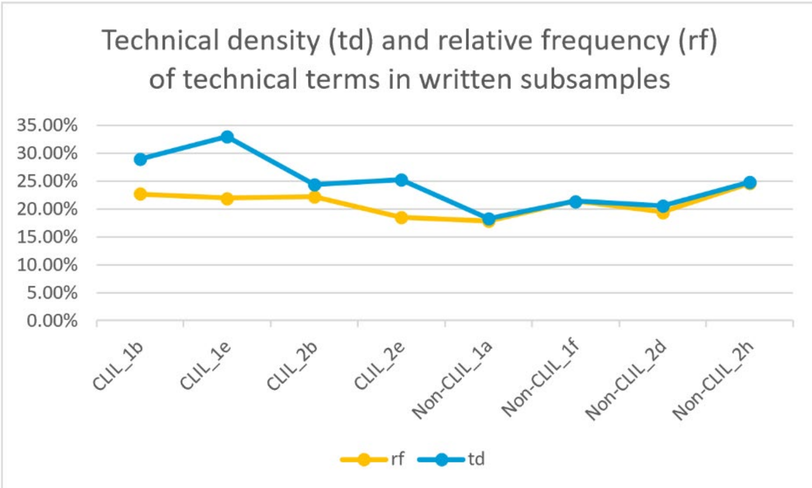

Figure 29: Technical density (td) and relative frequency (rf) of technical terms in the written subsample of the EG_BIO corpus

With regard to the teaching materials themselves, as hypothesized, it is indeed the case that T1's self-compiled scripts (1e, 2e, 1a, 2d) contain less technical terms on average (rf=19.4%) than T2's textbooks (rf=22.7%). Between the two textbooks used by T2, however, only minimal differences are observed (T2 CLIL: rf=22.5%; T2 non-CLIL: rf=23). Thus, summarizing the findings presented in this section, the written teaching materials are significantly denser regarding technical terms (td=24.8%; rf=21%) than the EG_BIO corpus (td=9.9%; rf=9%). Same as in the EG_BIO corpus, the td is also higher on average in the CLIL teaching materials compared to the non-CLIL teaching materials.

9.3.2 Discussion: Quantitative Analysis of Technical Terms

Following the quantitative analyses of technical terms in the EG_BIO corpus, this section summarizes and critically reflects on the main results before transitioning to the qualitative analysis of technical terms in Section 9.3.2. The first research question the quantitative analysis of technical terms sought to investigate was the following:

3. What technical terms can be identified in the EG_BIO corpus and how are they distributed? More specifically, what is the technical density and the relative frequency of technical terms across the variables explained in Section 7.2
   a. Lesson type (CLIL vs non-CLIL; T1 vs. T2; grade 10 vs. 11)
   b. Speaker (teacher vs. students)
   c. Classroom registers (instructional, regulative and social talk)?

Technical terms, in this study referring to nouns and compound nouns, were identified using a field-specific dictionary (Cole, 2015) and then coded according to three categories: position, unit and name. With regard to the position, the analysis has shown that technical terms occur most often as specific entries, meaning they have a single entry in Cole's dictionary, followed by headwords, which subsume multiple specific entries. As for the unit, the analysis has shown that the vast majority of technical terms consists of one word only and that multiword units are the exception. Lastly, regarding the category of name, an overwhelming majority of technical terms is spelled normally, meaning acronyms are actually not that frequent.

The reported number of technical terms is 10'793. These 10'793 instances of technical terms correspond to 1700 types of technical terms, meaning each technical term occurs on average 6.3 times in the EG_BIO corpus. But there are of course terms that occur more frequent than that, and terms that occur only once. For instance, even though there are not that many acronyms, the most frequent technical term in the EG_BIO corpus with 204 occurrences is an acronym, *CO_2,* because it is used frequently in both CLIL and non-CLIL lessons.

The 10’793 technical terms make up 11’738 words, thus the relative frequency is 9% and the technical density of the EG_BIO corpus is 9.9%. The main findings of the quantitative analysis show that the EG_BIO corpus has a technical density of 9.9%, meaning roughly every tenth word is (part of) a technical term. The relative frequency of technical terms is 9%, meaning per 100 words there are usually nine instances of technical terms (which can be more than one word). Assuming everyday talk has fewer to no technical terms, this would mean that teacher-led whole class interaction in science lessons contain about 9x as much technical vocabulary. Although one cannot forget that some headwords in Cole’s (2015) dictionary (e.g. *Wasser [water]*) are so common they would probably also be used in an everyday conversation (see Section 11.2 for a more thorough discussion on the methodology used).

On the other hand, studies such as Chung and Nation (2003) or Ha and Hyland (2017) report considerably higher numbers of technical vocabulary, but because they use written data and differing methods to identify technical terms, they are barely comparable to the present study. As to my knowledge there are no studies to date who have investigated technical vocabulary quantitatively in a spoken corpus, it is challenging to contextualize these results, i.e. that science lessons have more or less technical terms than other lesson. Therefore, the quantitative analysis of technical terms shows that technical terms in form of (compound) nouns, occur with a relative frequency of 9% and a technical density of 9.9% in the EG_BIO corpus, which is more than everyday conversation and less than in written texts. They occur most often as specific entries in Cole’s (2015) dictionary, in form of single words and spelled out.

With regard to lesson type, the quantitative analysis has shown that the CLIL lessons (rf=9.2%) contain only slightly more technical terms compared to non-CLIL lessons (rf=8.8%), but compared to the rest of the vocabulary, the technical terms make up a higher part in CLIL lessons compared to the non-CLIL lessons. Technical density is thus considerably higher in CLIL than non-CLIL lessons (td=11.1% vs td=8.9%). This has to do with the structural differences in word formation, specifically compound nouns, which are spelled as one word in German, and in English often as two- or multiword units. Consequently, almost all technical terms in the non-CLIL lessons are single words, whereas in the CLIL lessons the amount of two- or multi-worded units coded as technical terms is higher. The type-token ratio between CLIL and non-CLIL lessons is nearly identical, which means that variation regarding type of technical terms is almost the same in both contexts.

There are more technical terms in T1's classes (rf=9.7%) compared to T2's classes (rf=8.4%), and this difference is even more pronounced in CLIL lessons (T1: rf=10.6%; T2: rf=8.0%) relative to the non-CLIL lessons (T1: rf=9.0%; T2: rf=8.7%). This suggests that the overall difference in the use of technical terms between T1 and T2's classes primarily stems from the variance observed in their CLIL lessons. Several factors may account for this. One explanation is the influence of two outlier lessons identified in Section 9.3.1.1, both of which are CLIL lessons: one with a notably high relative frequency (rf) and term density (td) taught by T1, and another with a lower rf and td taught by T2, which affects the relative frequency within the CLIL subcorpus. Another contributing factor is the lesson topics. Lessons focusing on biochemistry tend to have a higher density of technical terms compared to other topics. While T1 teaches almost exclusively biochemistry-related topics in both his CLIL and non-CLIL lessons, T2, although covering some biochemistry when discussing photosynthesis with his non-CLIL class 1f, addresses a wider range of topics in his CLIL lessons that are generally less technical. Thus, the different thematic foci in T1's and T2's classes help explain the observed variation of the use of technical terms. With regard to grade, lessons in grade 10 have slightly more technical terms (rf=9.1%) compared to grade 11 lessons (rf=8.9%). This is also the case for CLIL and non-CLIL lessons.

With regard to the speaker category, surprisingly students have a considerably higher relative frequency of technical terms (rf=11.4%) than the teachers (rf=8.7%), which was unexpected. This finding may be linked to the use of display questions and the IRF-structure typical of institutionalized teacher-led whole class interaction. Interestingly, while students use more technical terms than their teachers in CLIL and non-CLIL lessons, the difference is more pronounced in the non-CLIL lessons. This finding could be particularly relevant for CLIL research, where not only exposure, but also student input is regarded as highly valuable for learning the TL. Both T1 and T2 see learning the TL as one of the main objectives of their CLIL lessons. For instance, T2 mentioned in the interview that the students are allowed to any topic in his CLIL lessons as long as it is in the TL English. Hidalgo McCabe (2020) has found that the teachers in her case study used a more dialogic approach to teaching science in the CLIL classroom compared to the non-CLIL classrooms. T1 and T2 might therefore unconsciously also adapt their teaching strategies to give students more room to talk in CLIL lessons compared to non-CLIL lessons.

Considering classroom register, the instructional register has the highest relative frequency (rf=10.6%), the regulative register_specific content the second highest (rf=7%), followed by social talk (rf=2.2%) and the regulative register_general (rf=1.5%), as expected. There is no difference between CLIL and non-CLIL lessons according to classroom register. Classroom register, along with the topic of a lesson, are thus decisive factors in predicting how technically dense (parts of) a science lesson is, no matter whether they are CLIL or non-CLIL.

The next research question the quantitative analysis of technical terms sought to answer concerned a comparison of modes:

4. How does technical density and relative frequency of technical terms in teacher-led whole class interaction compare to a subsample of written text in the teaching materials?

Technical density and relative frequency of technical terms differ vastly in regards to mode: In the written teaching materials it is more than twice as high (td=24.8%, rf =21%) compared to the spoken EG_BIO corpus (td=9.9%, rf=9%). This means that in the present study, classroom discourse about biology is very different from written scientific texts in the same discipline in regards to the frequency and density of technical terms. In other words, classroom discourse and the written teaching materials contain a different degree of technicality. In both CLIL and non-CLIL lessons the teacher then has to orally scaffold the high frequency of technical terms students encounter in form of written input to make them understand the content, to then repack these terms in a way the students can produce output of their own in a degree of technicality that is seen as appropriate for scientific writing (Lemke, 1990, p. 27). Since thematic units (spanning over several lessons) often begin with high-stakes reading and end up asking for some kind of high-stakes writing from students (Martin, 2013, p. 33), proper unpacking and repacking in form of semantic waves is essential (see Section 5.1.2 on semantic profiles and semantic waves). The difference in frequency of technical terms means that in the science classroom the teacher needs to unpack many technical terms, but also repack them so students can use the technical vocabulary adequately and in a higher frequency in their writing. How T2 un- and repacks technical terms in the classroom is analyzed in detail in Chapter 10.

As an additional challenge in CLIL, teachers have to navigate un- and repacking processes not only in two types of languages (everyday and academic), but also usually in two different languages. Consequently, decoding textbooks with a high frequency of technical terms is also more challenging in CLIL than in non-CLIL, because it is usually not written in the students' L1. This is especially true if the teaching materials are authentic and targeted at native speaker (as is the case with T2's textbook by Kent [2000]).

While the quantitative analysis of technical terms has provided an overview of what and how frequent technical terms occur in the

EG_BIO corpus, not all of these technical terms are new to the students or pose the same challenges for them in the classroom. In fact, many of the 1700 types of technical terms identified in the EG_BIO corpus already belong to the students' general vocabulary because they have learned them previously. Technicality is recursive (Wignell, 1998, pp. 298–299), i.e. one technical term is often used to define another one, reflecting how technical terms and concepts are interconnected and classified within a discipline-specific taxonomy. This is why it is all the more important that new technical terms are properly introduced to the students the first time they are mentioned. While new technical terms in textbooks are often marked orthographically to draw attention to this term visually and followed by a concise definition, other resources have to be used to highlight and define a new term in the classroom. In the following, the qualitative analysis of technical terms illustrates how the introduction of technical terms, i.e. the technicalizing process, is exactly realized in the teaching materials as well as in the classroom.

9.3.3 Qualitative Analysis of Technical Terms

This section presents an analysis of the introduction of 14 technical terms, examining how and to what extent the second step of their technicalizing process—making a term technical by assigning it a technical meaning (Wignell et al., 1993, p. 145)—is realized in the written teaching materials compared to classroom discourse. The analysis begins with a comparison of eight new technical terms in T1's self-compiled teaching materials and lessons (Section 9.3.3.1), followed by an exploration of the introduction of six technical terms in T2's teaching materials and corresponding lessons (Section 9.3.3.2).

9.3.3.1 Introduction of Technical Terms in T1's Teaching Material and Classes

As already outlined in Section 6.2.1, T1 uses a self-compiled script for both, his CLIL and non-CLIL classes. As he explains in the interview (see excerpt 4), the scripts for both classes are very similar in content but not exactly the same.

Excerpt 4: Interview T1

01 T1: I don’t translate everything one to one between these two scripts, but here and there I do. And this framework script that I have which I give to the students, that is very similar. Sometimes I first worked on it in English and then translated it into German, or vice versa, because I started pretty much in parallel, immersion and German, so I had the two lessons in parallel.

The texts in question both deal with the introduction of the concept of fermentation and highlight the new or important technical terms in italics and bold font.

Non-CLIL class 1a

In T1’s non-CLIL teaching materials, the following terms are highlighted (see Table 46). All of these are introduced and discussed in the lesson Non-CLIL_1a_20150528.

Table 46: Terms in T1’s non-CLIL teaching materials and corresponding lesson

<table>
<tr><th>Teaching materials 1a (non-CLIL)</th><th>Corresponding lesson:</th></tr>
<tr><td>Gärung [fermentation]</td><td rowspan="4">Non-CLIL_1a_20150528</td></tr>
<tr><td>Alkoholische Gärung
[alcoholic fermentation]</td></tr>
<tr><td>Milchsäuregärung [lactic acid fermentation]</td></tr>
<tr><td>Hefe [yeast]</td></tr>
</table>

The text in question starts off with the title “Die Gärung [the fermentation]” in bold and bigger font than the rest of the text, thus already highlighting *Gärung* as a technical term that will be explained in more detail in the subsequent text. The text itself begins by explaining anaerobic conditions, that is, an environment where organisms do not have oxygen at hand. It is here where the term *Gärung* is first introduced (see extract 9.3):

Extract 9.3: T1's teaching materials 1a (non-CLIL)

> Viele Organismen schalten dann auf die ***Gärung*** um. Das ist ein Prozess, bei dem Energie in Form von ATP gewonnen wird, aber in deutlich kleinerem Masse als bei der Zellatmung.
>
> [Many organisms switch to ***fermentation*** in these cases. This is a process, in which energy in form of ATPs is gained, but in significantly smaller amounts than with cellular respiration.]

The first time the term *Gärung* is mentioned in the teaching materials, it is highlighted through both italics and bold font. The phenomenon in question, *Gärung,* is thus identified purely through orthographic means; no other rhetorical means are used to highlight the term. The elaboration of said term follows in the subsequent sentence, where *Gärung* is referred to as "a process" which is then further explained. This is a typical example of how technical terms are introduced in textbooks: orthographically highlighted the first time they are mentioned, immediately followed by a definition (Wignell et al., 1993, p. 148). After a general introduction into the fermentation process, two other types of fermentation, *alkoholische Gärung [alcoholic fermentation]* and *Milchsäuregärung [lactic acid fermentation],* are introduced (see extract 9.4):

Extract 9.4: T1's teaching materials 1a (non-CLIL)

> Wir wollen hier nur auf die ***alkoholische Gärung*** und die ***Milchsäuregärung*** eingehen, zwei Prozesse, die gewisse Kleinstorganismen beherrschen, und die in der Lebensmittelindustrie seit Tausenden von Jahren eine sehr wichtige Rolle spielen.

```
[We only want to discuss alcoholic fermentation and
lactic acid fermentation here, two processes, which
certain microorganisms use, and which, for thousands
of years, have played an important role in the food
industry.]
```

As can be seen in extract 9.4, the introduction of the next two technical terms starts with “wir wollen hier nur auf (…) eingehen [we only want to discuss (…)]”. This phrasing is part of the regulative register_general usually used in Curriculum or Lesson planning (e.g. “what I want to do now”, see Section 7.2.3). The use of personal pronouns such as “we” is a common feature to signal the writer-reader dialogue in disciplinary textbooks (Bondi, 2016, p. 326). In this case the writer is T1 and the readers are his students. By using “we” and framing the two terms *alkoholische Gärung* and *Milchsäuregärung* as focus of the subsequent text, T1 is highlighting these terms as important. Together with the orthographic marking (bold font and italics), T1 is directing the students’ attention to *alkoholische Gärung* und *Milchsäuregärung,* thus setting them up as technical terms. Interestingly, the highlighting of these terms is not immediately followed up by a definition. It is though mentioned that these are “processes” (see extract 9.4), but other than that only contextual information is provided, such as that they are processes used by microorganisms and important for the food industry. Nevertheless, a full definition or field-specific meaning of these particular processes is still lacking at this point. Instead, the next move in the teaching materials consists of introducing another new term, *Hefe [yeast]*:

Extract 9.5: T1’s teaching materials 1a (non-CLIL)

```
So wird beispielsweise Hefe – das ist ein einzelliger
Pilz – bei der Herstellung von alkoholischen Getränken
eingesetzt (Bier, Wein, Spirituosen). Die Hefe
benötigt dazu Glukose (möglich sind auch andere
Einfachzucker), und ein sauerstoffarmes Milieu. Unter
diesen Bedingungen produziert die Hefe über die
```

```
alkoholische Gärung Ethanol (Trinkalkohol) und
Kohlendioxid und gewinnt gerade mal 2 ATP pro
Glukosemolekül.
```

`[That way` ***`yeast`*** `– this is a unicellular fungus – is used in the production of alcoholic beverages (beer, wine, spirits). For that, yeast needs glucose (other single sugars are also possible), and an oxygen-poor environment. Under these circumstances, yeast produces, via alcoholic fermentation, ethanol (drinking alcohol) and carbon dioxide, and gets only 2 APTs per glucose molecule.]`

In extract 9.5, a case of an immediate technicalizing process is illustrated with *Hefe*: The term is highlighted orthographically and right after a definition is inserted ("das ist ein einzelliger Pilz [this is a unicellular fungus]"). This is followed by some further elaboration on *Hefe*, namely its usage and the conditions needed in order for it to work. The explicit technicalizing process might be connected to the fact that *Hefe* has an everyday meaning (baking ingredient) as well as this highly technical meaning (unicellular fungus). Hence, students might be familiar with *Hefe* as a baking ingredient, but not with its field-specific meaning in biology, therefore it seems all the more important to introduce the term and assign its field-specific meaning immediately after it is first mentioned.

In the last sentence in extract 9.5, *alkoholische Gärung,* previously introduced in extract 9.4, gets assigned a field-specific meaning: Alcoholic fermentation is a process that through yeast produces ethanol and carbon dioxide and results in the gain of two ATPs. The text then moves on to explain the second type of fermentation, *Milchsäuregärung,* which was also first mentioned and highlighted in the previous extract (9.4). In extract 9.6., because it is the second time *Milchsäuregärung* is mentioned in the text, it is not orthographically highlighted anymore.

Extract 9.6: T1's teaching materials 1a (non-CLIL)

> Ein Gärprozess, den Sie schon an Ihrem eigenen Körper, aber sicher auch in Milch, die über das Verfallsdatum war, erfahren haben, ist die Milchsäuregärung. (...) Damit ein kurzfristiger Sauerstoffmangel nicht zum Stillstand der Muskulatur führt – das wäre für ein Tier auf der Flucht fatal – wird im Muskel auf eine ATP-Produktion umgestellt, die zwar viel weniger effizient ist, aber keinen Sauerstoff braucht, die Milchsäuregärung. Dabei entstehen aus einer Glucose zwei Milchsäuremoleküle und es wird wie bei der alkoholischen Gärung nur in der Glykolyse ATP gewonnen, also nur gerade mal 2 ATP pro Glukosemolekül.
>
> [A fermentation process that you have already experienced in your own body but also in expired milk is lactic acid fermentation. (...) In order for a short-term lack of oxygen not to lead to a halt of muscular activity – this would be fatal for an animal in flight mode – the process within the muscle switches to an ATP production that is less efficient but does not need oxygen, lactic acid fermentation. In this process, two lactic acid molecules are formed from one glucose and, same as in alcoholic fermentation, ATP is only obtained during glycolysis, i.e. just 2 ATP per glucose molecule.]

Milchsäuregärung has already been identified as a fermentation process in earlier sections of the text. This is reiterated in the first sentence of extract 9.6, followed by an elaboration on where students might know this particular fermentation process from. Additional information is then provided regarding where the process occurs (milk and muscle cells) and the reason it is necessary in the first place. Within the explanation of why such a process is needed, a first full definition of *Milchsäuregärung* is given: It is described as a less efficient form of anaerobic energy production, essential in situations such as flight mode. This is followed by a more detailed definition of *Milchsäuregärung* as a chemical process where one glucose molecule produces two lactic acid molecules, which equals a gain of two ATP.

In summary, the introduction of technical terms in T1's teaching materials of non-CLIL class 1a, draws on the following pattern: The marking or highlighting of the technical term is always realized through orthographic means (bold font and italics) the first time these terms are mentioned. In the case of *Gärung* and *Hefe,* the definition follows immediately in the subsequent sentence or through an insertion, in the case of *alkoholische Gärung* and *Milchsäuregärung* the elaboration is not realized immediately but follows later. Both are typical structures in textbooks (Bondi, 2016). It is, however, generally assumed that the closer the term to its assigned meaning (e.g. *Gärung* und *Hefe*), the easier it is for the student to unpack the technical term (Wignell et al., 1993, p. 148).

In lesson Non-CLIL_1a_20150528, these same terms are introduced in classroom discourse. First off, T1 starts with a repetition of cellular respiration, a process that delivers energy but is oxygen-dependent. In the absence of oxygen, processes such as fermentation are still running, and T1 decides that as a start into the topic, the students have to read about fermentation themselves in the teaching materials. His instructions to this reading task are also where T1 first mentions the word *Gärung:*

Extract 9.7: Non-CLIL_1a_20150528

```
01   T1:  Die Phänomene, die rechts beschrieben, haben mit
          einem solchen mit solchen Prozessen zu tun und
          Sie sollen dabei ein bisschen darauf hingeführt
          werden uhm auf diese Gärung hingeführt werden.

          [The phenomena, described on the right-hand
          side, have to do with such processes, and with
          that you should be led a bit to this uh to this
          fermentation.]
```

Even though T1 is not explicitly projecting *Gärung* as a technical term in extract 9.7, by using the regulative register_general ("Sie sollen dabei ein bisschen darauf hingeführt werden [with that you should be led a bit to this]") he makes it clear that the ultimate goal of the task consists of understanding this process called *Gärung*. Therefore, in this case, the students work on the technicalizing processes themselves: They see the technical terms orthographically highlighted in the script with their assigned field-specific meaning as described above. After this task, T1 then seems to assume that the four terms *Gärung, alkoholische Gärung, Milchsäuregärung* and *Hefe* are somewhat familiar, since his students have read up on it.

Research on students' text comprehension of German biology texts, however, has shown that one cannot assume that each student understands a technical text to the same degree (see e.g. Gilg, Schmellentin, Dittmar, & Schneider, 2019). The students' reading task, then, did not only consist of reading up on fermentation in the script, but also of answering specific questions about fermentation. This is a common strategy in teaching materials or science teaching in general to enhance reading comprehension (Kinniburgh & Shaw, 2009). Nevertheless, T1 seems to assume that students are now familiar with the core meaning of *Gärung* as a process that organisms use to gain energy (ATPs) in anaerobic (oxygen-absent) conditions. After the reading task, T1 starts to test students' understanding of the concept by going through the specific questions they had to solve, starting with what substrates the process of *Gärung* actually needs in order to work. This is also how *alkoholische Gärung* is first introduced in the lesson (see extract 9.8):

Extract 9.8: Non-CLIL_1a_20150528

```
01    T1:  Und dann gibt man ein bisschen Zucker dazu, das
           ist eigentlich dann die Quelle für das Produkt
           uh das bei der Gärung herausschaut. Bei der
           alkoholischen Gärung ist es was? Oder was könnte
```

		es sein (NAME)?
		[And then you add a bit of sugar, that's actually then the source for the product that results from fermentation. In alcoholic fermentation it is what? Or what could it be (NAME)?]
02	S:	Was rauskommt?
		[What it produces?]
03	T1:	Ja? was könnte herauskommen bei der alkoholischen Gärung?
		[Yes? What could be the product of alcoholic fermentation?]
04	S:	Ja Alkohol
		[Well alcohol]
05	T1:	Alkohol. Und was noch?
		[Alcohol. And what else?]

((several lines omitted; T1 conducting an experiment))

08	T1:	Sie haben gesehen, es entstehen Gase bei der alkoholischen Gärung ist es CO_2. Und was daneben auch noch entsteht ist Alkohol.
		[You have seen, gases are released, during alcoholic fermentation it is CO_2. And what it also produces is alcohol.]

In extract 9.8, T1 first briefly summarizes in a rather complex manner that "the source for the product that results from fermentation" can be sugar, before asking specifically for the product of alcoholic fermentation (line 01). Because of that rather complex summary of the fermentation process it does not seem clear to students that the "es [it]" in T1's question ("Bei der alkoholischen Gärung ist *es* was? [In alcoholic fermentation *it* is what?]") refers to the product. Therefore, the student in line 02 inquires "Was rauskommt? [What it produces?]", which is confirmed by T1 (line 03). The student in line 04 then replies that it is alcohol that is produced by alcoholic fermentation, which is evaluated as correct by the teacher (line 05). T1 goes on to show how alcoholic fermentation works in an experiment[112], after which he summarizes what the students have seen (line 08), namely that *alkoholische Gärung* is a process which produces CO_2 and alcohol.

With that summary he refines the second step to of the technicalizing process, assigning a meaning to the term. This is followed by another reading task and a subsequent discussion of the ATP production of alcoholic fermentation compared to regular cellular respiration (oxygen-dependent way of gaining energy), a very specific and detailed definition of the chemical reactions subsumed under *alkoholische Gärung*. In this discussion, the term *Milchsäuregärung* is used for the first time by T1, but only to mention that they will discuss this process later on (extract 9.9). Extract 9.9 shows how by means of the regulative register (organizing the structure of the lesson) the technical term is highlighted, since it projected as a term or concept that will be discussed later on in more detail, therefore it must be important.

Extract 9.9: Non-CLIL_1a_20150528

```
01   T1:  Ich komme darauf gleich nochmal zu sprechen,
          oder nein denken wir das mal schnell zu Ende.
          Wir können die Milchsäuregärung nachher kurz
          anschauen uhm.

          [I will get back to this again soon, or no let's
          think this quickly through. We can briefly look
          at lactic acid fermentation after uhm.]
```

After this insertion of *Milchsäuregärung,* the discussion about substrate, products and gained ATPs of *alkoholische Gärung* continues.

112 Adding yeast to a sugary water solution in an enclosed plastic bottle initiates the fermentation process. Enormous pressure builds up inside the bottle through fermentation releasing CO_2, which results in a hissing sound when opening the lid of the bottle.

Interestingly, at the end of this discussion T1 first mentions the term *Hefe.* Assuming students know what *Hefe* is, it is not surprising that the first two mentions of the term are neither highlighted, nor projected, nor elaborated as technical terms in any way:

Extract 9.10: Non-CLIL_1a_20150528

```
01   T1:  Sie wissen nie genau welche Hefen sie hier drin
          haben und es kann mit es kann zu einem bestimmten
          Grad Methanol entstehen, und Methanol ist
          giftig. (...) Also das Abfallprodukt, dass die
          dass die Hefebakterien hier die diese Gärung
          vollziehen, das Endprodukt ist das Ethanol, das
          hält noch enthält noch viel Energie.

          [you know never exactly which kind of yeasts you
          have inside here and it can with it can, to a
          certain extent, produce methanol, and methanol
          is toxic. (...) So the waste product, that the
          that the yeast bacteria that perform here the
          this fermentation, the end product is ethanol,
          which has still has still a lot of energy.]
```

In the extract 9.10 above, T1 explains that alcoholic fermentation can be used to produce alcohol, e.g. beer, and that this is dangerous if done illegally since one does not know the type of yeast that is used in the brewing process. In his explanation he is clearly assuming students know the field-specific meaning of yeast. In the second sentence in extract 9.10, T1 mentions *Hefebakterien [yeast bacteria]* as those organisms capable of running alcoholic fermentation. No further attention is paid at this point to these mentions of *Hefe/Hefebakterien.* After another lengthy explanation of alcoholic fermentation, T1 introduces the other type of fermentation the following way:

Extract 9.11: Non-CLIL_1a_20150528

```
01   T1:  Eine andere Gärung – gibt viele verschiedene
          Gärungen – eine andere Gärung auf die ich noch
```

kurz eingehen möchte, das ist die Milchsäuregärung. Was Sie dabei sehen ein Unterschied ist, es entsteht kein CO_2. Was aber eine Gemeinsamkeit ist, es wird ebenfalls, es werden ebenfalls Elektronentransporter entladen.

[Another fermentation – there are many different types of fermentation – another fermentation I quickly want to discuss, that is lactic acid fermentation. What you see here is one difference, there is no CO_2. What is a commonality, it is also electron transporters are also unloaded.]

In extract 9.11, T1 highlights the term *Milchsäuregärung* as an important term the same way the first time he mentioned it (extract 9.9), using the regulative register_general. By explicitly stating that the next type of fermentation he wants to discuss is *Milchsäuregärung,* T1 puts attention to the term that is discussed next. This time, the elaboration follows right after by listing differences and commonalities, making a direct comparison to what students have learned so far regarding the other type of fermentation, *alkoholische Gärung*. This is complemented by a discussion on why milk becomes thick (not shown in extract 9.11), which is one way T1 explains the process of *Milchsäuregärung*. After that, the teacher turns his attention back to *Hefe*:

Extract 9.12: Non-CLIL_1a_20150528

01 T1: Nehmen wir nochmal ein solches Hefebakterium uh Hefepilz, Entschuldigung. Hefe ist ein einzellige(r) Pilz, der ist sehr klein und der hat so kleine wenn man unter dem Elektronenmikroskop anschaut hat der so kleine wie Krater. Das kommt daher, dass diese dass Hefe einzellige Hefe sich eben teilt durch Zellteilung vermehrt und an der Stelle wo sie sich abnabeln gibt es so einen kleinen Krater. Wenn Sie den jetzt unter dem Elektronenmikroskop

```
anschauen dann können Sie genau sagen wie oft
die sich geteilt haben. Aso das hier ist eine
Hefe.

[Let's take another of such a yeast bacterium uh
yeast fungus, sorry. Yeast is a unicellular
fungus, it is very small and has like small if
you look at it under the electron microscope has
like small craters. This stems from the fact
that this that yeast, unicellular yeast
reproduces via cell division and on the spot
where they separate from each other these little
craters exist. If you look at this under the
electron microscope you can say exactly how many
times it has divided itself. So this here is
yeast.]
```

In extract 9.12, the teacher starts off with *Hefebakterium [yeast bacterium]* before realizing that in a technical sense, *Hefe* is not a bacterium but a fungus. He self-corrects after a hesitation marker ("*Hefebakterium* uh *Hefepilz" [yeast bacterium uh yeast fungus]*), and only after this mistake does he give a definition of the technical term in question, the same definition occurring in the written teaching materials: Yeast is a unicellular fungus. This is followed by some further elaboration on what yeast looks like under the electron microscope ("der ist sehr klein [it is very small]", "so kleine wie Krater [like small craters]"). The characteristic of yeast as a unicellular organism is emphasized again in the elaboration where he mentions *Hefe* and repeats the technical term but adding the characteristic: "Hefe, einzellige Hefe [yeast, unicellular yeast]". After this description, T1 makes a reference to the picture he is showing, saying "aso das hier ist eine Hefe [so this here is yeast]", concluding his explanation. After this, he continues to use *Hefe* as an already known term. Hence, when first mentioning the term *Hefe,* T1 did not highlight the term in any way (see extract 9.10). Only after realizing that he had made a mistake by referring to *Hefe* as a bacterium did T1 define the term and thus complete the technicalizing process by assigning it the correct field-specific meaning. One could speculate that T1 would not have introduced the term *Hefe* at all had he not made that mistake, thus feeling the need to clarify that in a technical sense, yeast is a unicellular fungus and not a bacterium.

In conclusion, the terms *alkoholische Gärung* and *Hefe* are not highlighted in any way the first time they are used in non-CLIL class 1a, whereas in the case of *Gärung* and *Milchsäuregärung* the terms themselves are highlighted through the regulative register. With regard to assigning a field-specific meaning, *Gärung* does not have that step, probably because students had to read up on it in the teaching materials and thus assign a field-specific meaning to the term themselves. Details of *alkoholische Gärung* and *Milchsäuregärung* are discussed at length in the lesson. With regard to *Hefe,* it is only the third time *Hefe* is mentioned that T1 assigns it a field-specific meaning, probably to self-correct a mistake he previously made.

CLIL class 1e

T1's CLIL class 1e has a similar script as non-CLIL class 1a. Consequently, the English text on fermentation highlights the same four technical terms as the German one (see Table 47). All of these are introduced and discussed in the lesson CLIL_1e_20150518.

Table 47: Terms in T1's CLIL teaching materials and corresponding lesson

Teaching materials 1e (CLIL)	**Corresponding lesson**
Fermentation	CLIL_1e_20150518
Alcoholic fermentation	
Lactic acid fermentation	
Yeast	

Fermentation is similarly introduced in the English script in that it starts with the title: "Fermentation solves the problem!" in bold and bigger font compared to the rest of the text. In contrast to the German script, however, it does not only mention the term *fermentation* but already implies something more about phenomenon, namely that it solves a problem. The text then introduces fermentation by mentioning it as an option organisms have at their disposal in anaerobic conditions. Same as in the German script, the term itself is first orthographically highlighted and then assigned a field-specific meaning in the subsequent sentence (see extract 9.13). Different to the German introduction, in addition to highlighting the term through bold font and italics, the script uses a non-projecting naming process[113]: Projecting and non-projecting naming processes can serve both, to highlight the naming of technical term by drawing explicit attention to said term, but also assigning meaning in that it relates said term to an already familiar phenomenon. In the case of extract 9.13 below, by using the verb "called" the term *fermentation* is explicitly set up as a technical term in reference to "processes". On the one hand, that verb draws attention to what this process is called (highlighting the term itself), on the other it relates it to "processes", i.e. fermentation is a process, which is partly already assigning a meaning. The elaboration that follows refines the definition of that process, thus completing the technicalizing process of *fermentation.*

Extract 9.13: T1's teaching materials 1e (CLIL)

> Many organisms can switch to processes called ***fermentation***. The processes use Pyruvate as a substrate and unload the electron transporters NADH.

In extract 9.13 then, the highlighting of the technical term is done through orthographic (bold font and italics), aided by grammatical means using a non-projecting naming process ("called"), followed by a

[113] Projecting and non-projecting naming processes are one way of assigning a field-specific meaning to a technical term, especially if it refers to an already known phenomenon or it has an existing vernacular term. It is thus a way to introduce the term in reference to something else. Examples for projecting naming processes are: *we say, we call it,* examples for non-projecting naming processes are *it is called/known as, the common name is* (see Wignell et al., 1993, p. 149).

definition in the subsequent sentence. The next two terms, *alcoholic fermentation* and *lactic acid fermentation* are introduced in the adjacent sentence of the teaching materials, shown in extract 9.14.

Extract 9.14: T1's teaching materials 1e (CLIL)

> There are several types of fermentation processes. We focus on the ***alcoholic fermentation*** and the ***lactic acid fermentation*** (Fig. 10), two processes that certain microbes but also cells of our own body master. Alcoholic fermentation and the lactic acid fermentation play a very important role in the food industry.

Same as in the German script, the writer (T1) is using the personal pronoun "we" and the regulative register_general ("we focus on") to give importance to the subsequent technical terms. Together with the orthographic highlighting, this completes the first part of technicalizing step 2. After the highlighting, a reference is made to "Fig. 10", a figure which shows an abstract visualization of these processes. Figures are often used as a resource in textbooks to visualize complex processes and multiply semantic meaning (Dimopoulos, Koulaidis, & Sklaveniti, 2003; Lemke, 1998), hence it is no surprise that T1 does this here too. Even though the same figure is accompanying the text in the German script, T1 made no reference to the figure within the German text.. After the reference to the figure in extract 9.14, the highlighting of the terms is not immediately followed up by a definition. It is mentioned, though, that these are "processes", but other than that only contextual information is provided. For that, the technical terms themselves are repeated, a subtle difference compared to the German script where they are not. Same as in the German script, however, the term *yeast* is introduced before giving a full definition of *alcoholic fermentation*.

Extract 9.15: T1's teaching materials 1e (CLIL)

> For example, ***yeast***, a unicellular fungus, is used in the production of alcoholic [beverages]. Yeast needs glucose or other single sugars and an oxygen-poor environment to perform alcoholic fermentation. Under these conditions, yeast produces ethanol (drinking alcohol) and carbon dioxide and also gains some energy (ATP).

In extract 9.15, the same pattern as in the German script is observed, *yeast* being highlighted orthographically, directly followed by its definition and by some further elaboration on yeast, e.g. that it is needed to perform *alcoholic fermentation.* It is here where *alcoholic fermentation* is assigned its field-specific meaning as a process that through yeast produces ethanol and carbon dioxide and results in the gain ATPs. Next, the other fermentation process is introduced:

Extract 9.16: T1's teaching materials 1e (CLIL)

> A fermentation process you can experience through your own body, but also occurs in milk products when they pass the expiration date, is the ***lactic acid fermentation***. (...) In order to do work under these anaerobic conditions, muscle cells switch to lactic acid fermentation. This process is much less efficient with respect to the energy extraction from glucose but it works in absence of oxygen. Only 2 APT molecules are gained per glucose molecule.

Similar to the German script, the students already know from the previous parts of the text that *lactic acid fermentation* is a fermentation process. This is reaffirmed here (first sentence in extract 9.16), with an elaboration on where the students might know this particular fermentation process from. Interestingly, and in contrast to the German script, the term *lactic acid fermentation* is orthographically highlighted a second time through bold font and italics (the first time it was mentioned and highlighted is shown in example 9.14). In the last two sentences of extract 9.16, a first detailed definition of *lactic acid fermentation* is given, which completes the technicalizing process.

Compared to the teaching materials for the non-CLIL class, the technical terms in the English script for the CLIL class are similarly introduced, which makes sense in that both scripts build on each other (see T1 interview, excerpt 4 in Section 9.3.3.1). They are, however, not exactly the same as there are some subtle but noteworthy differences. These are the use of a non-projecting naming process (extract 9.13), explicit reference to the figure in the running text and repetition of technical terms (extract 9.14), as well as repeated orthographic highlighting (extract 9.16). What these differences might mean with regard to how T1 consciously or unconsciously adapts his CLIL teaching materials is subject of the discussion section (Section 9.3.4).

In the classroom, the technical terms in question are introduced in the corresponding lesson (CLIL_1e_20150518) the same way as in the non-CLIL lesson: T1 asks his students to read up on the process of fermentation in his teaching materials. However, in his task instructions he does not explicitly mention the term *fermentation.* Instead he says the students should get an idea of "two examples" of how this problem (gaining energy in anaerobic conditions) could be solved (see extract 9.17). With the use of "two examples", the teacher already hints at the two types of fermentation processes.

Extract 9.17: CLIL_1e_20150518

```
01    T1:  there are two examples described on the on the
           next page, so please read that so you get a uhm
           an idea of how the problem is solved. (...) We
           have we have the equipment our cells and our
           muscle cells have the equipments uhm and many
           unicellular organisms like yeast yeast that's
           Hefe that's a unicellular fungus
```

Same as in the non-CLIL class, T1 tasks his students to do the technicalizing process on their own based on their individual reading. Hence, he can expect that after the reading task, students are familiar with the terms *fermentation, alcoholic fermentation, lactic acid fermentation* and *yeast* to a certain degree. Here, in contrast to the non-CLIL lesson, it is in these instructions for the reading task in extract 9.17 where T1 already completes the technicalizing process for *yeast:* First, the preposition "like" links the term *yeast* to "many unicellular organisms", consequently, yeast is a unicellular organism. This is then followed by a repetition of the term followed by a translation into German ("Hefe") and its definition ("unicellular fungus"). As mentioned in Chapter 4 on translanguaging, translations from English into German are common in CLIL classes. By translating the term into German the teacher can quickly provide a more familiar reference to students. After about six minutes into the reading task, T1 gives further instructions, shown in extract 9.18.

Extract 9.18: CLIL_1e_20150518

```
01   T1:  So if you who are finished can try to label the
          figure below. (...). Which of the two pathways
          is the lactic acid fermentation and which one is
          the alcohol fermentation. Those of you who are
          through the text try (to) label these reactions.
```

Same as in the teaching materials before, explicit reference is made to the figure accompanying the text, here by T1 asking his students to label the figure. It is also here where he first mentions the two terms *lactic acid fermentation* and *alcohol fermentation,* as his students should assign the chemical reactions visualized in said figure to one of the two fermentation processes. After a few minutes, T1 starts discussing the figure with the whole class, clarifying which chemical process corresponds to which technical term (see extract 9.19).

Extract 9.19: CLIL_1e_20150518

```
01    T1:   Exactly, and you can see the carbon dioxide here
            so this here must be and here’s the CO2 you have
            a gas production in this process, so this here
            is alcoholic fermentation basically (well it
            passes here). So the other one must be lactic
            acid fermentation.
```

Extract 9.19 shows how T1 summarizes this discussion of which process is which in the figure. Some elaboration is already provided, in that case, an explanation as to why one process is called *alcoholic fermentation* (because it produces gas [carbon dioxide/CO_2]). By process of elimination, the other is identified as *lactic acid fermentation*. This is a good example of how the technicalizing process can be achieved through multimodal means, that is through reading, writing, visual representations and a discussion afterwards. After this comparison, the teacher goes into more detail about the two fermentation processes, starting with *lactic acid fermentation*. At this point, *lactic acid fermentation* was already introduced through the reading task and the comparison discussed above, but is reintroduced again, shown in extract 9.20:

Extract 9.20: CLIL_1e_20150518

```
01    T1:   Now first of all, let’s look at the lactic acid
            fermentation. In the text it says that it’s
            something that actually occurs in our muscles,
            so when your body nee- needs a lot of energy for
            a time and your body is not capable of delivering
            enough oxygen uhm then lactic acid fermentation
            will set in.

((several lines omitted))

05    T1:   now how much energy does a microorganism or a
            cell if it does lactic acid fermentation gain
            from a glucose molecule
```

```
06   S:   It's just these two ATP molecules from
          glycolysis

07   T1:  Exactly, that's all there is. The it also said
          that it is a very unefficient way to gain energy
          or extract energy that's the reason it only
          extracts energy from glycolysis.
```

In extract 9.20 the teacher uses the regulative register_general ("now first of all, let's look at") to focus and thus set up *lactic acid fermentation* as a technical term in classroom discourse. This is followed by another resource from the regulative register, a reference to students' reading task ("in the text it says"). T1 repeats the contextual information provided in the text (such as where lactic acid fermentation occurs), repeating the term again (last sentence in line 01). After this, T1 does a physical exercise with his students (opening and closing your hand really fast; not shown in extract 9.20) to explain the process of lactic acid fermentation in a more practical manner. After this, he summarizes the discussion on lactic acid fermentation by co-constructing its exact meaning with his students (lines 05–07), completing technicalizing step 2 at this point. Subsequently, T1 focuses on *alcoholic fermentation* again (extract 9.21):

Extract 9.21: CLIL_1e_20150518

```
01   T1:  uhm another fermentation process that certain
          organisms master is the alcoholic fermentation
          and as you heard it, it's yeast for example. The
          yeast is one of these unicellular organisms that
          master this process and that's why yeast is used
          to produce alcohol in the food industry.
```

In extract 9.21, the teacher reintroduces *alcoholic fermentation* by repeating what students already now, namely that it is a fermentation process. Technical terms are used to establish a scientific taxonomy, that is, a representation of a scientific understanding of how certain phenomena relate to each other and consequently, how one technical term can be used to define another (Wignell, 1998; Wignell et al., 1993). Here, *alcoholic fermentation* is defined in reference to *yeast*: Alcoholic fermentation is a process only certain organism master, one of these is yeast. Even though T1 already completed the technicalizing process for *yeast* at the beginning of the lesson (see extract 9.17), he repeats it here, first as shown in extract 9.21 by emphasizing it being a unicellular organism, and then again in extract 9.22. In extract 9.22, T1 is about to show a movie about alcoholic fermentation, and when he mentions *yeast* he immediately adds the definition ("this is a unicellular organism"), pointing it out on the movie thumbnail on the beamer ("that's a bit what it looks like"). He completes the technicalizing process with "that's yeast", followed again by a translation into German.

Extract 9.22: CLIL_1e_20150518

```
01   T1:  So take a yeast this is a unicellular organism
          that you might once (sides). Well, that's a bit
          what it looks like. That's yeast. Hefe.
```

To summarize the results for the analysis of the introduction of technical terms in T1's CLIL class: The written teaching materials for CLIL, same as in the non-CLIL teaching materials, use bold font and italics for the highlighting of technical terms, and immediate (in the case of *fermentation* and *yeast*) or follow-up definitions (in the case of *alcoholic* and *lactic acid fermentation*) to assign the field-specific meaning. There are subtle differences between the CLIL and non-CLIL teaching materials, which are further explored in the discussion section (9.3.4). With regard to classroom discourse, same as in the non-CLIL class, the teacher assigns his students a reading task to make themselves familiar with the technical terms. In the CLIL lesson itself, T1 does not mention *fermentation* at all, but instead focuses on the details of *alcoholic* and *lactic acid fermentation.* Interestingly, and in contrast to the non-CLIL class, the term *yeast* is introduced almost three times in the CLIL lesson, once even before the reading task (extract 9.17) and then again in the discussion (extracts 9.21 and 9.22), using not only defining but also translanguaging as a resource for the technicalizing process.

9.3.3.2 Introduction of Technical Terms in T2's Teaching Materials and Classes

In contrast to T1, T2 uses two biology textbooks in his lessons, Markl's *Biologie Oberstufe* (2010) for his non-CLIL classes and Kent's *Advanced Biology* (2000) for his CLIL classes.

Non-CLIL class 1f

Markl (2010) uses orthographic highlighting in a particular way, in that the terms which are particularly relevant for a section are highlighted in bold and can be found in the glossary at the end of the textbook. There are also some terms highlighted in italics, though no specific function for this type of highlighting has been identified thus far Therefore, for the text of non-CLIL class 1f on photosynthesis, the terms in italics were ignored, but the ones printed in bold were taken as technical terms for this study, the overview of which can be found in Table 48:

Table 48: Terms in T2's non-CLIL teaching materials and corresponding lessons

Teaching materials 1f (non-CLIL) (Markl, 2010, pp. 132–133)	Corresponding lessons
Fotosynthese [photosynthesis]	Non-CLIL_1f1_20150505 Non-CLIL_1f1_20150512 Non-CLIL_1f2_20150512
Chloroplasten [chloroplasts]	
Calvinzyklus [Calvin cycle]	

Since each term is discussed in another lesson, the analysis is structured differently compared to the previous two sections. The introduction of the first term *Fotosynthese* is looked at first in the teaching materials, followed by its introduction in the respective lesson. Then the second term *Chloroplasten* is analyzed first in the teaching materials and in the classroom discourse, followed by a discussion of the introduction of the last term *Calvinzyklus.*

Starting with *Fotosynthese,* the technicalizing process begins with the title (extract 9.23):

Extract 9.23: T2's teaching materials 1f (non-CLIL)

> **Die Fotosynthese ist die Umkehrung von Verbrennung und Zellatmung**
>
> **[Photosynthesis is the reversal of combustion and cellular respiration]**

According to Markl (2010, p. 13), the titles of sections should represent the essential content and biological concept of said section. In this case, the whole title is highlighted in bold font and a bigger font than the rest of the text, drawing the reader's attention to said title. In the title, *Fotosynthese* is first mentioned and immediately followed by a definition through an identifying relational clause (*x* is *y*, cf. Halliday, 1985), in that photosynthesis is the reversal of combustion and cellular respiration. A first technicalizing process is thus already realized, however, this time heavily dependent on the readers presupposed knowledge of what combustion and cellular respiration are. If one does not know these terms, one cannot know from this definition alone what photosynthesis refers to. It illustrates the interconnectedness and recursiveness of technicality in science, where the technicality of one term can be used to build the technicality of another (Wignell, 1998, pp. 298–299). Nevertheless, the text goes on to introduce *Fotosynthese* in more detail, as shown in extract 9.24. In this extract, photosynthesis is highlighted through bold font the first time it is used in the running text, immediately followed by a definition of *Fotosynthese* in the subsequent sentence.

Extract 9.24: T2's teaching materials 1f (non-CLIL)

> Pflanzen lösen genau diese Aufgaben bei ihrer **Fotosynthese.** Mithilfe der Sonnenenergie erzeugen sie energiereiche Glucose aus gasförmigem CO_2 der Luft und H_2O aus dem Boden, also aus energiearmen Molekülen, und dabei wird O_2 frei. (...). In der Fotosynthese wird somit Wasser gespalten, und zwar zu Sauerstoff und Wasserstoff.
>
> [Plants solve exactly this task with their **photosynthesis.** With the help of solar energy, they produce energy-rich glucose from gaseous CO_2 in the air and from H_2O in the ground, that is, from energy-poor molecules, and thereby O_2 is released. (...) During photosynthesis water is thus broken down into oxygen and hydrogen.]

Hence, highlighting is done through orthographic means, immediately followed by the meaning of the highlighted term. Later in the text this explanation of *Fotosynthese* is concluded by a summary (last sentence in extract 9.24), where *Fotosynthese* is once again linked to its core field-specific meaning. In the running text, Markl (2010) only highlights those terms orthographically which are essential for the reader's understanding, a definition of which can then be found in the glossary of the textbook. The purpose of this system is reader guidance—whenever the reader (students) come across a technical term highlighted in bold font, they will read the definition within the running text, and then go to the glossary for a full definition of the term. Therefore, it seems worthwhile to also look at how the term is introduced in the glossary.

> **Fotosynthese** → **S. 118** *photosynthesis* wichtigste Form der autotrophen → Assimilation, bei der mithilfe des → Chlorophylls unter Einwirkung des Sonnenlichts aus CO_2 und Wasser → Glucose und Sauerstoff entstehen

Figure 30: Definition of photosynthesis in glossary of Markl (2010, p. 488). Reproduced with permission. © Ernst Klett Verlag GmbH.

Figure 30[114] shows the entry for *Fotosynthese* in Markl's (2010) glossary The term itself is highlighted through bold font, an arrow and blue color mark the page number where photosynthesis is discussed most thoroughly. This is followed by a translation of the technical term into English, marked in italics. In addition to this, blue arrows mark other important terms in the glossary connected to this term (*assimilation, chlorophyll, glucose*). This glossary entry illustrates an ideal technicalizing process, i.e. it very clearly shows how a term becomes technicalized in Wignell et al.'s (1993) sense: The term is set up as technical first through orthographical highlighting of the term itself (bold font) as well as of its translation (italics). The translation itself also contributes to the highlighting of the term in that the word that is translated is given importance. This is followed by a concise and technical definition of said term (elaboration), ultimately defining "the meaning that it [this term] will encode whenever it is used again within the context of that field" (Wignell et al., 1993, p. 148), as well as its relation to other technical terms used in the discipline. The glossary also nicely illustrates what Wignell (1998) referred to with regard to the recursiveness of technicality, namely that technical terms are interconnected and can be used to set up other technical terms which can be used to set up other technical terms:

> This [technicalizing] process is recursive: the technicality, once established, can be used to create further technicality, which can then be used to explain and can then be used to set up further technicality and so on. (Wignell, 1998, pp. 298–299)

Here, in order to understand photosynthesis, one needs to understand what kind of process assimilation is, as well as what chlorophyll and glucose refer to, otherwise the definition in the glossary does not help

[114] English translation: "Photosynthesis → p. 118 *photosynthesis* most important form of autotrophic → assimilation, in which → glucose and oxygen are produced from water and CO_2 with the help of → chlorophyll under the influence of sunlight".

one understand the concept of *Fotosynthese.* By referring to the other terms' entries in the glossary, the definition of *Fotosynthese* in the glossary thus facilitates this recursiveness of technicality for students. In the classroom, *Fotosynthese* is introduced in the first recorded lesson of non-CLIL class 1f:

Extract 9.25: Non-CLIL_1f1_20150505

```
01   T2:  Wenn man, stellen Sie sich folgende Situation
          vor. Sie nehmen irgendein Gefäss geschlossenes
          Gefäss, geben da Algen hinein die machen
          Fotosynthese und geben irgendwelche Organismen
          kleine Organismen hinein, die diese Algen
          fressen. (...) Fotosynthese macht ja Sauerstoff
          uh uh Atmung produziert CO2 Zellatmung.

          [If you, imagine the following situation. You
          take any vessel, closed vessel, and put in algae
          which run photosynthesis and add any organisms
          microorganisms that feed on these algae. (...)
          Photosynthesis produces oxygen uh uh respiration
          produces CO2, cellular respiration.]
```

One can assume by the way T2 mentions *Fotosynthese* that this is not the first time students have heard the term. Later in the same lesson (second sentence in extract 9.25), T2 gives a very brief elaboration as to what *Fotosynthese* is, in that it "produces oxygen" in analogy to cellular respiration, which produces carbon dioxide (CO_2). For the next two lessons, *Fotosynthese* is always used as a familiar term. Interestingly, in lesson Non-CLIL_1f2_20150512, T2 reintroduces the term by explicitly stating:

Extract 9.26: Non-CLIL_1f2_20150512

```
01   T2:  Bevor wir uns ein bisschen genauer mit der
          Fotosynthese beschäftigen, bisher haben wir
          immer immer nur gesagt, ja, Fotosynthese, wird
          Glukose hergestellt, Sauerstoff wird
```

freigesetzt, CO_2 wird verwendet. Aber damit wir eben ein bisschen genauer schauen, wie das läuft. Nicht so im Detail wie die Zellatmung, keine Angst, will nicht allzu ins Detail gehen, aber ein bisschen betrachten.

[Before we look at photosynthesis in a bit more detail, until now we have always always just said, yeah photosynthesis produces glucose, oxygen is released, CO_2 is used. But in order for us to look at this in more detail, how this is running. Not in detail like cellular respiration, no worries, don't want to go into too much detail, but look at it a bit.]

In extract 9.26, the opening of the lesson is shown. T2 announces that in this lesson they will have a more detailed look at *Fotosynthese*. So again, the highlighting of the term is realized through the regulative register by explicitly stating that photosynthesis is the topic of the lesson. Interestingly, T2 here gives a brief repetition of how the term had been defined up until this point, namely as a process that "produces glucose, oxygen is released, and CO_2 is used". This definition is added immediately after the term is highlighted the first time. However, T2 adds that now in this lesson they will go into more detail about *Fotosynthese,* consequently further elaborating on the definition mentioned in the opening. He does so later in the lesson (see the discussion of *Calvinzyklus* afterwards). In the meantime, the term *Chloroplasten [chloroplasts]* is introduced in the teaching materials as follows:

Extract 9.27: T2's teaching materials 1f (non-CLIL)

In den Zellen des Schwamm- und vor allem des Palisadengewebes befinden sich die **Chloroplasten**, die grünen Organellen für die Fotosynthese (→ Abb. 2, → Abb. 4, S. 212).

[The cells of the mesophyll contain **chloroplasts**, the green organelles for photosynthesis (→ Fig. 2, → Fig. 4, S. 212).]

In extract 9.27, the technical term is highlighted through bold font, and is immediately followed by a definition, explaining that chloroplasts are green organelles responsible for running photosynthesis. This is followed by a reference to two figures visualizing these organelles. In addition to the definition and the illustration, *Chloroplasten* also has an entry in the glossary (Markl, 2010, p. 485) completing the technicalizing process in the teaching materials

It is during lesson Non-CLIL_1f1_20150512 when discussing the differences between sun and shade leaves, chloroplasts are first mentioned. In extract 9.28 a student replies to the teacher's previous question that the sun leaf contains more chloroplasts (line 01), thus using the term as an already familiar term at this point. The teacher then responds by confirming that indeed sun leaves have more chloroplasts, but goes on to (re-)introduce the term *Chloroplasten* in his reply (line 02).

Extract 9.28: Non-CLIL_1f1_20150512

01 S: Das Sonnenblatt hat mehr Chloroplasten.

[The sun leaf has more chloroplasts.]

02 T2: Hat mehr Chloroplasten, genau. Diese grünen Körner stellen Chloroplasten dar. (...) Das heisst, wenn viel Licht kommt, gibts da viel mehr Apparate, Chloroplasten, welche Fotosynthese machen können. (...) hats mehr Zellen, die Fotosynthese machen und diejenigen Zellen sind die Chloroplasten.

[Has more chloroplasts, exactly. These green grains represent chloroplasts. (...) That means, if there is much light, there are more apparatuses, chloroplasts, which can run

```
photosynthesis. (...) has more cells that do
photosynthesis, and these cells are the
chloroplasts.]
```

The teacher highlights the term *Chloroplasten* by first pointing them out as the “grüne Körner [green grains]” in the picture they see. After that, he twice defines *Chloroplasten,* once as “Apparate (...) welche Fotosynthese machen können [apparatuses (...) which can run photosynthesis]” and once as “Zellen, die Fotosynthese machen [cells that run photosynthesis]”, wrapping it up by specifically mentioning that “these cells are the chloroplasts”. Apart from the interaction shown in extract 9.28, *Chloroplasten* is used by the teacher and his students as a familiar technical term in this as well as all other lessons of non-CLIL class 1f.

Moving on to the introduction of the third technical term, *Calvinzyklus [Calvin cycle].* In the textbook, *Calvinzyklus* is introduced at the end of the text with the following phrasing:

Extract 9.29: T2’s teaching materials 1f (non-CLIL)

> Die Thylakoidstapel sind der Ort der lichtabhängigen Reaktionen, im Stroma finden die lichtunabhängigen Reaktionen statt, auch als **Calvinzyklus** bezeichnet (→ Abb . 3, S. 141).
>
> [The thylakoid stacks are the site of the light-dependent reactions, the light-independent reactions take place in the stroma, also known as **Calvin cycle** (→ Fig. 3, p. 141).]

In extract 9.29, the text describes the site of the light-dependent and light-independent reactions, before at the end using a non-projecting naming process (“bezeichnet als [known as]”) to link the “light-independent reaction” to the *Calvinzyklus*. Thus, highlighting of the term is realized once again orthographically (bold font), but this time aided by a non-projecting naming process stating that *Calvinzyklus* is the technical term for light-independent reactions. In the text in question, however, there is no elaboration on what exactly a light-independent reaction is. The only definition of *Calvinzyklus* provided is that it is a synonym for the light-independent reaction. Without knowledge of the light-independent reaction, understanding the *Calvinzyklus* remains, however, unclear. The text then refers to a figure on a different page, which shows a visualization of the complex chemical processes and compounds involved in the *Calvinzyklus.* Thus, technicalizing step 2 of the *Calvinzyklus* is supported by a visual representation of said cycle. Also, because the term is highlighted through bold font in the running text, there is a separate entry in the glossary at the end of the textbook (see Figure 31).

Calvinzyklus (lichtunabhängige Reaktionen) → **S. 139**
Calvin-Benson cycle zyklische Reaktionsfolge, die der lichtabhängigen Reaktion der → Fotosynthese nachgeschaltet ist, bei der CO_2 fixiert und → Glucose gebildet wird

Figure 31: Definition of Calvin cycle in glossary of Markl (2010, p. 484). Reproduced with permission. © Ernst Klett Verlag GmbH

In Figure 31[115], the term in question is highlighted through bold font. Interestingly, both terms are highlighted here, that is, *Calvinzyklus* and in brackets the synonym, *lichtunabhängige Reaktionen [light-independent reactions]*. Same as in the other glossary entry for *Fotosynthese* (Markl 2010, p. 488), there is a reference to a page number where this phenomenon is explained in the textbook, followed by a translation into English highlighted in italics. This is followed by a concise definition, including references to other technical terms such

[115] English translation: "Calvin cycle (light-independent reaction) → p. 139 *Calvin-Benson cycle* cyclic reaction sequence downstream of the light-dependent reaction of → photosynthesis, in which CO^2 is fixed and → glucose is formed"

as *Fotosynthese* or *Glucose,* each marked through blue arrows, hence completing the technicalizing process of *Calvinzyklus.*

Overall, the teaching materials introduce the term *Calvinzyklus* as technical by foregrounding the highlighting of the term—bold font, non-projecting naming process—and a minimal definition plus reference to figure. Thanks to the glossary, where the technicalizing process is complete, readers, if they know how to use the textbook properly, will have no problems understanding the term *Calvinzyklus.*

In the classroom, the discussion of the term *Calvinzyklus* itself is minimal, in that it is only mentioned three times. This has, however, much to do with the fact that T2 uses the term *lichtunabhängige Reaktion* instead of *Calvinzyklus*. It is therefore worthwhile to extend the introduction of *Calvinzyklus* to the introduction of the *lichtunabhängige Reaktion*. To do so, it is necessary to revisit the lesson where T2 introduces *Fotosynthese* in more detail (opening shown in extract 9.26, continuation here in extract 9.30).

Extract 9.30: Non-CLIL_1f2_20150512

```
01    T2:  Unter Fotosynthese gehören zwei Gruppen von
           Reaktionen. Die eine Gruppe der Re- Reaktionen
           wird hier die lichtabhängige Reaktion genannt,
           die andere Gruppe sind die lichtunabhängigen
           Reaktionen.

           [Photosynthesis includes two groups of
           reactions. One group of re- reactions is called
           the light-dependent reaction here, the other
           group are the light-independent reactions.]
```

In extract 9.30, T2 starts by saying that there are two groups of reactions that are subsumed under the term photosynthesis, the light-dependent and the light-independent reaction. As mentioned in Chapter 5, technicality in science is also used to reorganize the world according to scientifically grounded taxonomies (that can be different from common-sense taxonomies, see Section 5.1.1). In the case of extract 9.30, technical terms are put into a taxonomic relationship with each

Fotosynthese [photosynthesis]

- *lichtabhängige Reaktion [light-dependent reaction]*
- *lichtunabhängige Reaktion [light-independent reaction]*

Figure 32: Scientific taxonomy of photosynthesis established by T2

other to construct a part-whole relationship (Wignell, 1998, p. 302), in this case the *lichtabhängige* and the *lichtunabhängige Reaktion* make up *Fotosynthese* (Figure 32).

As shown in extract 9.30 above, the term *lichtunabhängige Reaktion* is first introduced as being one part of *Fotosynthese.* In the lesson itself, T2 goes on to explain both reactions in more detail. Looking at his introduction of light-independent reactions (extract 9.31 below), he first shows a graphic visualization of these reactions on the beamer, he first shows a figure on the beamer, taken from the textbook (see Figure 33).

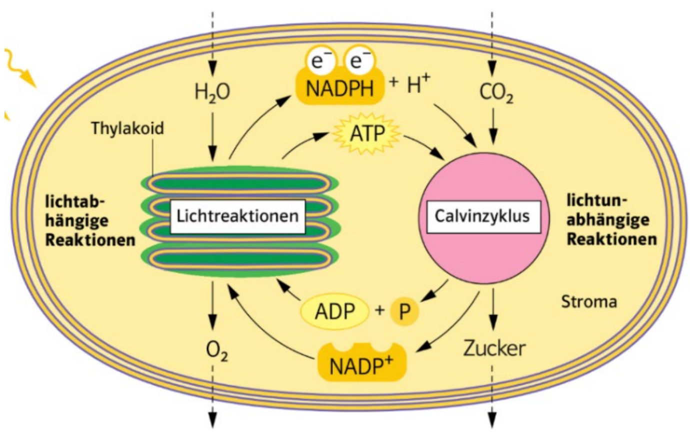

Figure 33: Graphic visualization of photosynthesis in Markl (2010, p. 133) presented by T2 to his students in lesson Non-CLIL_1f2_10150512. Reproduced with permission. © Ernst Klett Verlag GmbH

In Figure 33, the two terms that are highlighted in bold font are the *light-dependent reactions* (on the left) and the *light-independent reactions* (on the right). In boxes, two alternative names for these reactions are shown, that is *Lichtreaktionen [light reactions]* for light-dependent and *Calvinzyklus* for light-independent reactions. Based on this figure, T2 explains in extract 9.31 that the reaction on the right side depicts the light-independent reaction, which is sometimes also called *Dunkelreaktion [dark reaction]*. For that he uses a non-projecting naming process ("sometimes one also hears the name") to introduce a synonymous term for the light-independent reaction.

Extract 9.31: Non-CLIL_1f2_20150512

01 T2: Rechts dargestellt die lichtunabhängige Reaktion. Manchmal hört man auch den Namen,uh, Dunkelreaktion, und dann meinen viele, es müsse dunkel sein, damit die passieren kann. So ist es nicht, aber die lichtunabhängige Reaktion kann, uh, stattfinden, egal, ob es Licht hat oder nicht. Da brauchts Licht, sonst geht nix. Aber das (x), egal, obs Licht hat oder nicht, deshalb lichtunabhängige Reaktion. Findet im Stroma statt. Und dort mol schnell alle das Buch holen, die das Buch noch, uh, a(l)so. Lichtunabhängige Reaktion findet im Stroma statt, wandeln CO_2, da geht das CO_2 hinein, wandeln das um mit Hilfe von ATP und dem Wasserstoff hier, wandeln das um in Zucker, es wird ein bisschen Wasser freigesetzt, nur ein bisschen, und das ADP, das NADP, geht dann zurück, und hier können, kann die Lichtreaktion stattfinden.

[Illustrated on the right hand side is the light independent reaction. Sometimes one also hears the name, uh, dark reaction, and then many think it needs to be dark for it to work. That's not how it is, but the light-independent reaction can, uh, take place, no matter if there is light or not. There needs to be light, otherwise nothing works. But this (x), doesn't matter if there is light or not, that's why light independent reaction. Takes place in the stroma. And there take all the book, who do have the book still, uh, so. Light-independent reaction takes place in the stroma, change CO_2, there goes the CO_2, changes it with help of ATP and the hydrogen here, change it into sugar, a bit of water is released, only a bit, and the ADP, the NADP, go then back, and here can, the light reaction can take place.

After that, T2 goes on to explain why the reaction is called light-independent, i.e. because in contrast to the light-dependent reaction, it can work with or without light, thus is not dependent on light, therefore the name light-independent reaction. This finalizes the highlighting of the term. A detailed definition of what this reaction actually does follow (last sentence in extract 9.31).

It is only after this detailed definition and the subsequent task instruction that a student asks a question mentioning the term *Calvinzyklus* (see extract 9.32 below). The student suddenly mentioning the term *Calvinzyklus* only makes sense in context of T2 showing Figure 33 to his students, where they, even without explicit mention from the teacher, receive a direct link between the light-independent reactions and *Calvinzyklus.*

Extract 9.32: Non-CLIL_1f2_20150512

02 S: Uh, aso die Frage, beim Calvin-Zyklus geht aber immer H_2O ab? Aber warum ist das da drin nicht?

[Uh, so the question, within the Calvin cycle is H_2O always released? But why is it not in here?]

((several lines omitted))

07 T2: Können Sie gern dazu zeichnen, ja ja ja. Ich hab die Abbildung aus dem Buch ein bisschen angepasst, auch die Beschriftung (war)

Thylakoid, steht bei Ihnen nur in drei Abbildungen drin (oder zwei) ich hab hier so ein bisschen so zusammengebaschtelt wie ichs für richtig im Sinn habe. Und H_2O geht weg vom Calvin-Zyklus, ein bisschen. Sie sehen dann nachher wie viel H_2O weggeht. Also, Ihre Aufgabe ist es, versuchen Sie für die lichtunabhängigen Reaktionen mit dem Schritt hier, Calvin-Zyklus ist Teil, und für mich der zen- der zentrale lichtunabhängige Reaktionen sind noch paar weitere uh, in diesem, in dieser Hälfte hier zusammenzustellen, was die Summengleichung ist

[You can add it to the illustration, yes yes yes. I have adapted the illustration from the book a little, also the caption (was) Thylakoid, this is only in three of the illustrations (or two) I have put them together here a little bit the way I think it is right. And H_2O goes away in the Calvin cycle, a bit. You will see later how much H_2O goes away. So, your task is to try for the light-independent reaction with this step here, Calvin cycle is a part, and for me the ce- central light-independent reactions there are some more uh, in this, put together in this half, what the summation equation is.]

The student's specific question in line 02 is then directed at discrepancies between the figure on the beamer and the figure they have on the handout. After a further discussion of these discrepancies (lines omitted in extract 9.32), T2 acknowledges that there are some differences, but that the student is correct, H_2O is released in the Calvin cycle. It is here where T2 adds another taxonomical relationship to the term *Calvinzyklus:* By claiming that the *Calvinzyklus* is only one of the light-independent reactions, he implies that there are other light-independent reactions and thus establishes a hierarchical relationship between the two, whereas the textbook seems to suggest a synonymous relationship.

The introduction of the term *Calvinzyklus* in the classroom is mainly done through visualization in that T2 extensively introduces the term light-independent reaction, but only on the beamer projection could students connect the *Calvinzyklus* to the light-independent reaction. This illustrates nicely what Wignell et al. (1993, p. 149) meant when they said that the technicalizing process "is really about translating: giving a field-specific gloss to phenomena which may be known as something else in another field or in folk taxonomies." In this case, the teacher spends much of his time explaining the term light-independent reaction. Hence when in the textbook or in Figure 33 the term *Calvinzyklus* is equated with light-independent reactions, the phenomenon known to students as light-independent reactions is given a field-specific gloss, namely *Calvinzyklus.* Therefore, the technicalizing process here is indeed a translation process.

Generally, the textbook highlights all terms orthographically (bold font) or, in the case of *Calvinzyklus,* also with a non-projecting naming process. In the running text, assigning a field-specific meaning is sometimes realized minimally (minimal definition), aided by references to figures (*Chloroplasten* and *Calvinzyklus*). This is further supported by the glossary system in Markl (2010), where the ideal technicalizing process of each highlighted term in the running text is shown (as illustrated here with *Fotosynthese* [Figure 30] and *Calvinzyklus* [Figure 31]). In classroom discourse, in the case of *Fotosynthese* and *Chloroplasten,* the terms do not seem to be completely new to students since they are used as already somewhat familiar terms in the classroom (extracts 9.25 and 9.28). In the case of *Fotosynthese,* the phenomenon is reintroduced specifically and in more detail in a later lesson. Therefore, the technicalizing process for this technical term is realized through various means over the span of a whole lesson. One of the ways *Fotosynthese* is introduced is in reference to light-dependent and light-independent reactions. While the introduction of the light-independent reaction is extensive, students only make the connection to *Calvinzyklus* through the textbook or the figure on the beamer. Thus, the introduction of *Calvinzyklus* in the classroom entirely relies on multimodal resources.

CLIL class 1b

For his CLIL classes, T2 uses *Advanced Biology* by Kent (2000). In contrast to Markl (2010), Kent (2000) does not include a glossary at the end, a disadvantage of said book according to T2. In the interview, T2 emphasized that it is important to him to have a textbook intended for native speakers of English rater than one adapted specifically for bilingual teaching. He believes that exposing students to authentic academic English, as used in the field of biology, is crucial for their language development and disciplinary literacy. T2 also mentioned that he prefers using *Kent* (2000) because he feels that composing English texts himself to meet this high standard would be challenging. In the selected teaching materials of Kent (2000), the topic is roots, and the following terms are highlighted (see Table 49). They are all discussed in lesson CLIL_1b_20150528.

Table 49: Terms in T2's CLIL teaching materials and corresponding lessons

Teaching materials 1b (CLIL) (Kent, 2000, p. 272)	**Corresponding lessons**
Taproot system	CLIL_1b_20150528
Fibrous root system	
Adventitious roots	

In the textbook, all three terms are introduced within one paragraph, depicted in extract 9.33.

Extract 9.33: T2's teaching materials 1b (CLIL)

> The roots of a plant usually form either a **taproot system** or a **fibrous root system** (figure 1). In a taproot system, the radicle (the first root to emerge from a seed) forms the major root that persists throughout the life of the plant. In a fibrous root system, the radicle does not persist for long after germination but is replaced by **adventitious roots** (roots that grow from stems and leaves).

In the first sentence, the terms *taproot system* and *fibrous root system* are highlighted (bold font) and put in a taxonomical relationship with each other insofar that roots can either have one system or the other. This is complemented by a reference to a figure illustrating both types of root systems. In the first sentence, only the highlighting of terms is realized. In the subsequent sentence, the term *taproot system* is repeated but not orthographically highlighted anymore, followed by a definition. The same pattern is applied in the next sentence with *fibrous root system:* repetition of term without highlighting, definition of term. New is that within the definition of the *fibrous root system,* a new term is introduced: *adventitious roots. Adventitious roots* are essential for the definition of the *fibrous root system,* but have not been introduced at this point. Therefore, the term is highlighted in bold font, and followed by a brief definition in brackets. This represents a complete technicalizing process of *adventitious roots* within technicalizing step 2 of *fibrous root system,* further supporting Wignell's (1998) argument on the recursiveness of technicality (technicality can be used to generate additional technicality and so on). There are thus three complete technicalizing processes in one single paragraph.

Extract 9.34 reveals that T2 introduces these concepts in the classroom in a manner similar to the textbook.

Extract 9.34: CLIL_1b_20150528

```
01    T2:  As you may remember, there are two different
           kind of root structures. One which we very often
           see and which seems the logical, because it's
           like the tree they they're a (little) round,
           it's the taproot system, where other plants have
           the fibrous root system where we have ver- very
           very many ver very fine thr- uh roots.
```

First, he mentions that there are “two different kinds of root structures”, though without mentioning the terms themselves. Then he zooms in, starting with a description of one of these “root structures” before linking them to the term itself (“it’s the *taproot system*”). He continues with the other type of “root structures”, but this time first mentioning the term *fibrous root system* before the description. The terms are highlighted through the phrasing in the first sentence. In the case of *taproot system,* T2 reverses the typical structure of the technicalizing process by describing the phenomenon first, then linking it to the term itself. In contrast, with the *fibrous root system,* the term is mentioned first, followed by a description. Even though this is the first time T2 mentions these two terms in any of the recorded lessons of this class, he introduces them with “as you may remember”, implying that this is a repetition rather than a new introduction of these two terms. This also explains the somewhat short elaborations of these terms in the lesson.

With regard to the third term *adventitious roots,* something interesting is happening. Talking about palm trees, which are monocots and have thus no secondary growth (growth in width), T2 mentions that these trees have “some kind of special roots” and “you often see additional roots grow from further up”, without mentioning any relation of these descriptions to the actual term *adventitious roots.* Therefore, students up to this point cannot be sure whether the teacher is actually referring to *adventitious roots* with these descriptions. A student then suddenly asks for the meaning of *adventitious* (line 01 extract 9.35). Up to this point, T2 did not mention that term specifically in his explanations of root systems, neither is it written on any of the beamer projections (he is showing pictures of different plants, in that case a maize plant and a palm tree including their roots). On the video-recording, however, it can be seen that this particular student and her neighbor have the textbook (Kent, 2000) open on their desk. Consequently, one can assume that she read the term *adventitious roots* in the textbook paragraph exemplified above extract 9.33. Even though in the textbook the technicalizing process is complete (highlighting of term followed by a definition), it does not seem clear to that student what it is.

Extract 9.35: CLIL_1b_20150528

01	S:	What is adventitious?
02	T2:	Adventitious that’s, oh, literal translation of adventitious. Adventitious, adventitious. They’re additional in a way, but let me see what adventitious. “Coming to us from abroad”.
		((Ss laughing))
03	S:	What?
04	T2:	That’s (weird). So, “happening or carried on according to change rather than design. Bio- in biology formed accidentally or in an unusual anatomical po- position”.
05	S:	And so, these plants really have uhm other roots than the ones above the ground?
06	T2:	Uh yes and no. (xx). The maize plant of course has additional roots below.
07	S:	Okay, and this stem does go the ground or (xx)
08	T2:	The stem continues. That’s the stem, it’s not well visible, here the stem continues to the ground
09	S:	Aha, okay.
10	T2:	And that’s, may have two even two or three layers

```
          of adventitious roots.
11   S:   Okay, so they grew longer.
```

In extract 9.35, T2 is talking about different types of roots, among them adventitious roots. The term *adventitious roots* occurs in Cole's (2015) dictionary, thus it was coded as a technical term in the quantitative analysis. In the extract above, however, the student explicitly asks for the meaning of the adjective *adventitious* (line 01). T2 first gives his own explanation in line 02 ("they're additional in a way") and then looks it up in the embedded dictionary of his computer, a strategy he often applies in his CLIL lessons in cases when he does not immediately know the proper translation or circumscription of a given word. In extract 9.35, however, it seems that the definition of *adventitious* provided in line 02 does not make that much sense to the students judging from their laughter and the student question ("what?") in line 03. It also does not seem to make sense to T2, based on his comment in line 04 ("that's weird"). He continues reading the definition for *adventitious,* and then starts co-constructing with his students what this means with regard to roots (lines 05–11).

This interaction regarding the meaning of the word *adventitious* as in *adventitious roots* shows how language and content are integrated in CLIL lessons. Based on the reading of the text in Kent (2000, p. 272), the students might very well have understood the scientific concept of what *adventitious roots* are, i.e. that these are roots growing from the stem and leaves, but not what the adjective *adventitious* actually means in German. The dictionary definition did, in a first instance, not contribute much to the understanding of the word. The student in line 05 then attempts to transfer the meaning of the definition T2 had just read to them onto the topic of roots. In co-construction, using visual aids as well, students and teacher then seem to be able to make sense of what *adventitious* means. A literal translation into German as initially suggested by T2 in line 02 would, in this case, not have enhanced chances of successful negotiation of meaning as the literal translation of *adventitious* is *adventiv* (Cole, 2015, p. 332), thus technicality is encoded the same way in English and German (see Section 5.2, or pilot study 4 in Section 10.2.1). The CLIL student survey[116] further shows that the CLIL students participating in this study explicitly enrolled in the CLIL program to improve their English, therefore they often ask for the meaning of words they do not understand. This has also been confirmed in the translanguaging analysis (see Section 8.3.2.1.1), which shows that of the 31 co-constructed translations in the CLIL lessons, 16 were initiated by students, while in the non-CLIL lessons students initiated only three of the total of 17 co-constructed translations.

In summary, the second step of the technicalizing processes of the three technical terms (*taproot system, fibrous root system, adventitious roots*) in the textbook (Kent, 2000) all follow the same concise schema: orthographically highlighting the term the first time it is mentioned, followed by a succinct definition as well as references to figures for visualization, all within one single paragraph. In the classroom, it seems that *taproot system* and *fibrous root system* have already been discussed previously and are therefore only minimally introduced as "two kind of root structures" before mentioning the terms themselves and briefly describing what these root structures look like. The case of *adventitious roots* is more interesting in that, similar to *Calvinzyklus* in the non-CLIL class 1f before, the term itself is fist mentioned in a student question. This means that the students must have made the connection between token (technical term) and its value (meaning) through other means than the teachers' explanations in the classroom. In this case it seems likely they have already heard the term *adventitious roots,* plus the student asking the question has her textbook open, where the technicalizing process of *adventitious roots* is written

[116] The CLIL student survey was a questionnaire in English given to the CLIL students participating in the study to gain information on the students' backgrounds, class compositions, and their attitudes, beliefs and experiences with the CLIL program (see Section 6.2.2).

down. Interestingly, the student only asked for the meaning of the term *adventitious,* and not *adventitious roots* as such. The subsequent discussion of the meaning of *adventitious* and its connection to *adventitious roots* shows how closely interrelated language and content in CLIL science lessons are. It further shows that technical adjectives like *adventitious* are an important part of technical vocabulary.

9.3.4 Discussion: Qualitative Analysis of the Introduction of New Technical Terms

This section aims to summarize and critically discuss the key findings of the previous analysis regarding the introduction of new technical terms. In particular, the most notable differences between the introduction of technical terms in written and oral mode are discussed, along with any similarities and differences regarding the CLIL and non-CLIL data, as well as the different teaching materials (T1's self-compiled script vs. T2's use of textbooks). The analysis sought to answer the following research question:

5. How are technical terms introduced in written vs. spoken mode? More specifically,

   a. how is the second step of Wignell et al.'s (1993) technicalizing process (setting up a term as technical by assigning it a field-specific meaning) realized in a subsample of written teaching materials?

   b. how is the second step of Wignell et al.'s (1993) technicalizing process realized in the corresponding lessons of classroom discourse?

6. Are there any similarities and differences regarding the variable of lesson type (CLIL vs. non-CLIL and T1 vs. T2)?

The qualitative analysis of the introduction of 14 new technical terms, more specifically the technicalizing process involved in such an introduction, has revealed several interesting findings. While T1 uses a self-compiled script tailored to his lesson planning, T2 uses textbooks as main teaching materials but supports this with self-compiled handouts. Regarding the highlighting of technical terms, the analysis shows that all new and important technical terms in the written teaching materials, independently of whether self-compiled or not, CLIL or non-CLIL, are highlighted orthographically the first time they are mentioned (bold font and italics in T1's script, bold font in T2's textbooks). This is a common strategy to highlight terms in textbooks, as already observed by Wignell et al. (1993, p. 147) in geography textbooks. In some cases (e.g. *alkoholische Gärung/alcoholic fermentation* and *Milchsäuregärung/lactic acid fermentation* [extracts 9.4 and 9.14]), additional attention to technical terms was brought on through the use of the regulative register_general. In two cases a non-projecting naming process are used to draw additional attention to the term (*Fermentation* [extract 9.13], *Calvinzyklus* [extract 9.29]).

With regard to assigning a technical meaning to the highlighted term, in most cases (except for *alkoholische Gärung/alcoholic fermentation* and *Milchsäuregärung/lactic acid fermentation* [extracts 9.4 and 9.14]) the elaboration (definition or description) followed immediately after the first mention of the term; immediately hereby referring to the same or the subsequent sentence. This kind of structuring facilitates the technicalizing process: The closer the token (technical term) to its value (meaning), the easier it is for the student to connect the two (Wignell et al., 1993, p. 148). In the cases of *alkoholische Gärung/alcoholic fermentation* and *Milchsäuregärung/lactic acid fermentation* where the elaboration follows later, the technical terms were repeated again before elaborating them, so the distance between 'token' and 'value' is still close. However, because the elaboration is realized the second time the term is mentioned, the term is not orthographically highlighted anymore.

Another finding of the introduction of technical terms in the teaching materials concerns references to figures. In the analysis, references to figures are used for instance in extract 9.14 (*alcoholic* and *lactic acid fermentation*) as well as in the textbooks (e.g. *Fotosynthese* and *Chloroplasten* [extract 9.27] or *taproot* and *fibrous root system* [extract 9.33]).Many textbooks and teaching materials use a number of visual elements (Kress, 2010, pp. 47, 143) to scaffold the reader through the learning process. However, such visual elements are only relevant for knowledge-building if they represent facts precisely and have a direct and clear relationship to the text. Captions, explanations and references are particularly helpful (Kernen & Riss, 2012, p. 10). The added value of visual elements is only an added value if the relationships between visual elements and the text are clear. Therefore, simply adding images and graphs without relation to the running text does little to guide the reader in her or his learning process, as it is much more laborious to connect new information on multimodal planes correctly to each other without explicit instruction. This was the case in T1's German script, which was accompanied by a figure of alcoholic and lactic acid fermentation, but no reference was made to it, so students had to figure out the connection between the text and image by themselves (*alkoholische Gärung* and *Milchsäuregärung* [extract 9.4]).

The most obvious difference of the introduction of technical terms in the teaching materials compared to spoken classroom interaction concerns the highlighting of the technical terms, as this cannot be done orthographically in classroom discourse. Instead, the teachers use multiple resources to highlight a new term in the classroom: from using the regulative register_general (e.g. *Gärung* [extract 9.7], *Milchsäuregärung* [extracts 9.9 and 9.11], *lactic acid fermentation* [extract 9.20], *Fotosynthese* [extract 9.26]), or synonyms or circumscriptions (e.g. "two examples" and "these reactions" for *alcoholic* and *lactic acid fermentation* [extracts 9.17 and 9.18], or "some kind of special roots" or "additional roots" for *adventitious roots* [extract 9.35]). In the examples analyzed, the teachers, in contrast to the teaching materials, do not use any non-projecting naming processes (apart from the introduction of *lichtunabhängige Reaktion* i.e. *Calvinzyklus* [extract 9.31], which is a special case anyways). Sometimes technical terms are not highlighted at all, since the teacher assumes they are familiar to the students, either because they have had to read up on it themselves (e.g. *Hefe* [extract 9.10]) or they are not entirely new (e.g. *Fotosynthese* [extract 9.25]).

With regard to assigning a field-specific meaning to the technical term, multiple practices are observed in the classroom to do so. One is to introduce them similarly to the teaching materials, so the elaboration follows immediately after the first mention of the term (e.g. *yeast* [extract 9.17], *taproot* and *fibrous root system* [extract 9.34]). Another practice observed in the classroom is to not introduce the term proactively, but reactively, that is in reaction to student input (e.g. *Chloroplasten* [extract 9.28], *adventitious roots* [extract 9.35]), or in reaction to a previous mistake (e.g. *Hefe* [extract 9.12]). One of the most important findings of classroom practices with regard to assigning a meaning to a technical term is the extent to which this relies on the use of multimodal resources in the classroom. Both teachers make ample use of multimodal resources so students can connect token and value themselves through these means (e.g. use of reading task in T1's lessons, use of figure in *Calvinzyklus* [extracts 9.31 and 9.32], use of textbook in *adventitious roots* [extract 9.35]).

In the following, the findings from the qualitative analysis are addressed, focusing on the similarities and differences in the introduction of technical terms in CLIL versus non-CLIL classes. T1's classes 1a and 1e are ideal for such a comparison between CLIL and non-CLIL: The selected teaching materials treat the same topic and highlight the same terms, and in the corresponding lessons the same terms are newly introduced. With regard to the teaching materials, the analysis reveals that even though the teaching materials are very similar, there are some subtle differences concerning the introduction of the terms in question. That is, in contrast to the non-CLIL teaching materials of 1a, the CLIL teaching materials additionally employ repetition of orthographic highlighting (extract 9.16), repetition of the terms themselves (extract 9.14), explicit reference to figure (extract 9.14), and the use of a non-projecting naming process (extract 9.13) to focus on a term.

The combination of these subtle differences might indicate that the teacher consciously or unconsciously adapts the teaching materials to the CLIL class. Wignell et al. (1993, p. 147) note that in some cases, technical terms are explicitly marked orthographically in a text for a second time, which is what T1 does in the English script (*lactic acid fermentation* [extract 9.16]), but not in the German script. T1 also makes an explicit reference to the accompanying figure (extract 9.14), something he does not do in the German script. As seen in the paragraph before, explicit references to relevant figures are crucial in making the relationship between text and figures clear, thus guiding the students' learning process on a multimodal level (Kernen & Riss, 2012, p. 10). In the interview, T1 acknowledges that he adapts his CLIL teaching materials to some extent, in that he, for instance, simplifies the sentence structure. The simplified sentence structure might explain the repetition of technical terms in the English script (extract 9.14). Another adaptation of the CLIL teaching materials is the use of translanguaging, more specifically, translations of terms that might be unfamiliar to students. Even though there has been no example of that in the analyzed extracts in this part, both teachers do employ this in their CLIL teaching materials, T2 in his handouts and T1 in his scripts. In the end, one might argue that T1 consciously adapts his CLIL teaching materials in areas where he is aware of the role of language (e.g. simplifying sentence structure, translanguaging), while the other subtler adaptations (repeated orthographic highlighting, explicit reference to figure and non-projecting naming process) are the result of a more subconscious process considering biology as more challenging in English than in German. This being said, it cannot be excluded that these subtle differences are there by chance—for that, a more thorough comparison of T1's remaining teaching materials would be necessary.

Comparing the introduction of technical terms in the CLIL and non-CLIL classroom discourse, there is one example in particular that stands out: *Hefe/yeast.* In both lessons, T1 instructs his students to familiarize themselves with the technical terms in the script first. In the CLIL lesson, T1 proactively completes the technicalizing process of *yeast* even before the reading task, including translanguaging (extract 9.17), and repeats the technicalizing process twice again after the reading task (extracts 9.21 and 9.22). In the non-CLIL lesson, T1 only unpacks the term *Hefe* once he realizes that he has made a mistake by calling it a bacterium instead of a fungus (extract 9.12). In other words, the introduction of *yeast* in the CLIL lesson happens proactively, whereas the introduction of *Hefe* in the non-CLIL lesson happens reactively. The small adaptations of the CLIL material as well as the different introductions of the term *Hefe/yeast* in the classroom suggest that T1 has some language awareness, meaning that he regards teaching and learning biology in an additional language as more challenging and is therefore in need of more (conscious and/or subconscious) guidance and scaffolding.

With regard to T2, a comparison between CLIL and non-CLIL is more difficult since the terms investigated are very different. Also, it seems that most of these terms have already been introduced to the students at some point preceding the recordings. Therefore, these terms are rather repeated than newly introduced in the classroom. In both CLIL and non-CLIL lessons this is reflected in minimal elaborations (e.g. *Fotosynthese* [extract 9.25], *taproot* and *fibrous roots system* [extract 9.34]) or reactive elaborations after student input (e.g. *Chloroplasten* [extract 9.28]*, adventitious roots* [extract 9.35]). The example of *Calvinzyklus* (extracts 9.31 and 9.32) in the non-CLIL lesson has illustrated how much T2 relies on multimodal resources to link the technical term with its meaning. He also does so in the CLIL lessons, but not in the discussion of the terms selected for analysis. Nevertheless, the analysis of technical terms in T2's classes is able to show how the technicalizing process is handled in discipline-specific textbooks in CLIL and non-CLIL lessons. The examples in Markl (2010) nicely illustrate the added value of a glossary for the technicalizing process of technical terms, supposing readers know how to use it accordingly. Such a glossary might be particularly helpful for CLIL students to look up the definition of interconnectedness of technical terms in the TL. In the interview, T2 mentioned that he wanted to use a textbook with a glossary for his CLIL classes, but has not yet found an appropriate one. Access to appropriate CLIL teaching materials then is a subject further elaborated on in the conclusion (Section 11.2).

The qualitative analysis of the technical terms in the teaching materials further shows how T1's script and T2's textbooks have a similar structure in their introduction of technical terms, from orthographic highlighting to usually immediately assigning a field-specific meaning. There are, though, subtle differences, such as for instance the fact that the writer-reader relationship is stronger in T1's script (use of "we"), which is not as evident in the selected textbook pages. Or the fact that the textbooks are denser in their technicalizing processes (e.g. extract 9.33 with three complete technicalizing processes within one paragraph) than T1's self-compiled script. By writing the script himself, T1 evidently adopts a more narrative style, which explains the observed differences. This is actually confirmed by the quantitative analysis (Section 9.3.1.4), which has shown that T2's teaching materials have a higher technical density and relative frequency of technical terms than T1's scripts.

This leads me to my last aspect of the discussion regarding multimodality and recursiveness of technicality. Using Wignell et al. (1993)'s technicalizing process as an analytical tool showcases how much the introduction of technical terms is characterized by multimodality and the recursiveness of technicality. Multimodality plays an important role in knowledge-building in science (see e.g. Jaipal, 2010; Lemke, 1998; Tang, Delgado, & Moje, 2014). In addition to using the textbooks or handouts as well as figures mentioned in previous examples, T1 for instance also uses an experiment to illustrate process of *lactic acid fermentation.* All of these resources contribute to assigning a field-specific meaning to a technical term. Especially in CLIL, the use of multimodal resources can help students in their acquisition of scientific language as well as knowledge if scaffolded appropriately (Fernández-Fontecha et al., 2020).

The qualitative analysis further shows that the introduction of technical terms often relies on previous knowledge, that is, on technical terms that have been defined and learned previously. In other words, technicality is recursive, meaning one technical term can be defined through or by other technical terms in order to establish a field-specific scientific taxonomy. Examples of this in the current study are the glossary entries in Markl (2010), as well as the following extracts: *alcoholic fermentation / yeast* (extract 9.21), *Chloroplasten / Fotosynthese* (extracts 9.27 and 9.28), *Fotosynthese / Calvinzyklus* [extracts 9.30–9.32), *fibrous root system/adventitious roots* (extract 9.33). Teachers need to be aware of how scientific concepts build on each other to then be able to appropriately unpack each component one by one, and eventually repack them into the more abstract scientific concept.

9.4 Summary of Chapter

This chapter has brought together two distinct approaches to analyze technicality in CLIL and non-CLIL lessons, one quantitative and one qualitative. Both draw on Wignell et al.'s (1993) concept of technicality. For the quantitative analysis, the objective was to take stock of technical vocabulary in CLIL and non-CLIL biology lessons and gain an insight into the relative frequency and technical density of technical terms. Based on Wignell et al.'s (1993) definition of a technical term, a framework using a field-specific bilingual dictionary (Cole, 2015) for identification of technical terms has been developed to calculate the technical density and relative frequency of technical terms. This framework works independent of language, making it a suitable approach to study technical terms in CLIL and non-CLIL biology lessons. Technical terms, in this study referring to nouns and compound nouns, have been coded according to three categories: POSITION, UNIT and NAME.

Relative frequency of technical terms in the EG_BIO corpus is 9%, and technical density 9.9%, which is more than everyday conversation and less than in written texts. Due to the structural differences between English and German, technical density is considerably higher in CLIL than non-CLIL lessons. Relative frequency of technical terms, however, shows that CLIL lessons use only slightly more technical terms than non-CLIL lessons. Interestingly, students use more technical terms than their teachers, in both CLIL and non-CLIL subcorpora, probably due to the institutionalized character of teacher-led whole class interaction. Overall, neither type of instruction (CLIL vs. non-CLIL) nor the teaching style (T1 vs. T2) are decisive factors in regards to the amount of technical terms. Instead, classroom register and the topics covered in the lessons seem to be good predictors of a high frequency of technical terms, as the instructional register and topics related to biochemistry have the highest frequencies of technical terms.

Rf and td differ most in regards to mode: The subsample of the written teaching materials has a relative frequency of 21% and a technical density of 24%—almost 2.5x increase compared to the classroom discourse in the EG_BIO corpus (rf=9%, td=9.9%). This means the input student receive through their teaching materials is considerably denser in regards to technicality than actual teacher-led whole class interaction. The qualitative analysis showed that one reason for this is that especially the textbooks contain concise technicalizing processes including recursiveness of technicality. It is therefore even more important for the teacher to scaffold and unpack written input appropriately. This means teachers have to introduce new technical terms accordingly. The analysis has shown that in the classroom, the teachers often highlight the term accordingly, but then leave the completion of the technicalizing process implicit, relying on multimodal resources such as reading tasks or graphic reorientations for students to make the connection between token (technical term) and its value (assigned meaning) themselves. The unpacking of technical terms is also done through translanguaging, which is why the next chapter investigates the exact role translanguaging plays in the negotiation of technicality.

10 Research Focus 3: Translanguaging in the Negotiation of Technicality

This chapter investigates the role of translanguaging in the negotiation of technicality, integrating the two central theoretical lenses of this research: translanguaging and technicality. Specifically, it examines the how translanguaging practices contribute to the un- and repacking processes of technicality. The chapter begins by revisiting the rationale and the corresponding research questions (Section 10.1). The methodology section (10.2) outlines how of semantic profiles and semantic waves (Maton, 2013) are used to analyze the role of translanguaging in the unpacking and repacking of technical terms is analyzed and explains the selection process for the episodes chosen for close analysis. The findings from the four selected episodes are then presented (Section 10.3) and critically discussed (Section 10.4).

10.1 Research Questions

Bieri (2018b) already demonstrated that teachers as well as students employ a variety of multilingual resources—translanguaging practices—to deal with technical terms. Particularly striking was the finding that translanguaging involving source languages (etymological roots such as Latin or Greek) of the technical vocabulary seems to be a useful tool for the negotiation of meaning of technical terms in CLIL as well as non-CLIL lessons. The translanguaging analysis in Chapter 8 has further shown that translanguaging with languages other than Latin or Greek can also occur in negotiations of technicality. The technicality analysis in Chapter 9 has illustrated how essential technical terms are for science teaching, and how important it is to explicitly introduce them the first time they come up in the classroom. It seems therefore particularly worthwhile to explore the connection between translanguaging and technicality in more detail, which is thus the third research focus of this project. The following overarching research question guides this exploration:

7. What is the role of translanguaging (including different linguistic, non-verbal semiotic and multimodal resources[117]) in the negotiation of technical terms?

Negotiation of technical terms hereby refers to instances of unpacking and repacking of technicality. This leads to the following key sub-question:

a. How can linguistic translanguaging practices (translations and integrations) contribute to the unpacking and repacking processes of technical terms?

Since the translanguaging framework established in Chapter 8 focuses exclusively on linguistic translanguaging, the following sub-question is also addressed:

b. What is the role of non-verbal semiotic and multimodal resources in the negotiation of technical terms?

Based on the previous analyses of translanguaging and technicality, four episodes where translanguaging plays a pivotal role in the negotiation of technical terms are identified and selected for analysis. Using Maton's (2013) model of semantic profiling serves as an analytical tool to illustrate and examine in detail the role of translanguaging practices in the negotiation of meaning of technical terms within these four episodes.

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[117] As explained in the theory chapter on translanguaging (Section 4.1.2), a distinction is made between the use of linguistic (verbalized translanguaging), non-verbal semiotic (e.g. gesturing) and multimodal resources (e.g. use of a blackboard). The use of all of these resources is considered translanguaging in the current study.

10.2 Methodology: Translanguaging in the Negotiation of Technical Terms

In this section, the methodology for the analysis of the role of translanguaging in the negotiation of technical terms is explained. First, the main findings of a pilot study on the encoding of technicality in English and German technical terms are summarized (Section 10.2.1). This is followed by a detailed presentation of the semantic profile model (Maton, 2013), which is used to analyze the role of translanguaging in the negotiation of technical terms (Section 10.2.2). Lastly, the selection criteria for the chosen episodes are outlined (Section 10.2.3).

10.2.1 Pilot Study 4: Translanguaging and the Encoding of Technicality in CLIL lessons (Bieri, 2019a)

This pilot study was conducted in order to demonstrate the value of investigating CLIL biology lessons through a combined technicality and translanguaging lens. More specifically, it pursued two goals: first, to show that technical terms are a major challenge depending on whether they are encoded the same way or not in the ML and the TL, and second, to illustrate how translanguaging practices might be potentially successful strategies to scaffold the meaning of technical terms in these situations. The encoding of technical terms refers to whether or not the term in question employs the same technicalizing process in the ML and the TL and consequently, uses the same word or expression for the same scientific concept. For a more detailed explanation see Section 5.2. From the CLIL-subcorpus (15 lessons), four episodes were manually selected where the problem of technicality due to different or same encoding seemed particularly prevalent. Table 50 shows the four selected episodes for the pilot study. Episode 1 and 2 are episodes where the term in question has the same encoding in the TL English as in the ML German, and episodes 3 and 4 refer to scenes where the technical term is encoded differently in the TL and ML.

Table 50: The four selected episodes for pilot study 4

Episode	Class	Technical term in question (TL/ML)
1	CLIL_2e_20150521	Affinity/Affinität
2	CLIL_1b_20150518	Dendrochronology/Dendrochronologie
3	CLIL_2e_20150521	Chemical equilibrium/chemisches Gleichgewicht
4	CLIL_1b_20150528	Peanuts/Erdnüsse

The full transcripts of these episodes can be found in Bieri (2019a). The qualitative analysis of the four episodes highlighted four translanguaging practices when dealing with the same or different encoding of technicality. The pilot study showed, on the one hand, that if the TL and the ML share the technicalizing process of a technical term, i.e. the term is encoded the same way, the teacher cannot simply translate the term in question. In episode 1 (*affinity*), the teacher used a more everyday term in the ML (*Begehren* [desire]), in episode 2 (*dendrochronology*) the teacher used translanguaging with the source languages of the technical vocabulary (*dendro* = tree, *chronos* = time, *logy* = the study of, thus *dendrochronology* = the study of time in trees). On the other hand, the pilot study also showed that if the TL and ML do not share the same technicalizing process, the unaware teacher might end up using the wrong terminology in the TL based on a literal translation from the ML (episode 3, *chemical equilibrium*, the teacher used *equation balance*). Being aware of the different encoding, the teacher can also highlight how terms have become technicalized in the TL and contrast it with the ML (Lin, 2016, p. 50), thereby switching smoothly from everyday meaning of the term to the scientific one (episode 4, *peanuts* = *Erdnüsse*, botanically they are not nuts but fruits from a specific plant family).

A further observation revealed by the pilot study concerns spontaneous and planned translanguaging: It seems that in episodes 1 (*affinity*) and 3 (*chemical equilibrium*) the teacher translanguaged spontaneously as a reaction to student initiations, whereas in episodes 2 (*dendrochronology*) and 4 (*peanuts*), the teacher appeared to have pre-planned the use of translanguaging to purposefully unpack the term. Striking was that in the former two cases, translanguaging did not seem to contribute much to the successful negotiation of meaning of the technical terms in question, whereas the planned translanguaging in episodes 2 and 4 seemed to have been more successful.[118]

Overall, the pilot study revealed that looking at the encoding of technicality in the ML and TL is a fruitful approach to investigate translanguaging and technicality qualitatively in CLIL lessons. However, this approach does not work in non-CLIL lessons, since there is no TL that could encode a technical term differently from the ML. Therefore, while this approach is interesting in regards to CLIL lessons, a more holistic approach to investigating translanguaging and technicality had to be found. It was found in the form of semantic profiling or semantic waves model (Maton, 2013), which, in short, refers to a model that allows for detailed descriptions of un- and repacking processes of technical terms independent of language. It is described in more detail the following section.

10.2.2 Semantic Profiles as an Analytical Tool

For the qualitative analysis of CLIL and non-CLIL lessons, semantic profiling (Maton, 2013) is used as an analytical tool to examine the role of translanguaging in the negotiation of technical terms. This way, the role of translanguaging practices in the unpacking and repacking of technical terms can be illustrated in detail independent of language or

[118] For more details on this pilot study see the article published by Bieri (2019a).

discipline. Semantic profiling is a model developed by Maton (2013), itself rooted in Legitimation Code Theory (LCT), a theory of knowledge organization. LCT, which is explained in detail in Section 5.1.2, focuses on the underlying organizing principles governing the cumulative acquisition of knowledge.

In essence, LCT suggests that knowledge structures are built by legitimizing certain practices or codes in certain contexts. The dimension most relevant to this study is the dimension of semantics, which, according to LCT, comprises two continua: semantic gravity (SG) and semantic density (SD). Semantic gravity refers to the degree of which meaning relates to a particular context, i.e. how much something is context-dependent. Consequently, the weaker the semantic gravity (SG–), the more abstract it is and the less context is needed to decode the meaning of a certain term or concept. Semantic density, in turn, describes the degree of complexity of meaning, i.e. how condensed the meaning of a term is. Strong semantic density (SD+) thus infers multiple or condensed and thus complex meanings encoded in one term, and thus more unpacking is needed to understand a term with strong semantic density (SD+).

Technical terms with a highly field-specific meaning assigned to them, are usually abstract and decontextualized (SG–) with a highly condensed meaning (SD+). Therefore, in order to unpack technical terms, a teacher should strengthen semantic gravity (SG↑, e.g. providing a concrete example) and weaken semantic density (SD↓, e.g. connecting it to previously learned terms). As mentioned in the theory chapter on semantic profiles (Section 5.1.2), unpacking happens simultaneously with regard to content (as described by the shift in SG and SD above), and with regard to language (shift from academic into everyday language).

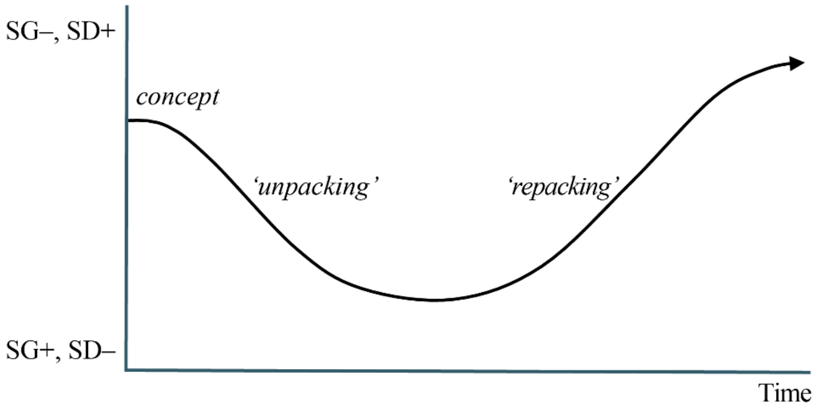

Figure 34: Semantic profile of a semantic wave (Maton 2013, p. 15). Reproduced with permission

Unpacking technical terms and scientific concepts properly is crucial for student comprehension. However, during the lessons, students are not only expected to learn and understand these technical terms and scientific concepts, but also to express these accordingly in classroom interaction or written assignments. For them to succeed in so-called "high-stakes writing" (Martin, 2013), technical terms and concepts need to be repacked, which then results in a specific semantic profile, the **semantic wave** (Figure 34).

In the classroom, however, teachers rarely repack technical terms (Lin, 2016, p. 73; Martin, 2013; Maton, 2013), which can result in a semantic profiles that look more like a downward escalator (see Figure 35).

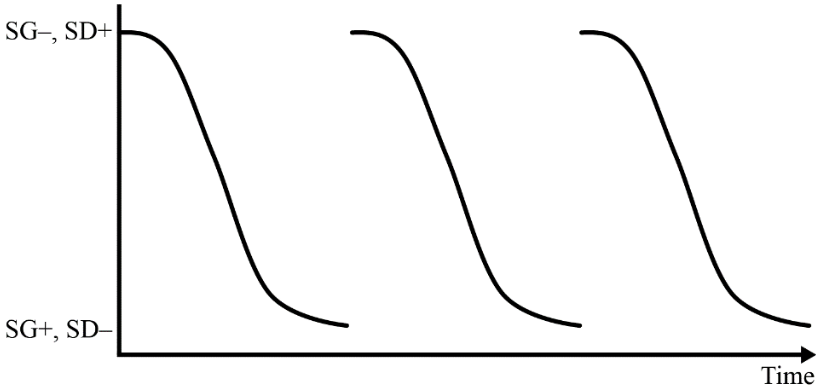

Figure 35: Semantic profile of a downward escalator (Maton 2013, p. 14). Reproduced with permission.

Semantic profiles in LCT are created by plotting semantic gravity and semantic density inversely against each other[119]. That way, semantic profiles offer a way to trace classroom practices which contribute to unpacking and repacking.

Lo et al. (2020) used semantic profiles as an analytical tool for the detailed description of un- and repacking processes in two excerpts of CLIL science lessons in Hong Kong. They found that teachers used various strategies to unpack specific concepts and academic language, from paraphrasing of nominal groups to unpacking abstract ideas with more specific concepts to using students' prior knowledge and visual aids. Translanguaging, in this case the use of the L1, was shown to be primarily used in downward shifts of the semantic wave (SG↑, SD↓). Translanguaging, in the present study, is not restricted to the L1 but includes multilingual as well as non-verbal semiotic and multimodal

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[119] Weak semantic gravity and strong semantic density (SG–, SD+), i.e. decontextualized (abstract) and complex meanings, are on the top margin of the y-axis, whereas strong semantic gravity and weak semantic density (SG+, SD–) are at the bottom margin of the y-axis. For more information, see Section 5.1.2.

resources used to convey meaning. In the analysis in Chapter 8, translanguaging has been shown to occur not only in CLIL, but also in non-CLIL lessons, and that translanguaging practices involving source languages are particularly often used in the negotiation of technicality. Therefore, a semantic profiles approach is used to examine the role of translanguaging practices in CLIL and non-CLIL lessons more thoroughly, thereby taking into account translanguaging practices that go beyond the use of the L1.

There are indeed several advantages to using semantic profiles as a model to analyze the role of translanguaging practices in the negotiation of technicality. For one, it is a holistic approach that does not depend on any specific language, discipline or program, and is therefore very well suited to investigate knowledge practices in CLIL and non-CLIL biology lessons. On the other hand, technical terms encode technicality, i.e. a field-specific meaning. Viewing instances of negotiation of technicality as the processes of un- and repacking of technical terms, including the decoding of technicality, the semantic profile model proves to be an ideal approach for not only describing these processes in detail but also identifying the role translanguaging practices play within these semantic profiles—specifically, whether they serve to weaken or strengthen SG and SD.

Further, since the semantic codes are always plotted in relation to each other, there is no specific starting point of an analysis, but the semantic entry and semantic exit of any analysis can be determined individually. This means that one can look at semantic profiles over an indefinite amount of time and in as much detail as seems appropriate—one can describe whole lesson structures in these terms (e.g. Lo et al., 2020) or even create semantic profiles of written texts (e.g. Hood, 2016). Or one can pinpoint the practices and its effect on semantic gravity and semantic density in one specific interaction, which is the approach applied in the current study.

In CLIL lessons specifically, the easiest way to unpack a technical term using translanguaging is to simply translate said term into the students' L1/ML, thereby creating a more familiar reference for the students (see extract 10.1).

Extract 10.1: CLIL_1e_20150504

01	T1:	and don't forget to indicate the path of intermediate products or intermediates, *Zwischenprodukte.*

Assuming students are indeed more familiar with the term in the L1, this would, in LCT terms, mean a minor strengthening of semantic gravity (SG↑) and weakening of semantic density (SD↓), resulting in an overall slight semantic downshift of the semantic profile. Co-constructed instances of translations work the same way, but if initiated by the teachers, they need to make sure that students (or at least the student answering) is in fact familiar with the L1 (see extract 10.2), something the teachers only assume when doing the translation by themselves. Co-constructed translations initiated by students, on the other hand, make it obvious that students have not understood the word in question (see extract 10.3).

Extract 10.2: CLIL_1e_20150511

01	T1:	What are chickpeas?
02	S:	*Kichererbsen.*
03	T1:	*Kichererbsen,* exactly.

Extract 10.3: CLIL_2b_20150505

01	S:	What is ovary in German?
02	T2:	What does it, where is it? *Eierstöcke.*

The semantic profiles of these extracts (10.1–10.3) can be illustrated as in Figure 33. Thus, translanguaging in form of a translation can help unpack a technical term rather easily in that by referring to a more familiar L1 term, the technical term is contextualized and made more tangible and therefore causing a slight downshift in the semantic profile (SG↑, SD↓).

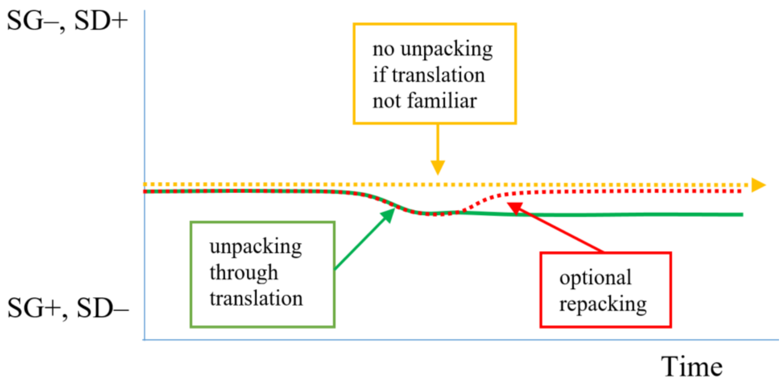

Figure 36: Prototypical semantic profiles of extracts 10.1–10.3

This, however, only works if the translation is indeed more familiar to students. In extract 10.1 for instance, if the teacher translanguages but the translation is not more familiar to the students, the semantic profile could more look like a flatline (the yellow dotted line in Figure 36) and consequently, translanguaging does not contribute to unpacking. As the pilot study has shown, this is especially the case if the encoding of the terms is the same in both the TL and ML/L1. In the case of *affinity,* for instance, there is no added value in translating *affinity* into the ML *Affinität* because they share the same encoding process, and if students are not familiar with one term, they will most likely not be familiar with its translation. In the cases of extracts 10.2 and 10.3, the semantic profile may look more like the green line in Figure 36, since the teacher makes sure that students are actually familiar with the respective translation.

The translanguaging analysis (Chapter 8) has demonstrated that the kind of translations shown in extracts 10.1–10.3 are indeed common ways to use translanguaging in CLIL lessons and that they occur not only in CLIL lessons, but also in non-CLIL lessons, and in languages other than the L1 or ML. However, negotiations of technicality by simple translations only involve slight unpacking. Therefore, in order to illustrate the role of translanguaging in actual negotiations of technicality, I am particularly interested in situations where technicality is negotiated over a series of turns or within a stretch of teacher talk, so multiple un- (and repacking) processes and its use of translanguaging can be described. By investigating the role of translanguaging in the negotiation of technicality in CLIL and non-CLIL lessons, the aim is to highlight the potential pedagogical value of translanguaging practices, particularly in biology and CLIL lessons. It is expected that in the negotiation of technicality, translanguaging practices, especially those involving source languages, play a significant role in the repacking of technical terms, as such uses are often pre-planned, particularly in T2's case. Additionally, it is anticipated that repacking is still a challenge for teachers. The findings of the two previous analyses are used to identify episodes where translanguaging is particularly prevalent in the negotiation of technicality, which are then subjected to semantic profiling according to Maton (2013). The selection criteria for the episodes are outlined in the next section.

10.2.3 Selection of Episodes

The selection of episodes draws on findings from the translanguaging analysis (Chapter 8) and technicality analysis (Chapter 9). More specifically, the translanguaging analysis in Chapter 8 has shown that translations in particular seem to play a pivotal role in the negotiation of technical terms[120]. This is underlined by the qualitative analysis of technical terms in Chapter 9, which has illustrated how translation can help facilitate the technicalizing process of a technical term (see Section 9.3.3.1, the example "yeast"). The selection of episodes further draws on the variable of classroom register (Section 7.2.3), in particular, the instructional register (dealing with the actual content of the lesson) as the quantitative analysis in Chapter 9 has shown that the most technical terms do indeed occur in the instructional register (see Section 9.3.1.3). Therefore, in order to narrow down the number of potential episodes involving translanguaging and technical terms, the first top-down selection criteria are the following:

- All TRANSLATIONS occurring in the INSTRUCTIONAL REGISTER

There are a total of 121 translations occurring in the EG_BIO corpus, of which 100 occur in the instructional register. Not all of these, however, deal with technical terms. Looking through these 100 instances of translation, eight can be excluded because they do not deal with technical terms[121]. As previously noted, I am particularly interested in episodes other than the ones described in extracts 10.1–10.3. In other words, the focus is on interactions where a technical term or a concept is talked about over a series of turns, or the teacher negotiates the meaning of a technical term in a longer stretch of teacher talk. Such interactions involve actual negotiations of technicality, and therefore multiple un- and repacking processes. Therefore, the remaining 92 translations are looked at manually and all translations in

[120] Integrations can also be an essential part of the negotiation of technicality (see Section 8.3.2.1.2). However, the focus here lies on translations, as this is the most common form of translanguaging when dealing with technical terms.
[121] Three translations in the category "else" referring to *ja [yes],* two translation of verbs and one phrase from Swiss German to Standard German (which are more like a form of self-repair, see extracts 8.22 and 8.23 in Section 8.3.2.1.1), and two nominal translations concerning *Harasse [crate].*

the form of extracts 10.1–10.3 are excluded, unless they contain several instances of translanguaging about the same concept. That way, another 69 translations are excluded, leaving 23 translations. These 23 translations can be summarized in four episodes, an overview of which is shown in Table 51.

Table 51: Selected episodes for semantic profiling

Episode	**Lesson**	**Technical term/concept**	**Translations**
1	CLIL_1b_20150504	Epidermis	*exo, dermis* (2x), *Epizentrum, epi* (4x)
2	CLIL_1b_20150518	Dendrochronology	*dendro, chronos*
3	CLIL_1b_20150528	Peanuts	*Erdnüsse* (2x), *Erd-, Nüsse, Erderbsen, Erdbohnen*
4	Non-CLIL_ 1f2_20150526	Assimilation / Dissimilation	*similar, dis-* (2x), *un-, ease, at ease, disease*

All four episodes selected this way come from T2’s lessons, an issue that is further elaborated on in the discussion section (Section 10.4). For all of these episodes, a semantic profile is created by looking at which turns and sentences contribute either to unpacking (a semantic downshift [SG↑, SD↓]) or repacking (a semantic upshift [SG↓, SD↑]). Based on these semantic profiles, the role of the translanguaging practices and their contributions to un- and repacking is described and illustrated. Even though translations were used as a determiner for the selection of episodes, most of these episodes also contain integrations, as well as other non-verbal semiotic and multimodal resources. Non-verbal semiotic resources hereby refer to the use of gestures and facial expressions. Multimodal resources refer to the inclusion of different modes, such as the use of the blackboard or beamer.

Due to its quantitative nature, the translanguaging framework in Chapter 8 did not consider non-verbal semiotic and multimodal resources even though they form part of translanguaging (see Chapter 4). This was a conscious pragmatic decision, since a transcription of all 31 including non-verbal semiotic and multimodal resources would have gone beyond the scope of this thesis. However, in order to analyze the role of not only the linguistic translanguaging practices recorded in Chapter 8, but also of non-verbal semiotic and multimodal resources used in the negotiation of technicality, the same episodes 1–4 (Table 51) were watched again. This time, particular attention was paid to the use of non-verbal semiotic and multimodal resources present in these interactions[122]. Thus, all translanguaging practices present, whether linguistic, non-verbal semiotic or multimodal, are analyzed in the semantic profiles.

10.3 Analysis: Translanguaging in the Negotiation of Technicality

In this section, the different semantic profiles of the selected episodes 1–4 are presented and the role of the translanguaging practices within these episodes is examined in detail.

10.3.1 Semantic Profile 1: An Incomplete Semantic Wave

Episode 1 is taken from a CLIL lab class, in which students had to look at cross sections of garden cress seedling roots under a microscope. The episode occurs in the latter part of the lesson when students are working on their desks with their microscopes while the teacher goes from desk to desk to answer questions. Right before the exchange in episode 1 (extracts 10.4 and 10.5), the teacher explains that the blue parts students

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[122] The annotation of these resources is not as detailed as for instance in a multimodal conversation analysis (Mondada, 2008, applied to CLIL science lessons by Evnitskaya & Jakonen, 2017) or systemic functional multimodal discourse analysis (O'Halloran, 2008, applied to a CLIL context by Fernández-Fontecha et al., 2020), but is limited to what the author of the study considers relevant non-verbal semiotic or multimodal translanguaging practices.

see through their microscopes belong to the epidermis, and the red ones to the exodermis. Upon this, a student initiates the exchange negotiating the meaning of epidermis, shown in extracts 10.4 and 10.5.

Extract 10.4: CLIL_1b_20150504 – Episode 1

01	S:	Uhm *Herr* (T2's NAME) ah *nei* uh doesn't uhm *exo* mean <u>outside</u>
02	T2:	Yes
03	S:	So it would be outside the epidermis oh no it's *dermis* what does *dermis* mean?
04	T2:	*Dermis* is <u>skin</u>
05	S:	Aha
06	T2:	And ep- what does *epi* mean that's the question
07	S:	Uhm ah *Epizentrum*
08	T2:	Mhm it's an <u>epicenter</u> yes. But what does *epi* mean?
09	S:	So <u>more in the middle than outside</u>
10	T2:	No
11	S:	Okay then

Two integrations (*Herr [Mister]* and *nei [no]*) are used in the student's initiation in line 01, but these do not contribute to any shifts in the semantic range since they are both parts of the regulative register: The former is used to get the teacher's attention while the latter is a particle used as a filler. It is the translation of *exo* in line 01 that marks the first slight semantic downward shift (SG↑, SD↓) unpacking the meaning of *exo* into "outside", which is confirmed by the teacher in line 02. This is taken up and further elaborated on by the student in line 03, where she thus tries to further unpack *exo* by confirming her understanding of *exo* in relation to the meaning of epidermis ("so it would be outside the epidermis"). Within this unpacking process, the student though introduces another technical term, epidermis, which is then the subject of the following unpacking process: Asking for the meaning of *dermis*, one component of epidermis, semantic density is weakened (SD↓) by deconstructing the condensed meaning of epidermis into more specific, simpler meanings. T2's translation in line 04 further unpacks the meaning of dermis into its English equivalent "skin" (SG↑, SD↓).

The same unpacking process is employed for the other component of epidermis, *epi*. This time, however, it is the teacher who initiates the exchange (line 06). The student replies with translanguaging, using the Standard German word *Epizentrum* [epicenter] (line 07). She thus gives an example of something that is familiar to her starting with *epi.* This is then translated into English by T2 (line 08), while still repeating the question of what *epi* actually means. Therefore, the use of translanguaging by the student to the more familiar *Epizentrum* does, at first, not seem to contribute much to the unpacking of *epi* (a so-called flat-line, the yellow box in Figure 37). However, the student's elaboration of *epi* in line 09 is based on her association of *Epizentrum* as something "more in the middle than outside", which is evaluated as incorrect by T2 (line 10). After the students' elaboration in line 09, the teacher explains the meaning of *epi,* and he does so using explanatory translations, which contribute further to the unpacking process of epidermis, and of *epi* specifically (line 12 in extract 10.5 below). Explanatory translations are translanguaging practices where the corresponding unit (CU) of a translanguaged word is a multi-worded explanation of the said word (see Section 8.2.3). In other words, the term, in this case the affix *epi,* is circumscribed. This is of particular interest language-wise, since T2 does circumscribe that term with everyday language and in connection to the student's previous association of *epi* with *Epizentrum.*

Extract 10.5: CLIL_1b_20150504 – Episode 1 continuation

12	T2:	Epicenter, *epi* has nothing to do with center, *epi* is something above the center
13	S:	Aha, so it's more outside than *exo*
14	T2:	*Epi* in this at least in this case it's more outside and then you have *exo*
15	S:	Ah
16	T2:	and *exo* in many contrast to *endo*
17	S:	Ah
18	T2:	There is also the endodermis
19	S:	Mhm
20	T2:	That's what you should know

Drawing on T2's explanations of *epi*, the student reconnects the meaning of *epi* to the meaning of *exo* in line 13, correctly stating that *epi* is "more outside than *exo*". This conclusion is reaffirmed by the teacher in line 14. Linking the meaning of a technical term to previously learned terms is a typical strategy for unpacking (Maton 2013). Therefore, lines 13 and 14 continue the unpacking process by further affirming the students' understanding of *epi*, using everyday language as well as reference to previously learned concepts (*exo*) to make it more tangible (SG+) and semantically less dense (SD–). Having unpacked *epi* in relation to *exo*, T2 then starts the repacking process by contrasting *exo* with *endo* (line 16). This represents a semantic upshift (SG↓, SD↑) in that connecting *exo* with *endo* without explanation or unpacking presupposes knowledge of *endo,* making the connection more abstract and more semantically dense. This continues in line 18 when T2 mentions endodermis as another technical term related to *exo* and *endo*. T2 thus ultimately repacks *exo* (and with this implicitly also *epi,* since it was previously defined in relation to *exo*) as opposite of *endo* and consequently the exodermis as opposite of the endodermis. The statement in line 20 ("that's what you should know") wraps up the negotiation of epidermis. The complete semantic profile of episode 1 is presented in Figure 37.

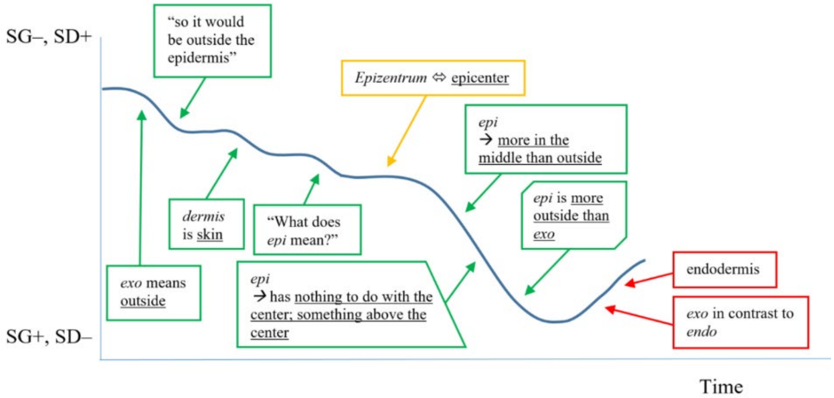

Figure 37: Semantic profile of episode 1: Negotiation of epidermis

Key: yellow= no un- or repacking; green= unpacking; red= repacking

Figure 37 shows that the negotiation of epidermis results in an incomplete semantic wave. Regarding the translanguaging practices and their role in the un- and repacking processes, Figure 37 also shows that it is mainly translations—equivalent translations in the case of *exo* and *dermis* and explanatory translations in the case of *epi*—which contribute to the semantic downshifts, that is the unpacking processes of *exo* and epidermis. On the other hand, it is the use of integrations, namely of the affixes *exo* and *endo* that play a part in the repacking process. The fact that it remains an incomplete semantic wave, i.e. that the curve's semantic entry point has lower semantic gravity and higher semantic density (SG–, SD+) compared to the semantic exit point, is due to the teacher not having completely repacked the concept of epidermis. Although he is able to relate epidermis back to exo- and endodermis, but he never repacks the individual components *epi* and *dermis* into epidermis. It is, therefore, not a complete repacking process, since students have to repack the meaning of *epi* and *dermis* into epidermis themselves to be able to follow the further repacking process into epidermis' relation to exo- and endodermis.

Furthermore, in this episode, all relevant translanguaging instances that contribute either to unpacking or repacking belong to source languages of technical vocabulary, that is either Greek or unclear[123]. The Standard German instance of *Epizentrum* does, at first, not contribute much to unpack the meaning of *epi,* as it is simply translated by the teacher (line 08, extract 10.4) without further elaboration. However, T2 then unpacks the term *epi* in relation to epicenter, therefore the student's interjection in Standard German serves as preparation for the semantic downshift that follows later.

10.3.2 Semantic Profile 2: A Multimodal Semantic Downshift

Episode 2 is taken from a CLIL lesson on dendrochronology, which denotes the study of dating trees based on their annual rings.[124] In the lesson, students work on different exercises dealing with dendrochronology. Only after a discussion of these exercises, in the latter half of the lesson, does the teacher zoom in on the actual technical term dendrochronology. T2 sits in front of his laptop; he has the textbook (Kent, 2000) and the handout on his desk. Next to his desk is the overhead projector (OHP). On the OHP he shows a transparency with a foreign word list, a list where he keeps track of the meaning of mostly Greek and Latin affixes frequently used in technical terminology in the field of biology. This foreign word list is one reason why T2's classes contain more translanguaging instances overall (see

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[123] *Epi, exo* and *endo* are Greek affixes. In the case of *dermis,* it cannot be clearly assigned to one language as it is a "modern Latin derivative of Greek *derma"* (OED, 2021b).

[124] More specifically, dendrochronology refers to the "science of arranging events in the order of time by the comparative study of the annual growth rings in (ancient) timber" (OED, 2021a).

Section 8.3.2.2). In extract 10.6 the negotiation of the term dendrochronology is shown.

Extract 10.6: CLIL_1b_20150518 – Episode 2

01	T2:	Have you written down *dendro*- what does dendrochronology mean? I guess I've got it on the sh- task sheet, did I not ((3.5s)) no, uh, uh, (x). Have you written down *dendro*?
		((T writing *dendro* and *chronos* on transparency; 6.5s))
02	T2:	So *dendro, chronos.* We have written down *logy*, that's now, question there
		((T looking through his notes; 5.2s))
03	T2:	dendrochronology [ˈdɛndroʊ ˈkrənɑ ˈlədʒi], we have written down [*logy, logos*
04	S:	[Ah, *logy*, aha
05	T2:	We got, I'm just scrolling through the list, what else I have skipped because I didn't bother to take out this sheet here

T2 starts by asking the class whether or not they have already added the prefix *dendro* to the foreign word list (line 01). In doing so, he slightly weakens semantic density (SD↓) since he is indicating that *dendro* is a part with a distinct meaning that combined with other components constructs the meaning of dendrochronology. Therefore, the sentence "what does dendrochronology mean" (line 01) after asking if they have already dealt with *dendro* represents a slight repacking because it strengthens semantic density again (SD↑). After not finding an explanation of dendrochronology in the handout, T2 repeats the question of whether or not they have already added *dendro* to the foreign world list. The question is supported by T2's action of writing the words *dendro* and *chronos* on the OHP transparency. This multimodal action further adds to the weakening of semantic density

(SD↓) since it is indicating that both *dendro* and *chronos* are distinctive parts of the term dendrochronology. This is further underlined by the teacher's verbal reaffirmation "so, *dendro, chronos*" in line 02.

He further deconstructs and thus weakens semantic density of dendrochronology by asking the class whether or not they have already written down *logy,* the third component of dendrochronology. After looking through his notes, T2 reiterates the term dendrochronology in line 03, but this time stressing the beginning of each component [ˈdɛndroʊ ˈkrənɑ ˈlədʒi]. This type of speech delivery supports the deconstruction of dendrochronology into three distinct components. The teacher's last utterance in line 03 then serves as answer to his previous question, confirming that the class has already dealt with the third component *logy* or *logos.* The student's almost simultaneous reply in line 04 then implies that she remembers that they have written down *logy* on the list. However, the unpacking process of what *logy* means is somewhat left implicit and up to the students. It is unclear from the video-recording alone whether or not the transparency actually also shows the entry for *logy.* In case it does, the students' unpacking process still remains implicit, but is supported by a multimodal resource.

In line 05, T2 announces that he will go through the foreign word list and add any terms that they may have missed, which is also why there are several lines omitted moving from extract 10.6 to extract 10.7. In these, T2 looks at terms like *xylo* and *terminal,* and only returns to dendrochronology after having discussed these terms.

Extract 10.7: CLIL_1b_20150518 – Episode 2 continuation

((several lines omitted))

07 T2: *Dendro*, could you know the word *dendro*? Probably not. *Dendro* is a <u>tree</u>

((T2 writing "tree" next to *dendro* on transparency; 7.3s))

08	T2:	*chronos* ((3s)) that's a word you might know chronolog- of chronology. One who has not (x) spoken before, (NAME), mhm?
09	S:	(x)
10	T2:	It's not exactly, no, a chronometry, that's, if therefore, what is chr- what we call a stopwatch was originally called a chronologer, yes?
11	S:	Time
12	T2:	It's time, time, yes
		((T2 writing "time" next to *chronos*; 3.3s))
13	T2:	and the chronometer
		((T2 writing "chronometer" on transparency; 1.5s))
14	T2:	meter is a device to measure the time, don't call it stopwatch

In line 07, T2 again asks his students whether or not they know the meaning of *dendro,* but this time more in rhetorical manner as he does not pause after posing the question and immediately continues with the answer. Using a translation, T2 strengthens semantic gravity (SG↑) by unpacking the meaning of *dendro* into "tree"*,* thus making it more tangible and concrete. This semantic downshift is once again supported by the teacher's writing down of this translation on the OHP transparency.

In line 08, T2 continues with the unpacking process of the next component of dendrochronology, *chronos.* In contrast to *dendro* before, the teacher seems to assume that students might know this word, and in the pause following *chronos* in line 08, T2 is looking at the class. Since no one raises their hand*,* T2 mentions another related term students might be familiar with, "chronology". By giving them a concrete example of a more familiar term, T2 is attempting to strengthen semantic gravity and to weaken semantic density (SG↑; SD↓).

Unfortunately, the student's answer in line 09 is unintelligible, but judging from T2's feedback in line 10 it seems not yet to have been the correct answer. Instead, T2 suggests other related terms, such as "chronometry", "stopwatch" and "chronologer" (line 10). These terms seem to have served the purpose, and the student in line 11 is able to deduce the correct answer, namely "time", which is evaluated as correct by the teacher in line 12. The unpacking process of *chronos* is a typical example of scaffolding, an instructional strategy whereby the teacher uses "different types of support and assistance (...) to help students understand and engage with content at levels higher than they would be able to reach on their own" (Tedick & Lyster, 2020, p. 129). Students would probably not have been able to decode the meaning of *chronos* on their own, but the teacher's suggestions of related words led the students to eventually deduce that *chronos* must mean time. In contrast to the translation and unpacking process of *dendro* in line 07, which is solely done by the teacher, the unpacking process of *chronos* is co-constructed with the students and therefore much more nuanced. This co-constructed translation process is once again underlined by the multimodal action of writing it up on the OHP transparency.

The last two lines (12–13) are a further unpacking process. Now that the meaning of *chronos* is clear to students, the teacher connects this to the previously mentioned term "chronometer", stating that a chronometer is thus a "device to measure the time". This focus on chronometer is further enhanced by T2's action of writing down the term chronometer on the OHP transparency. This process can also be interpreted as a further semantic downshift (SG↑, SD↓) in that chronometer is yet another more concrete example to illustrate the meaning of *chronos*. The semantic profile for the negotiation of dendrochronology is presented in Figure 38.

Figure 38 visualizes the unpacking process of dendrochronology. There are two major semantic downshifts, the first one representing the interaction presented in extract 10.6, and the second, larger one reflecting the interaction transcribed in extract 10.7.

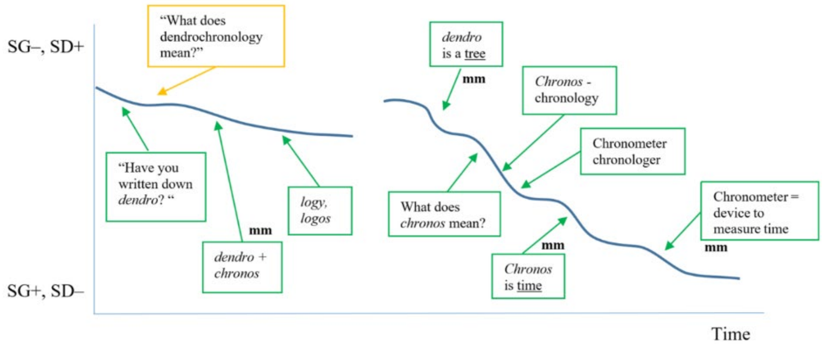

Figure 38: Semantic profile of episode 2: Negotiation of dendrochronology

Key: yellow= no un- or repacking; green= unpacking; **mm**= multimodal

The first semantic downshift is flatter compared to the second one, and this mainly has to do with the fact that this unpacking process only happens on the level of semantic density. T2 weakens semantic density (SD↓) by showing that dendrochronology is a term made up of individual components, each with their own technical meaning. He thus divides the dense and complex meaning of dendrochronology into smaller components *dendro, chronos,* and *logy/logos.* However, since T2 does not provide an actual explanation or translation of any of these components' meanings, semantic gravity (SG) remains unchanged and on the same level of abstraction, something further elaborated on in the discussion section (10.4). This is why the first semantic downshift is flatter in Figure 38 compared to the second semantic downshift. It is also why in the first semantic downshift, T2 only uses Greek integrations and no translations to deconstruct the term dendrochronology.

This is additionally supported by the use of multimodal resources, in this case writing down the components *dendro* and *chronos* on the OHP transparency. In the case of *logy*, T2 does not explicitly mention its meaning in the interaction (extract 10.6), instead it becomes clear that the class has already covered and unpacked this term previously, therefore T2 relies on students' previous knowledge to unpack the term here. The second semantic downshift eventually consists of two translations: *dendro* means "tree" and *chronos* "time". Each of these unpacking processes is supported by the multimodal action of writing down the translated meanings next to the Greek affixes on the transparency, thereby visualizing the translation process. While the first translation of *dendro* is provided by the teacher himself, T2 uses a scaffolding technique to co-construct the meaning of *chronos* together with his students. In this episode, the translanguaging practices of integration and translation of Greek affixes, along with the multimodal resource of writing these down on a transparency, contribute to the unpacking process.

10.3.3 Semantic Profile 3: A Continuous Semantic Upshift

Episode 3 is taken from a CLIL lesson about roots. T2 is sitting at his desk, having one elbow on the desk and holding a pen in the other hand. He is showing a selection of plants and their corresponding roots on the beamer, which the students then have to discuss. In line 01 in extract 10.8, T2 asks the class what they see on the picture.

Extract 10.8: CLIL_1b_20150528 – Episode 3

01	T2:	And can you figure out what the picture on top shows?
		((Silence; Ss raising their hands, 9s))
02	S:	Peanuts?
03	T2:	Peanuts, yes. <u>Peanuts</u>, *Erd*- think of the German name *Erdnüsse*. Well, uhm this is all the also the, the English name Peanuts, pea is correct, it belongs to the family of peas of beans.
		((T2 pointing to the beamer))
04	T2:	but nuts is incorrect. These are not nuts. Peanuts are not nuts. And in German, *Erdnüsse*,

		Erd-, earth, is correct, because they (live), they grow underground, but of course, nuts, *Nüsse*, it's not correct. *Ja [Yes].*
05	S:	So, peanuts in German should actually (be) called *Erd-, Erd-*
06	T2:	*Erderbsen [earth peas].*
		((Ss laughing))
07	T2:	*Ja.* Something like that or *Erdbohnen [earth beans].*

After a longer silence and students slowly raising their hands, a student replies with "peanuts" (line 02), which is confirmed by the teacher's repetition in line 03. It is here where the unpacking process of peanuts actually starts. I have discussed this episode elsewhere (Bieri 2019) through the lens of the encoding of technicality[125], but here the focus lies on the use of translanguaging practices in the un- and repacking processes of technicality. Important to note here is that the students have an everyday understanding of the concept of peanuts as a salty snack. As such the term is concrete and has a simple meaning (SG+, SD–). However, in botany, peanut has a specialized field-specific meaning referring to the fruits of the plant species *Arachida hypogaea* of the pea or bean family (*Fabaceae*). This technical meaning of peanut is more abstract and more complex, has thus weaker semantic gravity and stronger semantic density (SG–, SD+). In this case, the teacher does not have to unpack, but rather repack[126] the everyday notion of peanuts (SG+, SD–) into a scientific understanding of peanuts (SG–, SD+). How T2 solves this is illustrated in extracts 10.8 and 10.9.

[125] See Section 10.2.1 for a summary of Bieri (2019a).

[126] Repacking usually requires unpacking, i.e. a technical term can only be repacked if it has been unpacked before. However, in this specific case, where a technical term has an existing vernacular, repacking is purely understood as the process of weakening SG and strengthening SD, which is why in this specific episode repacking can occur without unpacking.

In line 03, T2 starts with translating “peanuts” into its German equivalent, which causes a first slight semantic downshift (SG↑, SD↓). Interestingly, he then uses both, the English “peanut” as well as the German equivalent *Erdnüsse* to scaffold the scientific meaning of these terms. He first deconstructs the English term peanuts into its individual components, “pea” and “nuts”. This is a typical case of weakening semantic density (SD↓). However, he immediately repacks these individual components by showing their relation to the scientific meaning of peanuts, e.g. in line 03 “pea” is correct because it indeed belongs to the family of peas or beans. He supports this statement with the multimodal action of pointing to the picture on the beamer, which shows an *Arachida hypogaea* plant. Similarly, T2 explains that the second component “nuts” is misleading since “these are not nuts” (line 04). The repetition of “peanuts are not nuts” further emphasizes the repacking process. T2 then employs the same scaffolding technique with the German term *Erdnüsse,* which weakens semantic density (SD↓) by looking at the individual components *Erd* and *Nüsse.* This is coupled with a translation of said components into English, thus causing a further semantic downshift. In the case of the affix *Erd-,* T2 translates this into “earth”, further strengthening semantic gravity and weakening semantic density (SG↑, SD↓). He, however, immediately repacks this in a semantic upshift (SG↓, SD↑) when he explains how the meaning of “earth” reflects the fact that peanuts actually grow underground (line 04). In the same vein, “nuts” is translated by the teacher into German *Nüsse,* causing a slight semantic downshift, before he repacks it by evaluating that this is not accurate as peanuts are, botanically seen, not nuts.

T2’s explanations regarding the misleading terminology in English and German causes a student (line 05) to attempt the coinage of a scientifically correct term, starting with the affix *Erd-* (since this is the accurate part of the German term), but struggling to find a second component. This gap is filled by T2 in lines 06 and 07 with creative translations of peanuts as *Erderbsen [earth peas]* and *Erdbohnen [earth* *beans].* These creative translations are part of the repacking process, since they reflect the scientific meaning of peanuts more accurately. Semantic gravity is thus weakened (SG↓) while semantic density is strengthened (SD↑). The repacking process continues in extract 10.9, when a student specifically asks whether this means that peanuts are in fact peas (line 08), which is confirmed by another student (line 09).

Extract 10.9: CLIL_1b_20150528 – Episode 3 continuation

08	S:	*Aso sinds Ärbse? [So these are peas?]*
09	S:	*Jä [Yes]*
10	T2:	They, they're related to
11	S:	What is it different (x)
12	T2:	If if you look at it, think of the outside of the peanut, that's like a bean.
		((T2 hand movement imitating the shape of a bean))
13	S:	What's the (xx)?
14	T2:	Well it it's a plant family, which (does) this is kind of uh
15	S:	Ah
16	T2:	Okay.
17	S:	And then what is a, yeah, is it just part of the stem?
18	T2:	It's a, it's the the the fruit
19	S:	It's a fruit
20	T2:	It's a fruit. Peanut is a fruit. *Ja [Yes]*. In the bio- botanical sense of fruit. Like tomato is fruit

The fact that the students in lines 08 and 09 are speaking Swiss German might mean that the question was not oriented towards the teacher specifically, but rather to her fellow classmate. On the other hand, the student's gaze as well as the volume indicate that it was indeed also directed at the teacher. Whatever the reason for translanguaging, the teacher answers their question and relativizes the student's confirmation in line 09 by explaining that peanuts are not peas, but they are related to them (line 10). He is thus further repacking the technical meaning of peanuts, in this case in relation to peas. When another student in line 11 supposedly asks about the difference between peanuts and peas[127], T2 further repacks the meaning of peanut by stating that peanuts look like beans, which he underlines with hand gestures imitating the shape of a bean (line 12). The student's interjection in line 13 is partially unintelligible, making it unclear what she asked. However, based on the teacher's response in line 14, it likely pertains to the botanical definition of peas.

The teacher clarifies—a decisive moment in the scaffolding and repacking process in my view—that peas denote a specific plant family, which produces these kind of fruits. However, in line 14, T2 leaves the fruit part implicit and only mentions "this kind of uh". The fact that this implicitness is problematic becomes clear in line 17, when a student elaborates that in this case peanuts must be a part of the stem. A logical conclusion considering students have learned in extract 10.8 that peanuts grow underground. However, the teacher corrects this statement in extract 10.9 by saying that peanuts are in fact fruits, and not part of the stem (line 18). This is repeated by the student (line 19) and reiterated again by the teacher (line 20). T2 completes the repacking process by summarizing that peanut is indeed a fruit, adding that it is a fruit in the botanical sense (since fruit, too, has an everyday meaning that is different to a scientific understanding of fruit). In this whole interaction, T2 was able to make the conceptual change from students' everyday understanding of peanut as a snack to a technical

[127] Since the last word of the student's question in line 11 is unintelligible, it can only be assumed that this is the question she posed.

understanding of it being the fruit of a specific plant family. The semantic profile of this interaction is presented in Figure 39.

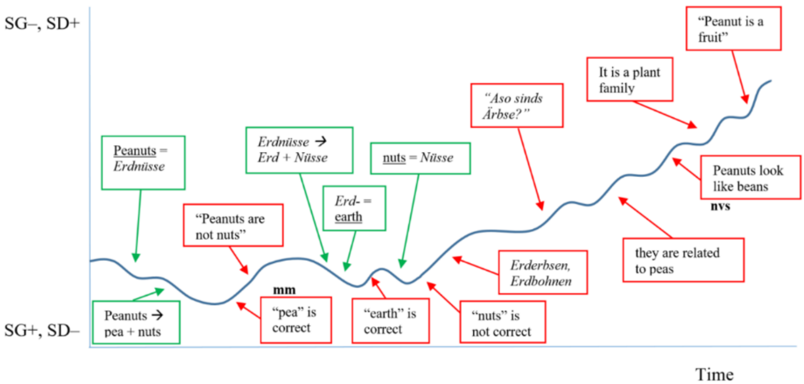

Figure 39: Semantic profile of episode 3: Negotiation of peanut

Key: green= unpacking; red= repacking; **mm**= multimodal; **nvs**= non-verbal semiotic

Figure 39 shows that the whole interaction can be summarized as one large repacking process, that is, a semantic upshift (SG↓, SD↑) by repacking the concrete and simple meaning of peanut familiar to students (SG+, SD–) into the more abstract and complex meaning of peanut as it is known in the field of botany (SG–, SD+). However, within this overall semantic upshift, there are several minor instances of unpacking or semantic downshifts (the green boxes in Figure 39). In regards to translanguaging practices, it is mainly equivalent translations in Standard German which are used to unpack the meaning of the term peanuts and its components. They are, however, immediately repacked again by relating their unpacked meanings to the scientific meaning of peanuts. In the case of "pea", a multimodal action (pointing to the picture) supports the repacking process. Other translanguaging practices used to repack are the creative translations *Erderbsen* and *Erdbohnen*, and an integration in Swiss German. Overall, the analysis of episode 3 nicely illustrates that in cases of technical terms with an already existing vernacular, repacking is the most important pedagogical process. A semantic profile can, thereby, describe in detail how the concrete and simpler meaning of the everyday term is repacked into the more abstract and complex meaning of the technical term.

10.3.4 Semantic Profile 4: Interconnected Semantic Waves

Episode 4 is the only one taken from a non-CLIL lesson. It takes place at the beginning of the lesson, right after the opening when the teacher explains that they will review some technical vocabulary that they have not yet covered on the foreign word list already discussed in episode 2. T2 stands next to the OHP. Starting with the technical term "assimilation" (SG–, SD+), T2 is already weakening semantic density (SD↓) by referring to an individual component of the same word, i.e. simile (lines 01–02 in extract 10.10), which is further underlined by the multimodal action of writing that component down on the OHP transparency. Interestingly, T2 claims students should know "simile" from English or French, when in fact this is a term codified in the German Duden (2021). Thus, the assigned language of "simile" is Standard German, and the use of Standard German in a non-CLIL class is not considered translanguaging in this study. This is, however, another good example illustrating the concept of translanguaging in that what is classified as part of the German language from an external perspective may not align with the participant's own internal perception.[128].

The first translanguaging instance in extract 10.10 is *aso*. *Aso* may have several functions primarily related to structuring discourse (see e.g. Section 8.3.5), none of which, however, contribute to un- or repacking processes of assimilation. What contributes to the unpacking

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[128] For more information on the theory of translanguaging, see Chapter 4. For a discussion of another example illustrating the external and internal view of translanguaging, see Section 8.3.6.

process though are the teacher's integrations of *similar* and *similaire,* and its subsequent translation. It is a co-constructed translation in that T2 specifically asks the class for the meaning of *similar* in German (line 02).

Extract 10.10: Non-CLIL_1f2_20150526 – Episode 4

01 T2: Assimilation. Gehen wir vom, gehen wir vom Begriff aus

[Assimilation. Let's start with the term itself]

((T2 writing "simile" on transparency, 2s))

02 T2: Simile, kennen Sie aus dem Englischen, aus dem Französischen, *aso* die Endung ist ein bisschen anders. *Similar* or or *similaire,* französisch oder englisch *similar,* heisst was? Ja

[Simile, you know from English, from French, *that is* the ending is a bit different. *Similar* or or *similaire*, French or English *similar* means what? Yes]

03 S: Gleich und gleichwertig

[Same and equivalent]

04 T2: Gleich, ja. Gleich

[Same, yes. Same]

((T2 writing "gleich" on transparency, 3s))

05 T2: und bei der Assimilation werden diejenigen Prozesse bezeichnet, die Stoffe gleichmachen wie die eigenen Stoffe.

[and assimilation are those processes called which make substances the same like your own substances.]

((T2 is moving both his hands from outwards to inwards to indicate "to make the same"))

06 T2: Und das ist zum Beispiel das, was die

```
               Fotosynthese macht. Sie nimmt CO₂, ist
               anorganisch, fremdes Produkt,

               [And this is for example what photosynthesis
               does. It takes CO₂, is inorganic, foreign
               product]

               ((T2 is waving his hands to indicate "foreign"))

07    T2:      (huh) und Wasser, und macht daraus einen
               biologischen Stoff, nämlich Glukose. Und deshalb
               wird, werden Prozesse wie die Fotosynthese
               Assimilat- auch Assimilation genannt. Und das
               Produkt der Fotosynthese wird manchmal auch als
               Assimilat bezeichnet. Das sind diejenigen
               Stoffe, die gleichgemacht wurden, wie die
               körpereigenen Stoffe. Wie Glukose zum Beispiel.
               Das ist Assimilation.

               [(huh), and water, and produces from it a
               biological substance, namely glucose. And this
               is why processes like photosynthesis are also
               called assimilate- also assimilation. And the
               product of photosynthesis is sometimes also
               called assimilate. These are those substances
               that were made the same as the body's own
               substances. Like glucose, for example. That's
               assimilation.]
```

The student in line 03 translates *similaire* as "same and equivalent", which is subsequently evaluated as correct (line 04). T2 supports the unpacking process of this translation with writing down the word "gleich [same]" next to "simile" on the OHP transparency. T2 then repacks the term assimilation a first time by relating the student's reply to the field-specific meaning of assimilation as a process that "make[s] substances the same like your own substances" (line 05). Here, a non-verbal semiotic resource is used to underline this repacking process in the form of the teacher gesturing with both of his hands to indicate the meaning of "etwas gleichmachen [to make something the same]". T2 thus weakens SG and strengthens SD by explicitly stating that these processes are called assimilation. Using a non-projecting naming process ("called")[129], the teacher links the technical term "assimilation" with its field-specific meaning "which make substances the same like your own substances" (line 05). Interestingly, the repacking happens here with everyday language

In line 06, T2 continues by giving a concrete example of an assimilation process, namely photosynthesis. Giving concrete examples of abstract meanings is a typical strategy used to strengthen semantic gravity (Hugo, 2014, p. 4) since the more abstract concept (here assimilation) is illustrated by means of a more concrete example (here photosynthesis). Thus, the teacher's utterance in line 06 represents another semantic downshift (SG↑, SD↓). T2 proceeds by briefly explaining the process of photosynthesis again, i.e. the reaction of CO_2 and water, which produces glucose (line 07). By emphasizing that CO_2 is an inorganic and foreign substance (line 06, supported by gesture indicating "foreign"), and the product of photosynthesis is a biological (organic) substance, he already repacks the more concrete example of photosynthesis (SG+) into the more abstract concept of assimilation (SG–). The repacking process (SG↓, SD↑) continues with T2 describing in more detail why photosynthesis is called assimilation, and why, in German at least, the related term "Assimilat" is used to refer to the product of such an assimilation. He explains the process of assimilation one more time in that "Assimilate" are those products which are "made the same as the body's own substances" (line 07). Highlighting glucose as an example of such an "Assimilat", T2 causes a minor semantic downshift at the end of the repacking process. He wraps up the entire negotiation with "that's assimilation" (line 07).

[129] Non-projecting naming processes like "it is called/known as", "the common name is" link a field-specific meaning to a technical term. For more information, see the theory chapter on technicality (Section 5.1.1), or the qualitative analysis of the introduction of new technical terms (Sections 9.2.3 and 9.3.3).

Looking at Figure 40, which shows the semantic profile of extract 10.10, one can see that the negotiation of assimilation is depicted as one complete semantic wave, with minor integrated waves in it.

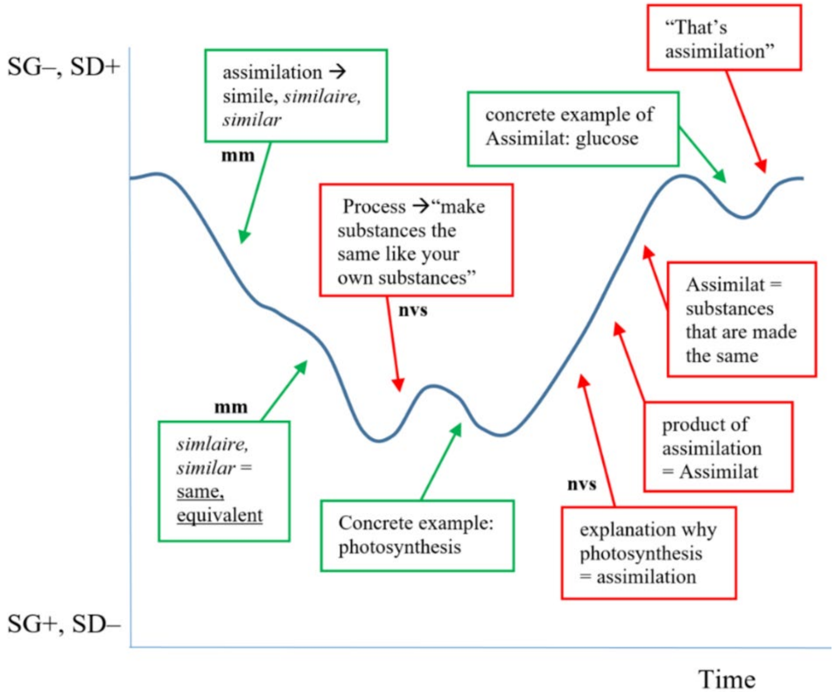

Figure 40: Semantic profile of episode 4, part 1: Negotiation of assimilation

Key: green= unpacking; red= repacking; **mm**= multimodal; **nvs**= non-verbal semiotic

More specifically, Figure 40 shows that linguistic translanguaging practices, i.e. French and English integrations and a translation (first two green boxes) are used to unpack the term assimilation, causing the major semantic downshift (SG↑, SD↓). Both of these are supported with the multimodal translanguaging practice of writing down the respective words on the OHP transparency. There are no linguistic translanguaging practices used in the semantic upshift of the term assimilation, however, two non-verbal semiotic translanguaging practices (gesturing) are used to support the repacking process.

In the second part of episode 4, which is illustrated in extract 10.11 below, T2 continues with an explanation of the opposite process, dissimilation.

Extract 10.11: Non-CLIL_1f2_20150526 – Episode 4 continuation

08 T2: Und die Umkehrung davon, etwas ungleich machen, jetzt muss ich grad überlegen, auf Französisch ungleich. Das Gegenteil von *similaire*, ich muss irgendeine Vorsilbe im Französischen davor hängen. Ich bin nicht, nicht, ich weiss, ich weiss nicht

[And the reverse of that, making something unequal, now I have to think, in French unequal. The opposite of *similaire*, I have to put some prefix in front of it in French. I'm not, not, I know, I don't know]

((T2 shrugging shoulders and hand motion indicating "I don't know"))

09 T2: *aso* der, der Fachbegriff ist Dissimilation. *Dis-*

[*aso* the, the technical term is dissimilation. *Dis-*]

((T2 writes *dis* on transparency, 3.5s))

10 T2: und *dis-* uh ist eine Vorsilbe, übersetzt mit <u>un-ungleich</u>

[and *dis-* uh is a prefix, translated with <u>un-unequal</u>]

((T2 writes *<u>un-</u>* on transparency, 6s))

11 T2: *dis-* was gibts Schlaues. Wort mit *dis-* das mit *dis-* beginnt.

[*dis-* what is there. Word with *dis-* that begins with *dis-*]

((Silence; T2 looks at class searching for a reaction, 6s))

12 T2: Kommen nur englische Wörter in den Sinn. Englisch wird sehr die, die Vorsilbe *dis-* sehr oft verwendet für *un-*

[Only English words come to mind. In English the, the prefix *dis-* very is often used for *un-*]

((Silence, 7s))

13 S: (x)

14 T2: *dis-ease,* ja *disease*, danke ja. *Dis-ease*

[*dis-ease*, yes *disease*, thank you yes. *Dis-ease*]

((T2 writes *disease* on transparency))

15 T2: uh, *ease*, das bedeutet wohl, dass es einem wohl ist. Man ist *at ease*, dann ist es einem wohl und *dis-ease*, das heisst eigentlich unwohl. Unwohl sein

[uh, ease, I guess that means you're at ease. One is at ease, then one is well and dis-ease, that actually means unwell. Be unwell.]

However, T2 does not explicitly mention the technical term itself at the beginning of line 08, instead he talks about the process itself as "to make something unequal". He continues with "the opposite of *similaire*", employing the same integration he used with assimilation before, thus relying on students' prior knowledge to invoke the meaning of dissimilation. T2, however, seems to struggle to find the French opposite of *similaire,* therefore he circumscribes it as something that needs a prefix added. He is thus weakening semantic density (SD↓) in that students now know that the technical term is made up of *similaire* and a prefix. In the end, T2 acknowledges that he does not know the opposite of *similaire* in French, and underlines this with a gesture of shrugging his shoulders and respective hand movements. This non-verbal semiotic action does, however, not contribute anything regarding un- or repacking. Yet T2's next sentence in line 09 does. He explicitly states there that the technical term he is trying to explain is "dissimilation" (SG–, SD+). In the same line, however, T2 already starts unpacking the technical term again by singling out the prefix *dis-*, and adding it to the foreign word list. A further semantic downshift (SG↑, SD↓) is achieved by translation of the prefix *dis-* (line 10), supported once again by making this translation visible on the OHP transparency.

T2 then looks for a word starting with *dis-* to exemplify what the component *dis-* refers to in dissimilation. The repetition of integrations (3x *dis-*) in line 11, however, does not further contribute to the unpacking process, since at this point it is simply a repetition of something the teacher has already explained before. Inviting help from his students to find a suitable illustrative example (line 12), T2 claims that he only knows of English words starting with this prefix, and repeats that in English, too, the prefix *dis-* often translates as *un-* in German. Since he already mentioned this translation beforehand (line10), it also does not add much to the unpacking process of dissimilation. However, by adding that in English *dis-* is a particularly frequent prefix, he might have inspired the subsequent student reply (line 13); it can therefore be viewed as a repetition that still causes a slight semantic downshift. Even though the student's answer in line 13 is unintelligible in the recording, T2 presumably repeats the student's suggestion in line 14 and thus it can be safely deduced that the student said indeed "*disease*". *Disease* as a concrete example for a word beginning with the prefix *dis-,* thus illustrating the meaning of the prefix, strengthens semantic gravity and weakens semantic density (SG↑, SD↓). This is aided by T2 adding it to the foreign word list (multimodal action). In the same line 14, T2 starts to further unpack the term *disease* by emphasizing its individual components through speech (instead of [dɪˈziːz], the stress is on each of the components [dɪzˈ iːzˈ]). He then further unpacks the term *disease* by translating each component into German using explanatory translations (line 15).

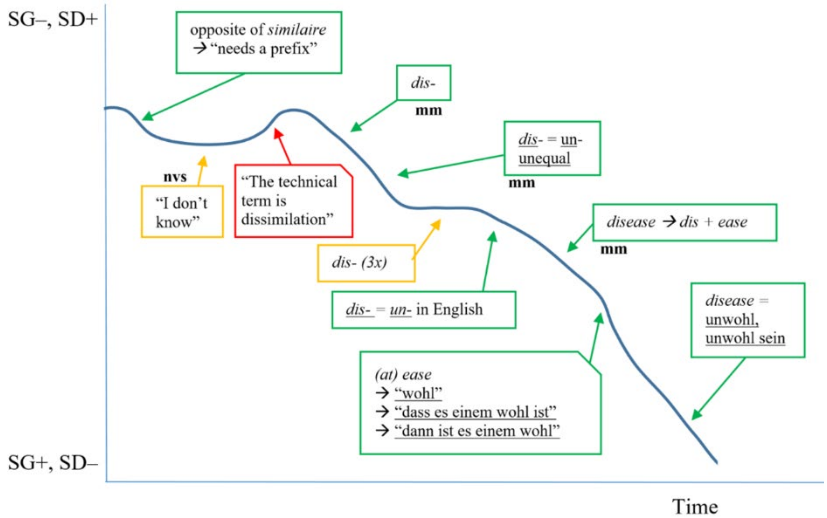

Figure 41: Semantic profile of episode 4, part 2: Negotiation of dissimilation

Key: yellow= no un- or repacking; green= unpacking; red= repacking; **mm**= multimodal; **nvs**= non-verbal semiotic

The semantic profile for extract 10.11, the negotiation of dissimilation, is presented in Figure 41. The figure shows that there is only one repacking process (the red box) taking place in the entire negotiation, namely when the teacher explicitly states that the technical term under discussion is dissimilation. All other processes contribute to the unpacking of dissimilation, that is, strengthening semantic gravity and weakening semantic density (SG↑, SD↓). Interestingly, there are two translanguaging practices that do not contribute anything to the un- or repacking process, indicated in yellow in Figure 41: once the non-verbal semiotic action of gesturing that simply emphasizes the teacher's "I don't know", and once the teacher's repetitions of the prefix *dis-,* which, because they are repetitions, do not contribute to a further semantic downshift. Apart from this, the translanguaging practices (multimodal by adding the words to the foreign word list, and linguistic by using integrations of *similaire, dis-* and *disease* and translations of *dis-, ease* and *disease*) all contribute to the unpacking process of dissimilation. Although one could argue that the second part of Figure 41 depicts the unpacking process of *disease* rather than “dissimilation”. This is also why Figure 41 depicts an overall semantic downshift, since the repacking process of how *dis-* as in *disease* is connected to “dissimilation” is left implicit and up to the students themselves.

The semantic profile of the entire episode 4, which involves the negotiation of the terms *assimilation* and *dissimilation*, is displayed in Figure 42.

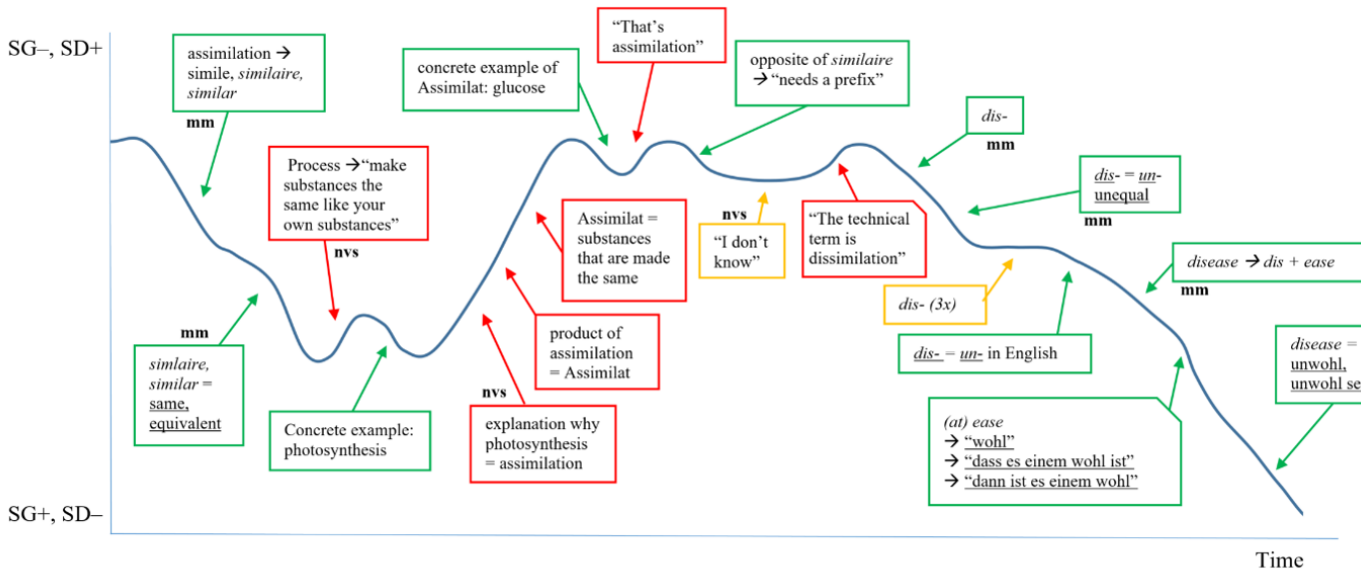

Figure 42: Semantic profile of episode 4: Negotiation of assimilation and dissimilation

Key: yellow= no un- or repacking; green= unpacking; red= repacking; **mm**= multimodal; **nvs**= non-verbal semiotic

Figure 42 summarizes nicely what has been illustrated in detail before: There is a complete semantic wave in regards to the term assimilation, which is followed by a semantic downshift when it comes to the negotiation of dissimilation. Focusing on the translanguaging practices used in these negotiations, it is noticeable that the use of integrations and translations exclusively contributes to the unpacking process (with the exception of the repetition of *dis*-), and repacking is mainly done through explanations in the ML. With regard to non-verbal semiotic and multimodal translanguaging practices, there are two different kinds used here: writing down certain words on the foreign word list (multimodal), and gesturing (non-verbal semiotic). The former is, at least in this episode, always used to support unpacking processes, often following the use of integrations or translations (e.g. *similar, dis-, un-, disease*). Gesturing, on the other hand, is used by T2 to emphasize certain features in his repacking processes (apart from the "I don't know" gesture).

10.4 Discussion

The analysis of translanguaging practices in the negotiation of technicality sought to answer the following research question:

7. What is the role of translanguaging (including different linguistic, non-verbal semiotic and multimodal resources) in the negotiation of technical terms?

The analysis and semantic profiles of four episodes shows that there are multiple translanguaging practices used in the un- and repacking processes, and their role within the semantic profiles can be very diverse. In the negotiation of epidermis (episode 1), equivalent and explanatory translations in the source languages have helped in the unpacking processes, whereas the use of integrations supported the (incomplete) repacking process. The negotiation of dendrochronology (episode 2) shows how both equivalent translations and integrations in source languages, as well as multimodal resources can be a useful tool for unpacking. The negotiation of peanuts (episode 3) illustrates, on the one hand, how creative translations in the ML Standard German, and integrations in the L1 Swiss German can contribute to the repacking process in a CLIL lesson. It further shows how such a repacking process is reinforced by the use of non-verbal semiotic and multimodal translanguaging practices. On the other hand, the analysis of episode 3 also demonstrates that even in an overall semantic upshift, equivalent translations always cause a slight semantic downshift since they are unpacking the term in question into a more familiar term. Lastly, the negotiation of assimilation (episode 4, part 1) illustrates what a complete semantic wave looks like. Equivalent translations and integrations in French and English as well as multimodal resources are used for unpacking the term, whereas mainly non-verbal semiotic resources support the repacking process. Similar to episode 2, the negotiation of dissimilation (episode 4, part 2), shows a constant semantic downshift, and illustrates how equivalent and explanatory translations, integrations as well as multimodal resources are used to achieve unpacking.

The analysis of multimodal and non-verbal semiotic translanguaging practices is of particular interest in this chapter since the translanguaging framework established in Chapter 8 only took linguistic translanguaging into account and was therefore unable to say anything about the use of multimodal and non-verbal resources in CLIL and non-CLIL lessons. Multimodal resources are often used to visualize or put into context what is talked about. The analysis of multimodal translanguaging practices in the four episodes shows that these refer almost exclusively to T2 using the OHP transparency for his foreign word list. In the episodes, multimodal resources in form of the foreign word list are only used for unpacking, since they help weaken semantic density (SG↓) by segmenting a technical term into its individual components, and strengthen semantic gravity (SD↑) by visualizing the translation of these components. The one exception where a multimodal action does not refer to the foreign word list concerns episode 3, when the teacher points to the picture on the beamer.[130] On the other hand, non-verbal semiotic translanguaging practices—which solely refer to gesturing in the examined episodes—always occur in the repacking process, often underlining the teacher's explanations.

The results summarized here, however, only reflect snippets of how a teacher can employ various translanguaging practices to un- and repack technical terms. For instance, all four episodes stem from T2's lessons. Since T2 uses the foreign word list as a pedagogical strategy, and his classes use more translanguaging in general, the selection criteria, which heavily focused on the use of translations in the instructional register, naturally favored episodes from T2's lessons. While this is not a problem in and of itself, this does not mean that T1 does not un- or repack technical terms. Especially with regard to non-verbal semiotic and multimodal resources, both teachers frequently use gestures and facial expressions as well as the beamer, the OHP, the blackboard, experiments and other teaching materials to convey meaning. For a more comprehensive analysis of non-verbal semiotic and multimodal translanguaging practices in the EG_BIO corpus, in particular also by T1, one could further expand the selection criteria to focus specifically on negotiations of technicality involving the use of non-verbal semiotic and multimodal resources.

One of the most striking findings of this analysis are that repacking, to varying degrees, is still left implicit and up to the students. Sometimes, the repacking process is simply not complete, in which case

[130] Pointing can also be seen as a type of gesturing, and therefore be viewed as a non-verbal semiotic resource. However, since he is pointing to the picture on the beamer (different mode), it is considered a multimodal action. In any case, the boundaries between non-verbal semiotic and multimodal are not clear-cut—see the theory chapter on translanguaging (Section 4.1.2) for a more thorough discussion.

the semantic profile looks like an incomplete semantic wave (e.g. episode 1). In other instances, no repacking is done at all, in which case the semantic profiles resemble a downward escalator (e.g. episode 2 and the second part of episode 4). In episode 1, the teacher repacks the meaning of *epi* in relation to *exo* and *endo,* but never actually repacks *epi* and *dermis* into epidermis. In episode 2, the teacher completes the task of unpacking the individual meanings of *dendro* and *chronos,* but relies on students' previous knowledge to figure out the meaning of *logy* and to repack everything into dendrochronology. And in episode 4, the teacher again unpacks dissimilation and its prefix *dis*- in great detail, but never explicitly repacks how the meaning of *dis*- and its example *disease* relate back to the technical meaning of dissimilation. Teachers do not often consciously leave the repacking implicit, but they do assume that it is clear to everybody, both in CLIL and in non-CLIL lessons. Based on different learner uptake, however, this implicit connection might not be clear to all students, therefore proper and explicit repacking is crucial from a pedagogical perspective. Semantic profiles can be powerful tools to show teachers why repacking is pivotal for students' success, and to visualize where repacking is missing in their own practice. It can further provide teachers with good examples of how repacking can be properly done, i.e. how semantic waves can be taught to students (Maton, 2017).

In addition to this, semantic profiles can be great tool for the analysis of technical terms that have an everyday meaning aside from a technical meaning. In episode 3, for instance, the teacher has to scaffold the students' everyday notion of peanuts into the field-specific meaning of peanuts. In such a case, the teacher's main task does not consist of unpacking the technical term, but rather repacking the everyday meaning into the technical meaning. In CLIL lessons, this can be a particular problem due to the different encoding of technicality, e.g. the TL uses a technical term derived from a vernacular, and the L1 does not (as demonstrated by Nikula, 2017b, with the negotiation of *moment* in a CLIL physics lesson). Translanguaging plays a pivotal role, and semantic profiles can visualize how exactly they contribute to the un- and repacking processes of technicality.

10.5 Summary of Chapter

This chapter has illustrated how translanguaging practices, including non-verbal semiotic and multimodal resources, can contribute to the negotiation of technicality, i.e. un- and repacking of technical terms. By means of semantic profiles, translanguaging practices that contribute to shifts in semantic gravity (SG) and semantic density (SD) have been visualized in four selected episodes dealing with negotiations of technicality. Semantic downshifts (SG↓; SD↑) thereby represent unpacking processes, and semantic upshifts (SG↑; SD↓) repacking processes.

The analysis and semantic profiles of four episodes has shown that there are multiple translanguaging practices used in the un- and repacking processes, and their role within the semantic profiles can be very diverse. For instance, translations, with the exception of creative translations, are always used to unpack, i.e. provide a more familiar term (the translation) to students. In the episodes from the CLIL lessons, this is done through the use of source languages, but also using Standard German. In the episode in the non-CLIL lesson, English, French and source languages are used. Integrations can fulfil both functions, un- as well as repacking. In the episodes analyzed, integrations are almost exclusively used in connection with source languages. Further, the example of "peanuts" has shown that semantic profiles are useful to describe negotiations of technicality in cases where the technical term has an everyday meaning as well as a scientific meaning. Instead of unpacking, the teacher has to do a sort of repacking, scaffolding students' everyday notions into the more abstract scientific meaning, causing a semantic upshift (SG↑; SD↓). Lastly, the analysis has illustrated the use of non-verbal semiotic and multimodal resources in un- and repacking of technical terms. In the episodes, multimodal resources are almost always used in form of T2's foreign word list and are thus contribute to unpacking (SG↓, SD↑). Non-verbal semiotic translanguaging practices in the form of gesturing are used in the episodes primarily underline the teacher's explanations, thus contributing to the repacking process.

11 Conclusion

In the preceding chapters I have identified and discussed translanguaging practices and the use of technical terms, as well as their interconnectedness in a Swiss CLIL and non-CLIL setting. This conclusion chapter synthesizes and discusses the key findings from the three research foci on translanguaging and technicality (Section 11.1). It then examines the implications of these findings for science pedagogy in general and CLIL subject pedagogy in particular (Section 11.2). The study's mixed-methods approach, which includes several novel methodologies for comparing CLIL and non-CLIL lessons, is critically evaluated in Section 11.3, addressing both its contributions and limitations. Finally, Section 11.4 reflects on the remaining challenges in (Swiss) CLIL research and offers directions for future inquiry.

11.1 Most Important Findings

The present study has set out to investigate classroom discourse in CLIL (English) and non-CLIL (Standard German) biology lessons at a Swiss upper-secondary school through the lens of translanguaging and technicality. It has done so in order to address the four research gaps identified in Chapter 1: the scarce existing research on CLIL in Switzerland, the lack of comparative-process oriented studies on CLIL and non-CLIL settings, the exclusive focus on the L1 of previous CLIL studies on translanguaging, and the lack of research on the role of technical terms in the CLIL classroom. Using a mixed-methods design, the self-compiled EG_BIO corpus—which includes transcripts of 15 CLIL and 16 non-CLIL biology lessons, teaching materials, and field notes—has been analyzed through the lens of translanguaging and technicality using a combination of quantitative and qualitative measures. Investigating three research foci, the study has compared the kind and distribution of translanguaging practices (Research Focus 1), the kind and distribution of technical terms as well as their introduction in the classroom vs. the written teaching materials (Research Focus 2) and finally, the interconnectedness of translanguaging and technicality, i.e. the role translanguaging practices play in the negotiation of technical terms (Research Focus 3) in CLIL and non-CLIL biology lessons.

The main findings regarding Research Focus 1 have revealed that translanguaging practices are actually scarce, constituting less than 1% of the entire EG_BIO corpus, and occur infrequently in both CLIL and non-CLIL biology lessons. Two types of translanguaging have been identified: translations, mostly used by teachers in the instructional registers, and integrations, predominantly used by students in the regulative register. The CLIL lessons, unsurprisingly, contain more translations in Standard German, mainly used by the teacher in the instructional register. Although CLIL lessons contain more translanguaging overall, the occurrence is lower than expected compared to non-CLIL classes, due in part to the specific local context of the study, where translanguaging with Swiss German is used in both, CLIL (English) and non-CLIL (Standard German) contexts. Additionally, both teachers, guided by their preference for a more monolingual approach to CLIL, actively remind their students to stick to English in their CLIL classes, which might have influenced the use of the L1/ML in these lessons. Furthermore, the focus on teacher-led whole class interaction might have also contributed to the limited the occurrence of translanguaging practices, leaving out activities that are potentially more prone to translanguaging (e.g. group work). Lastly, this relates to the expanded understanding of translanguaging applied in this study: Seeing translanguaging as inclusive of all kinds of linguistic resources, the analysis has shown that the EG_BIO corpus contains a fair amount of translanguaging with source languages (Latin, Greek and unclear). This leads to a key difference in teaching styles: T2 employs a translanguaging pedagogy by using a foreign word list to explain the meanings of recurring Latin and Greek affixes in field-specific terminology, whereas T1 does not incorporate such an approach. As a result, T2 and his students engage in translanguaging more frequently than T1 and his classes.

The most relevant findings regarding Research Focus 2 concern the distribution of technical terms in the EG_BIO corpus compared to the written teaching materials, as well as the importance of a proper introduction of new technical terms. To be more precise, the quantitative analysis of technical terms has revealed that almost every tenth word is part of the technical vocabulary in classroom discourse, whereas in the teaching material almost every fourth word is part of the technical vocabulary. This indicates a significant discrepancy in terms of technical density between the input students receive from the teaching materials (e.g. through a reading task), the classroom discourse itself, and the written output they eventually have to produce (e.g. in assignments or exams). Overall, the quantitative analysis shows that the topic as well as the classroom register are the most relevant factors in determining relative frequency of technical terms and technical density: Topics related to biochemistry tend to be denser in technical vocabulary than other topics covered in these lessons, which is why T1's lessons have an overall higher frequency of technical words compared to T2's classes. This also explains why CLIL lessons contain more technical terms than non-CLIL lessons, as T2 addresses topics other than biochemistry in his grade 10 non-CLIL classes, resulting in a lower technical density and frequency of technical words. Although CLIL lessons generally have a higher technical density than non-CLIL lessons, this seems primarily due to structural differences in word formation between English and Standard German. Interestingly, students exhibit a higher frequency of technical terms than teachers, likely due to the institutionalized nature of classroom discourse, which often limits students' responses to necessary words only.

As for the introduction of new technical terms, the analysis has illustrated the importance of a proper introduction in the classroom. In particular, it has highlighted how the technicalizing process is realized in a highly structured manner in the teaching materials (orthographic highlighting, followed by an elaboration of some sort), whereas in the classroom the resources to highlight and introduce new technical terms are more diverse. The analysis has also shown that in the classroom both teachers highlight new technical terms, but leave the rest of the technicalizing process (assigning a field-specific meaning to the term) sometimes implicit. Instead, they seem to rely on multimodal resources or previous knowledge for students to make the connection between a technical term and its meaning. The analysis has further provided a detailed illustration as to why the written teaching materials have a high technical density: The technicalizing process of technical terms is simply more concise. It is therefore all the more important for teachers to scaffold and unpack written input appropriately, which leads directly to the main findings regarding Research Focus 3.

Through the use of semantic profiles, which record shifts in SG and SD, the analysis in Research Focus 3 has illustrated the roles of translanguaging practices in the negotiation of technicality. In the four episodes, detailed processes of un- and repacking have been shown, demonstrating that translations are always used in regards to unpacking (except for creative translations), whereas integrations can be used for un- and repacking. Multimodal resources in form of the foreign word list are exclusively used for unpacking, whereas the non-verbal semiotic resources (e.g. gesturing) support the teacher's explanations, i.e. repacking. Lastly, the four semantic profiles have demonstrated how the teacher puts great effort into unpacking of technical terms and concepts, but except for one episode leaves the repacking process incomplete. Differences between the three episodes from a CLIL lesson and the one episode in a non-CLIL lesson mainly concern the assigned languages of linguistic translanguaging practices, i.e. that source languages, Standard German and Swiss German are used in CLIL, whereas French and English are used in the non-CLIL episode.

In summary, the present study has demonstrated that translanguaging and technicality are relevant aspects of Swiss CLIL and non-CLIL biology classrooms in their own right as much as in integration. Consequently, the findings of all three research foci have some implications for pedagogy in general, and CLIL pedagogy in particular.

11.2 Implications for Pedagogy

Translanguaging as a pedagogical strategy, i.e. the pre-planned use of translanguaging by the teacher, has been recognized as a promising approach in EAP settings (Liu, Lo, & Lin, 2020), ELF settings (Cenoz, 2019) and for the teaching of English itself (Cenoz & Gorter, 2020) Cenoz (2019, p. 79) highlights that a focus on multilingualism, i.e. encouraging multilingual speakers to use their whole linguistic repertoire in social interaction, "has great potential because it can provide a deeper understanding of the content and can also be useful as scaffolding across languages". The current study has shown that, in the specific context of biology lessons at a Swiss upper-secondary school, translanguaging—even when defined broadly and inclusively—does not compromise TL exposure, at least in teacher-led whole class interaction. Therefore, encouraging students to engage in translanguaging in the classroom can enhance their understanding of subject content without impacting overall exposure to the TL. This is particularly relevant given that breaking away from the traditional L1 - TL paradigm in previous translanguaging studies in educational settings has revealed one of the key findings of this research: the use of translanguaging with source languages as pedagogical strategy when dealing with technical vocabulary. The present study has illustrated that this seems particularly useful for science subjects where much of the technical vocabulary is rooted in Latin or Greek etymology.

Independent of CLIL or non-CLIL instruction, translanguaging with source languages can be an actual asset as already commented on by Harmon et al. in 2005:

> Focusing on meanings of Latin and Greek roots is beneficial in all subject areas (e.g., *pent*-; *oct*-; *dia*- in mathematics; *micro*-; *bio*-; *gene*- in science) and has the potential to assist readers of all ability levels unlock the meanings of new words encountered in text. (Harmon, Hedrick, & Wood, 2005, p. 276)

Even though Harmon et al. argue that translanguaging with source languages is "beneficial in all subject areas", it is naturally most effective in subjects with a high frequency of technical terms with etymological roots in Latin and Greek, as for instance biology. This aligns with Wignell et al.'s (1993) concept of technicality, more specifically, what they refer to as recursiveness of technicality, i.e. one technical term is built on the understanding of another technical term. Translanguaging with source languages can help to "unlock the meanings of new words" (Harmon et al., 2005, p. 276) because students can connect the different components of a word they already know in order to develop an understanding of the new technical term. This is in line with what Lin (2016) discusses when she suggests that teachers use Wignell et al.'s (1993) two-step technicalizing process as an explicit pedagogical strategy:

> To support students in tackling technical academic texts, this two-step [technicalizing] process can be highlighted to students to show how a term has become technicalized in a specific discipline. This explicit discussion can heighten students' awareness of how everyday words are transformed into technical terms (e.g. add → additives; preserve → preservatives). Likewise, students can be explicitly engaged in discussing the different technical (i.e. field-specific) meanings that different disciplines give to seemingly similar terms (...). (Lin, 2016, pp. 50–51)

Lin highlights the pedagogical value of explaining technical terms by highlighting how technical terms have become technicalized. Highlighting the technicalizing process can prove particularly useful in CLIL lessons when technicality is not encoded the same way in the ML and TL. Nikula (2017b), for instance, showed how students in Finland have difficulties negotiating the technical meaning of “moment” in a CLIL physics lesson, among other things because the Finnish language employs three different terms for “moment” depending on its technicality, whereas in the TL English, “moment” is used for its everyday meaning as well as a technical term. A particular translanguaging pedagogy focusing on the technicalizing processes of the technical term in each language might, in this situation, have contributed to the students’ understanding of the concept. Translanguaging with source languages can also be an especially useful pedagogic strategy when technical terms have the same technicalizing process in the ML and TL in a CLIL lesson and a simple translation is insufficient (see Bieri, 2019a).

The current study has further shown that translanguaging with non-verbal semiotic and multimodal resources is immensely important in the science classroom to not only un- but also repack technical terms and concepts. These findings echo the importance of what Lin (2015, p. 23) conceptualized as *trans-semiotizing*, i.e. the use of “multiple kinds of semiotics (i.e., meaning-making resources, among which language is just one kind, albeit a central one)”. Even though trans-semiotizing still constitutes part of translanguaging overall, coining trans-semiotizing—the integrated use of multiple varied semiotic meaning-making resources—as a separate term alongside translanguaging should emphasize the role non-linguistic resources play in the understanding of subject content (Lin & dos Santos, 2021). Lin and Wu convincingly show how a focus on translanguaging and trans-semiotizing as a pedagogical practice (they call it the Multimodalities-Entextualisation Cycle [MEC]) is particularly useful for CLIL biology lessons (Lin, 2019; Wu & Lin, 2019).

Another finding of the current study that has implications for pedagogy is the discrepancy between the technical density of the teaching materials and the technical density of classroom discourse. This means that it is all the more important to introduce new technical terms properly, through the two-step technicalizing process explained before, through translanguaging with source languages and trans-semiotizing or a combination of all of these. Semantic profiles have shown that translanguaging is extremely helpful in unpacking, and can also contribute to repacking of technical terms and scientific concepts. The semantic profiles have also shown, in line with previous studies (e.g. Martin, 2013; Maton, 2013, 2014a), that teachers sometimes still leave the repacking implicit. Repacking technical terms explicitly is, however, crucial considering not all students have the same reading and listening comprehension. This is even more relevant in CLIL where additional communicative challenges may occur due to the TL not being the teachers' and students' L1/ML. Making unpacking (and lacking repacking) processes visible in a semantic profile can serve as a starting point for CLIL teacher's to reflect and improve on their own practices (Lo et al., 2020, p. 19).

Effective pedagogical practice is always based on access to appropriate teaching materials. CLIL teachers "often comment that they do not have access to suitable materials" (Morton, 2013, p. 116). By self-compiling a script for both his CLIL and non-CLIL classes, T1 produces his own teaching materials. By using *Advanced Biology*, a textbook intended specifically for students in the Scottish curriculum (Kent, 2000, p. 3), T2 uses undiluted authentic materials. Both options bring their own challenges with them: Textbooks targeted at native speakers have a high lexical density and need to be unpacked appropriately in the CLIL classroom, whereas self-compiled teaching materials require much extra effort from the CLIL teacher's side but allow for adaptation to enhance student understanding of subject content (e.g. by adding translanguaging of important technical terms). While there is research and effort going into designing appropriate

CLIL teaching materials (see e.g. Banegas, 2016; Marongui, 2019, or Moore & Lorenzo, 2015), the lack of CLIL teacher education and suitable CLIL teaching materials is still a central issue in the Swiss context (Gajo et al. 2018, pp. 29–30).

While many of the pedagogical implications discussed in this section are relevant for both CLIL and non-CLIL biology lessons, the nuanced comparison of these two settings suggests that an effective CLIL pedagogy in biology that truly integrates content and language requires a range of strategies for un- and repacking scientific concepts and technical terms. These strategies include the use of pre-planned translanguaging with the L1/ML, negotiating technicality through translanguaging with source languages, employing non-verbal semiotic and multimodal resources and explaining the two-step technicalizing process of technical vocabulary in the L1/ML and the TL. Gaining insights into these potential pedagogies of CLIL science teaching has only been possible because of the way the data in the EG_BIO corpus has been analyzed. The various methodological approaches applied in the present study are novel in many ways, the value and associated challenges of which are commented on in the next section.

11.3 Methodological Considerations

In all three research foci I have, in some ways, used novel methodological approaches to compare CLIL with non-CLIL data. For Research Focus 1, a translanguaging framework has been created to capture translanguaging practices quantitatively in CLIL and non-CLIL lessons. In Research Focus 2, Wignell et al.'s (1993) concept of technicality has been used to establish a framework that identifies and analyzes technical terms by means of a bilingual field-specific dictionary in the EG_BIO corpus. The concept of technicality has been further used as a basis for a close analysis of the technicalizing processes of new technical terms in the classroom as well as the teaching materials. Research Focus 3 used the model of semantic profiles based on LCT to investigate the role of translanguaging practices within the negotiation of technical terms. In what follows, a brief reflection on the contributions of these various approaches to existing methodology and research design in the field of CLIL, particularly for comparative process-oriented studies, is provided. Applying novel methodological approaches to any data presents certain challenges and limitations, which will also be addressed, along with suggestions for improvement in future studies.

In Research Focus 1 I have established my own framework to analyze translanguaging instances quantitatively. To the best of my knowledge, this is the first study to operationalize the concept of translanguaging quantitatively considering the type, source, form and assigned language of a translanguaging instance. Establishing and applying the translanguaging framework has proven successful in that it achieved its primary objective of providing a tool to capture a more nuanced picture of translanguaging practices occurring in CLIL and non-CLIL lessons. With a coder agreement of 93% and higher (see Section 8.2.4), the translanguaging framework is reliably applicable not only in CLIL, but also non-CLIL lessons. Since the categories themselves are neither language- nor subject-specific, they can easily be adapted to any other context. The framework thus provides an opportunity for further comparisons, for instance across different CLIL content subjects and different geographical settings. Hence, it can further contribute to the development of understanding how translanguaging can enrich and inform a general CLIL pedagogy, but also help identify characteristics typical for certain subjects or geographical contexts.

One of the challenges in establishing such a codebook was the category of assigned language in connection to the theory of translanguaging. Translanguaging theory posits that there are no named languages, i.e. that the boundaries from one language to another are not clear-cut, seeing multilingual and -modal resources as inherently integrated (Otheguy et al., 2015, 2018). Yet, the translanguaging framework established for this study does exactly that, putting translanguaging instances into pre-defined categories relying on dictionaries and codified varieties to determine the language of a translanguaging instance. Relying on dictionaries to determine the assigned language thus takes an external view on language, and can, in a few cases, be challenging especially if languages share a large number of linguistic features, as is the case with Swiss German and Standard German. Nevertheless, I consider this a valid method of inquiry as long as the researcher acknowledges that the external perspective may not always align with the participants' internal perceptions of their own language use.

As for the methodological approach to Research Focus 2, combining the concept of technicality (Wignell et al., 1993) with the use of a bilingual field-specific dictionary (Cole, 2015) for the quantitative analysis of technical terms has also proven successful in many aspects. One great advantage of the approach taken in this study is that it allows for quantitative comparison of technical terms across different languages because the researcher can calculate both technical density and relative frequency of technical terms. Technical density calculates the amount of words counted as (part of) technical vocabulary compared to the rest of the vocabulary. Relative frequency counts the unit of analysis, in this case the technical term (ranging from 1–4 words) per 100 words. This way the methodology can account for diverse naming and word formation processes of technical terms in different languages, in written texts and oral interaction, something no other study on technical vocabulary has achieved yet (see Chung & Nation, 2004; Coxhead, 2018; Ha & Hyland, 2017; Kwary, 2011). Using this approach, I have been able to show, for instance, that CLIL lessons have a considerably higher technical density than their non-CLIL counterparts, but that this is mainly due to structural differences between the TL English and the ML Standard German, and that the relative frequency of technical terms is not inherently different between CLIL and non-CLIL biology lessons. Rather than type of instruction

(CLIL vs. non-CLIL), the topic and the amount of instructional register determine td and rf of technical terms.

Overall, I have demonstrated that the method of identification using Cole (2015) as a field-specific dictionary and adding two further subcategories (POS_special name and POS_special compound) works with high accuracy.[131] Nevertheless, there is room for improvement regarding the definition of a technical term, the degree of technicality and the amount of time needed for coding. As for the first aspect, the definition of a technical term applied in the current study focuses on nouns, compound nouns and simple noun phrases, because these are the most common forms of technical terms (Wignell et al., 1993, p. 144). Technical vocabulary, however, consists of more than the word classes mentioned above. Especially in English, technical vocabulary in form of nominalizations often consists of extended noun phrases including individual pre- and post-modifiers (Halliday, 1993, p. 129). Technical verbs and adjectives also form an important part of the technical vocabulary as the explicit discussion of the adjective *adventitious* (extract 9.35 in Section 9.3.3) has shown. Therefore, the definition and thus identification of technical terms could be expanded for future research to include extended noun phrases, as well as technical adjectives and verbs. That way, an even broader and more nuanced picture of technical vocabulary as a whole in CLIL and non-CLIL lessons could be obtained.

The current approach also does not account for different degrees of technicality, i.e. it could be argued that *Wasser* [water] in a generic sense is not a technical term, since it is part of our everyday vocabulary. But *Wasser* can have a highly technical meaning referring to the chemical compound H_2O. The method used in this study is not able to

[131] The subcategories of POS_special name and POS_special compound account for less than 10% of all technical terms coded in the EG_BIO corpus, which is why despite the subjectivity of these added subcategories, the identification method using Cole's (2015) dictionary is considered a reliable basis for the identification of technical vocabulary.

discern between such different degrees of technicality. The Technicality Analysis Model (TAM) proposed by Ha and Hyland (2017) includes the degree of technicality encoded in a technical term as a measurement for the identification of technical terms using general and field-specific dictionaries, consulting experts and using corpus linguistic methods. Such a TAM analysis would certainly be helpful in cases like *water,* since it has a generalized as well as a specialized sense and could therefore be put into perspective compared to other technical vocabulary. Taking context into account allows the researcher to get a more nuanced idea of the degree of technicality, but is, at the same time, also time-consuming and ideally requires a team of researchers working on the same issue to ensure validity.

A final point to discuss regarding the quantitative analysis of technical vocabulary concerns the amount of time needed for the identification and categorization of these terms. The automatic coding of nouns (step 1 in the identification process, see Section 9.2.2.1) may have helped to not overlook any potential technical terms in the dictionary, but checking 10’793 technical terms manually in a dictionary is extremely laborious. It is suggested that in future studies, particularly those expanding the framework to include technical verbs and adjectives, scan and compile the dictionary into a list. This list could then be used to automatically tag words in a corpus based on the compiled entries. This does not exclude manual double-checking of possibly misspelled words (especially if it is oral data that is analyzed), but it would save much time which could then be used to take the context into account in determining the degree of technicality just mentioned before.

Regarding the qualitative analysis of Research Focus 2 on the introduction of new technical terms, using the two-step technicalizing process as described by Wignell et al. (1993) has proven successful in regards to describing its realization in the teaching materials and classroom discourse. With regard to a comparison of teachers’ introductions in CLIL and non-CLIL settings, the selection of terms for

T1's classes has proven more useful in that it allows for a direct comparison of the same technical terms in CLIL and non-CLIL contexts in written as well as spoken mode. The selection of terms in T2's classes, however, seems ideal for a descriptive account of the varying resources used for the technicalizing process in general, but less ideal for a comparative analysis of CLIL and non-CLIL lessons because the technical terms analyzed are too different. Therefore, for a comparison of the introduction of new technical terms in CLIL and non-CLIL settings (and its conscious and subconscious adaptations) further research could compare the technicalizing process of the same teachers on the same technical terms in a CLIL and in a non-CLIL class.

Lastly, considering Research Focus 3, the use of semantic profiles as an analytical tool to examine the role of translanguaging in CLIL and non-CLIL lessons has turned out to be a fruitful approach. By analyzing shifts in SG and SD as well as visualizing them on a graph, semantic profiles provide the researcher with a quick overview and, depending on the detail of the semantic profile, a nuanced picture of what translanguaging practices contribute to pedagogical unpacking and repacking. In contrast to Lo et al. (2020), the analysis has shown that translanguaging is not only used in unpacking processes, but can equally contribute to repacking. One limitation of the semantic profile approach concerns its visualizations as inversely plotted dimension of SG and SD. The analysis of episode 2 (Section 10.3.2), for instance, shows that sometimes only one dimension (SD) is shifted while the other stays the same. These nuances are not recorded in a semantic profile as applied in this study, a shortcoming already commented on by Maton (2014b, p. 13). Recent studies such as Cranwell and Whiteside (2020) solve this problem by analyzing SG and SD separately and independently from each other, which is more time-consuming but useful if the objective is to analyze detailed shifts in SG independently from SD.

Un- and repacking processes involve content (SG↑↓, SD↓↑) as much as language (everyday ⇔ academic). The application of semantic profiles in the current study focuses mainly on content. That is, translanguaging practices are only analyzed in their relation to SG and SD, and not specifically in regards to how they facilitate understanding through the use of everyday and academic language. To emphasize the linguistic dimension of un- and repacking processes, one could combine a semantic profiles approach with SFL to gain further insights into how language works in negotiations of technicality, as for instance employed by Martin and Maton (2017), where they identify several potential synergies between LCT and SFL, or Lo et al. (2020) who use the concept of semantic profiles in combination with the SFL model of power grammar. Same as the previous methodologies, a semantic profile approach can be applied independently of language, discipline or program. Therefore, semantic profiling might also be a useful tool to investigate explanations of technical vocabulary from a comparative angle, e.g. how different teachers explain the same concept (more and less successfully), or the same teacher teaching in a CLIL and non-CLIL context. One could also compare the use (and success) of translanguaging practices in the negotiation of technicality in CLIL lessons across disciplines. Such comparative studies applying semantic profiling would give more insight into whether there are universal strategies to successfully teach semantic waves, and more specifically, what constitutes fruitful field-specific and context-dependent un- and repacking strategies.

In sum, all methodological approaches applied in the three research foci have in common that they are reliably applicable independent of language, content subject, or even local context. Therefore, they contribute much to the research design of comparative process-oriented studies of CLIL and non-CLIL lessons. However, more such studies are still needed to describe and confirm or dispute the findings of the present case study and further our understanding of how language(s) work in integration in CLIL and non-CLIL biology lessons.

11.4 Concluding Remarks

It has been the purpose of this study to investigate the use of language(s) in CLIL and non-CLIL biology through the lens of translanguaging and technicality in a Swiss context by means of a comparative process-oriented study. Being conducted in Switzerland, the case study has described and analyzed a CLIL and non-CLIL setting in a particular linguistic landscape involving multiple languages. Focusing on an inclusive definition of translanguaging has allowed me to go beyond the traditional L1-TL paradigm prevalent in many translanguaging studies, and instead propose translanguaging with source languages as a potential effective science pedagogy particularly useful for CLIL science teaching. Analyzing technical terms in CLIL and non-CLIL biology lessons has shed light on the importance of introducing new technical terms as well as negotiating—i.e. un- and repacking—them in the classroom. Lastly, this study has proposed novel methodologies to investigate CLIL and non-CLIL contexts comparatively. This paves the way for more comparative process-oriented studies and further research into CLIL subject literacy and CLIL teacher training, both in general and specifically within the Swiss context.

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Appendices

App. I: Transcription conventions

Transcription conventions are an abridged and adapted version of Dalton-Puffer (2007, pp. xi-x), itself based on Markee (2000, pp. 167–168).

Identity of speakers

`T`	generally the teacher
`T1, T2`	specifically teacher 1, teacher 2
`S`	unidentified student
`S1, S2`	probably student 1, student 2
`Ss`	several or all students simultaneously
`I`	interviewer

Commentary in the transcript

`((laughs))`	double brackets indicate a comment about non-verbal actions, activity types excluded from analysis, or cut-out scenes
`(x)`	indicates a single word unintelligible to the researcher
`(xx)`	indicates a stretch of talk unintelligible to the researcher
`(founder)`	indicates an unclear or probable item
`(...)`	indicates left-out parts of an extract
Hefe	italics indicate a translanguaging instance or a technical term
<u>yeast</u>	underlining indicates the corresponding unit (CU) of a translanguaging instance
`[yes]`	square brackets indicate a translation of a translanguaging instance into English

App. II: Overview of recorded and transcribed teacher-led whole class interaction

Class	Total Time		Time excluded		Teacher-led wci	
	[min]	[s]	[min]	[s]	[min]	[s]
CLIL_1b_20150504	45:02	2702	23:20	1400	21:42	1302
CLIL_1b_20150507	45:34	2734	01:45	105	43:49	2629
CLIL_1b_20150518	47:41	2861	09:15	555	38:26	2306
CLIL_1b_20150521	44:02	2642	36:50	2210	07:12	432
CLIL_1b_20150528	44:50	2690	04:05	245	40:45	2445
CLIL_1e_20150504	44:24	2664	27:10	1630	17:14	1034
CLIL_1e_20150507	46:24	2784	21:40	1300	24:44	1484
CLIL_1e_20150511	44:31	2671	19:15	1155	25:16	1516
CLIL_1e_20150518	44:34	2674	17:00	1020	27:34	1654
CLIL_1e_20150521	44:30	2670	26:30	1590	18:00	1080
CLIL_2b_20150505	43:07	2587	06:55	415	36:12	2172
CLIL_2b_20150526	44:52	2692	10:30	630	34:22	2062
CLIL_2e_20150507	43:10	2590	03:30	210	39:40	2380
CLIL_2e_20150521	46.19	2779	08:15	495	38:04	2284
CLIL_2e_20150528	40:12	2412	08:45	525	31:27	1887
Total CLIL [min] + [s]:	**669:12**	**40152**	**224:45**	**13485**	**444:27**	**26667**
Total CLIL [h]:	**11:09:12**		**03:44:45**		**07:24:27**	
Non-CLIL_1a_20150504	34:57	2097	14:10	850	20:47	1247
Non-CLIL_1a_20150507	44:55	2695	13:35	815	31:20	1880
Non-CLIL_1a_20150511	45:02	2702	05:38	338	39:24	2364
Non-CLIL_1a_20150518	44:53	2693	15:49	949	29:04	1744
Non-CLIL_1a_20150521	43:38	2618	07:30	450	36:08	2168
Non-CLIL_1a_20150528	44:35	2675	13:46	826	30:49	1849
Non-CLIL_1f1_20150505	44:59	2699	13:30	810	31:29	1889
Non-CLIL_1f2_20150505	43:32	2612	12:35	755	30:57	1857
Non-CLIL_1f1_20150512	45:20	2720	00:00	0	45:20	2720

Non-CLIL_1f2_20150512	43:05	2585	12:45	765	30:20	1820
Non-CLIL_1f1_20150526	45:40	2740	08:55	535	36:45	2205
Non-CLIL_1f2_20150526	44:45	2685	01:50	110	42:55	2575
Non-CLIL_2d_20150521	43:47	2627	11:40	700	32:07	1927
Non-CLIL_2d_20150528	45:15	2715	19:45	1185	25:30	1530
Non-CLIL_2h_20150507	40:29	2429	00:45	45	39:44	2384
Non-CLIL_2h_20150528	44:20	2660	03:00	180	41:20	2480
Total Non-CLIL [min] + [s]:	**699:12**	**41952**	**155:13**	**9313**	**543:59**	**32639**
Total Non-CLIL [h]:	**11:39:12**		**02:35:13**		**09:03:59**	
Grant total [min] + [s]: (CLIL + Non-CLIL)	**1368:24**	**82104**	**379:58**	**22798**	**988:26**	**59306**
Grand total [h]: (CLIL + Non-CLIL)	**22:48:24**		**06:19:58**		**16:28:26**	

App. III: Exact numbers for speaker distribution according to lesson type variable (see Section 7.2.2)

Exact word counts per subset:

	teacher (t)	student (s)	students (ss)
CLIL	44’770	6779	36
Non-CLIL	59’564	8163	25
T1	50’471	6332	11
T2	53’863	8610	50
10	69’273	9873	18
11	35’061	5069	43

Exact ratio per subset:

	teacher (t)	student (s)	students (ss)
CLIL	86.8%	13.1%	0.1%
Non-CLIL	87.9%	12%	0.04%
T1	88.8%	11.1%	0.02%
T2	86.1%	13.8%	0.8%
10	87.5%	12.5%	0.02%
11	87.3%	12.6%	0.1%

App. IV: Overview of teacher-student ratio across individual lessons

Lesson	Total word count	Teacher (t)	Student (s)	Students (ss)
CLIL_1b_20150504	1391	1240 (89.14%)	151 (10.86%)	0
CLIL_1b_20150507	5284	4177 (79.05%)	1106 (20.93%)	1 (0.02%)
CLIL_1b_20150518	4455	4051 (90.93%)	404 (9.07%)	0
CLIL_1b_20150521	962	846 (87.94%)	113 (11.75%)	3 (0.31%)
CLIL_1b_20150528	4862	4089 (84.10%)	765 (15.73%)	8 (0.16%)
CLIL_1e_20150504	2146	1991 (92.78%)	155 (7.22%)	0
CLIL_1e_20150507	2633	2292 (87.05%)	341 (12.95%)	0
CLIL_1e_20150511	2928	2617 (89.38%)	311 (10.62%)	0
CLIL_1e_20150518	3251	2881 (88.62%)	370 (11.38%)	0
CLIL_1e_20150521	2068	1929 (93.28%)	139 (6.72%)	0
CLIL_2b_20150505	4303	3860 (89.70%)	433 (10.06%)	10 (0.23%)
CLIL_2b_20150526	4292	3523 (82.08%)	761 (17.73%)	8 (0.19%)
CLIL_2e_20150507	4234	3738 (88.29%)	495 (11.69%)	1 (0.02%)
CLIL_2e_20150521	4520	3966 (87.74%)	552 (12.21%)	2 (0.04%)
CLIL_2e_20150528	4256	3570 (83.88%)	683 (16.05%)	3 (0.07%)
Non-CLIL_1a_20150504	2971	2766 (93.10%)	205 (6.90%)	0
Non-CLIL_1a_20150507	4051	3485 (86.03%)	566 (13.97%)	0
Non-CLIL_1a_20150511	4399	3712 (84.38%)	687 (15.62%)	0
Non-CLIL_1a_20150518	4212	4013 (95.28%)	197 (4.68%)	2 (0.05%)

Non-CLIL_1a_20150521	3123	2510 (80.37%)	610 19.53%)	3 (0.10%)
Non-CLIL_1a_20150528	3843	3521 (91.62%)	322 (8.38%)	0
Non-CLIL_1f1_20150505	4040	3616 (89.50%)	424 (10.50%)	0
Non-CLIL_1f1_20150512	6190	5266 (85.07%)	924 (14.93%)	0
Non-CLIL_1f1_20150526	4325	3905 (90.29%)	420 (9.71%)	0
Non-CLIL_1f2_20150505	3324	2453 (73.8%)	870 (26.17%)	1 (0.03%)
Non-CLIL_1f2_20150512	3505	3020 (86.16%)	485 (13.84%)	0
Non-CLIL_1f2_20150526	5201	4893 (94.08%)	308 (5.92%)	0
Non-CLIL_2d_20150521	4477	4333 (96.78%)	144 (3.22%)	0
Non-CLIL_2d_20150528	3702	3147 (85.01%)	555 (14.99%)	0
Non-CLIL_2h_20150507	4975	4142 (83.26%)	832 (16.72%)	1 (0.02%)
Non-CLIL_2h_20150528	5414	4782 (88.33%)	614 (11.34%)	18 (0.33%)

App. V: Overview of translanguaging instances across categories

Feature	N	Percent
Total Units	563	
TYPE	N=563	
- translation	121	21.49%
- integration	439	77.98%
- ambiguous	3	0.53%
SOURCE	N=563	
- student	141	25.04%
- teacher	368	65.36%
- co-constructed	54	9.59%
FORM	N=563	
- word	343	60.92%
- affix	86	15.28%
- phrase	31	5.51%
- clause	82	14.56%
- other	21	3.73%
ASSIGNED_LANGUAGE	N=563	
- swiss_german	232	41.21%
- standard_german	186	33.04%
- english	23	4.09%
- french	6	1.07%
- italian	1	0.18%
- latin	26	4.62%
- greek	56	9.95%
- unclear	33	5.86%

App. VI: Overview of technical terms according to grades

	10		11	
Feature	N	Percent	N	Percent
Total Units	7213		3580	
POSITION	N=7213		N=3580	
- headword	2531	35.09%	1398	39.05%
- specific_entry	3691	51.17%	1593	44.50%
- compound	307	4.26%	278	7.77%
- special_name	553	7.67%	254	7.09%
- special_compound	131	1.82%	57	1.59%
SPECIAL_NAME-TYPE	N=553		N=254	
- taxonomy	110	19.89%	52	20.47%
- chemistry	426	77.03%	150	59.06%
- miscellaneous	17	3.07%	52	20.47%
UNIT	N=7213		N=3580	
- one_word	6701	92.90%	3248	90.73%
- two_words	466	6.46%	287	8.02%
- multiword_unit	46	0.64%	45	1.26%
NAME	N=7213		N=3580	
- normal	6685	92.68%	3351	93.60%
- acronym	472	6.54%	115	3.21%
- part_acronym	47	0.65%	61	1.70%
- else	9	0.12%	53	1.48%

Content and Language Integrated Learning (CLIL) is a dual-focused educational approach in which academic subjects, such as biology or history, are taught in a second or foreign language to enhance both subject knowledge and language proficiency. Recent research emphasizes the importance of integrating content and language in the CLIL classroom and explores how this integration shapes effective pedagogy.

This book presents an in-depth case study examining the language use of students and teachers in CLIL (English) and non-CLIL (German) biology lessons at a Swiss upper-secondary school. Using the self-compiled EG_BIO corpus, which consists of 31 video-recorded lessons, the study analyzes and compares the use of multilingual and multimodal resources (translanguaging) and the role of technical terms (technicality) in these classrooms. By proposing a model for the quantitative analysis of translanguaging and developing a framework to identify and analyze technical terms, this book offers a comprehensive view of how language operates in CLIL and non-CLIL contexts. It further explores the interplay between translanguaging and technicality, shedding light on how different linguistic and non-linguistic resources are used to negotiate complex scientific terminology. The book thus provides valuable insights into a potentially effective CLIL pedagogy for biology and contributes to understanding the integration of language and content in CLIL and non-CLIL science education.

Aline S. Bieri is a researcher in English linguistics with a focus on CLIL and science education, the linguistics of football, as well as scientific writing and AI. She is also lecturer, currently teaching courses on multilingualism and translanguaging, technical language and bilingual communication for engineers.

Die Publikationsreihe NIHIN – New Ideas in Human Interaction – entstand 2010 und ist ein Kooperationsprojekt zwischen der Hermann Paul School of Linguistics (HPSL) und der Universitätsbibliothek Freiburg (UB).

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