A legitimation code theory perspective on work-integrated learning in South African school physical science curriculum policy

KAVISH JAWAHAR
Rhodes University, South Africa
CARVER POP
Cape Peninsula University of Technology, South Africa

ABSTRACT

While work-integrated learning (WIL) continues to gain prominence worldwide, the range of definitions indicates no consensus on what it actually includes. This contributes to a creative space in which to uncover its more nuanced forms and potential. Despite the range of available definitions there appears to be an emphasis on WIL at the level of post-schooling, at the expense of considering its relationship with school curriculum policy. This mirrors the emphasis that many countries seem to place on exit level education outcomes or achievement and can be criticised along the same lines. In response to the paucity of knowledge around WIL at school level, we consider a legitimation code theory perspective on 'work-integrated learning' in school science curriculum policy. We provide a general overview of Karl Maton's Legitimation Code Theory, paying particular focus on the notion of semantic gravity. With the South African school physical sciences as the case in this qualitative curriculum study, the paper uncovers aspects of school science education curriculum which align it to the precepts of work-integrated learning. The paper reveals the utility of legitimation code theory for uncovering epistemic shifts in school science curriculum that contribute to bridging science theory and contextualised practical knowledge. The results of the study provide insight into the epistemological contribution of work integrating learning, suggesting a complimentary relationship between formal education and work-integrated learning that goes beyond the notion of the former simply including the latter as a stepping stone towards meaningful engagement in the workplace.

Keywords: school science curriculum, work-integrated learning, epistemic shifts, theory-practice relationship, legitimation code theory

INTRODUCTION

Work-integrated-learning (WIL) in a more formal sense, has existed for over a century (Coll, Eames, Paku, Lay, Hodges, Bhat, Ram, Ayling, Fleming, Ferkins, & Wiersma, 2009). Workplaces are useful epistemological spaces by virtue of their potential for accommodating both theory and practice (Choy, 2009). The benefits of WIL programmes to students, employers and higher education institutions are numerous and well-documented in literature (e.g., Coll et al, 2009; Winberg, Garraway & Jacobs, 2011). It is thus not surprising that WIL has been able to attract substantial investment towards its expansion (Abeysekara, 2006), and has become an important feature of higher education globally (Smith, 2012). In Australia for example, although WIL has been integral in some disciplines for a long time, its presence in them is still growing and its significance in universities is expanding even further through recent legislative and policy shifts (Emslie, 2011).

While there is widespread agreement on the plethora of benefits WIL offers to a range of stakeholders and its prominence grows worldwide, there are a range of definitions attached to it (as presented in the literature review), suggesting no consensus on what it actually includes. This is confirmed by the literature describing it as a 'chameleon term' (Orrell, 2011), an'umbrella concept' (Lewis, Holtzhausen & Taylor, 2010) and 'provisional concept' (Jonsson, 2007, p. 5). WIL could also be viewed as a sensitizing concept (Hermansson, 2004, in Jonsson,

2007) – a concept that is frequently used despite its definition being diffuse (Blumer, 1954). The meaning of such concepts require ongoing conversation and they thus demand researchers be open to empirical data with potential for shaping the concept. This contributes to a creative space in which to uncover the more nuanced forms and potential of WIL.

Despite the range of available definitions there appears to be an emphasis on WIL at the level of post-schooling, at the expense of considering its epistemological relationships to school curriculum. This mirrors the emphasis that many countries seem to place on exit level education outcomes or achievement and can be criticised along the same lines – the knowledge-building experience which higher education institutions provide to students does not exist in isolation from the knowledge-building work of school curriculum.

Higher education (HE) in South Africa (SA) consists of 'traditional' universities- offering theoretically oriented qualifications, universities of technology - offering vocationally oriented qualifications, and comprehensive universities which offer a both theoretically and vocationally oriented qualifications. Universities of Technology (UoT) were previously referred to as Technikons, and are similar to polytechnics or institutes of technology in terms of their primary offering being career-focused three year diploma courses (Spowart, 2006). Most HE institutions irrespective of their categorisation have faculties with an applied focus, which offer professional education programmes. Such institutions have recognised the importance of preparing students for work and helping them gain practical experience, such as through inclusion of work-placements as a part of their curriculum (Winberg et al, 2011).

The SA Higher Education Qualifications Framework (HEQF) which came into effect in 2007 (South Africa. Department of Education, 2007) was the first instance of use for the term 'Work-Integrated Learning' (WIL) in a South African Department of Education document (Lewis et al, 2010). However, in its various forms and under the guise of other terms, WIL has always been a distinguishing feature of technical, vocational and professional education in the country (Winberg et al, 2011). Recognition of the workplace as both a learning resources and a site of knowledge production is evident in the South African training of professionals in fields such as health, applied sciences, engineering and business involving the actual sites of practice (e.g., a teaching hospital in the case of health professionals) (Winberg et al, 2011).

South Africa is one of many countries invested in curricular and pedagogical reform to support students from diverse backgrounds and prepare them for responsible citizenship and to face the challenges arising from the global economy. In contexts of development such as South Africa, for the successful integration of graduates into work life in a manner that allows them to contribute meaningfully, innovation is required in terms of curriculum, teaching, learning and assessment (Winberg et al, 2011). We contend that such innovation includes the potential for knowledge-building in vocational training (more specifically, through WIL) to capitalise on knowledge-building foundations at the level of schooling as will be outlined over the course of this paper.

PROBLEM STATEMENT

While the potential value of WIL is recognised across the globe, a growing body of literature (eg. Ferns & Moore, 2012) is focusing on how the rich potential of WIL may be better realized. For example, the impact of student learning as preparation for practice is actualised only through curriculum integration between theory and practice-based experience (Billett, 2009) and more can be done to better prepare students for work placements (Nagarajan & McAllister, 2015). These raise questions around mechanisms for scaffolded towards theory-practice integration before their WIL placement. In addressing this challenge, we can't ignore the fact that students at vocational institutions do not arrive there as blank canvases – they are products of school curriculum, amongst other factors.

In terms of epistemological articulation, science knowledge-building strategies at school level are stepping stones towards science students' successful theory-practice integration in their tertiary learning. It makes sense for the latter to capitalise on the epistemological foundations provided by the former. This is alluded to by Winberg et al (2011) who reveal the need for higher education practitioners to not only realise that knowledge is being produced in a variety of sites, but to also understand both theoretically and practically how different knowledge production systems function. Towards this end for science related coursed at vocational institutions, there is a need for the foundations of knowledge-building at school science curriculum level to be explored in order to identifying specific epistemic mechanisms which science vocational training can draw from and extend.

LITERATURE REVIEW

In broad terms, WIL is the practice of combining traditional/formal academic study with student exposure to the world-of-work related to their intended profession (Jackson, 2015). Some regard it as a generic term used by various writers for describing educational models that engage students in professional development within their curricula (Lewis et al, 2010). The range of literature definitions indicate confusion and even disagreement around WIL and its related concepts, some details of which we will now turn our attention to.

One reason for confusion about what WIL is, as pointed out by Du Plessis (2015), is that various terminologies are concurrently being used internationally for describing education programmes which have a practical component or are related to activities in the workplace or in professional practice. This is evident for example, by the terms 'cooperative education' and 'internships' being used as synonyms for WIL in the USA and many other countries, while the UK commonly uses the term sandwich degree (Coll et al, 2009). It is thus not surprising that Jonsson (2007, p. 5) describes WIL as a provisional concept since its more nuanced meanings are only evident in relation to the context of its use.

Another possible reason for confusion around what WIL includes, as pointed out by Patrick et al. (2009), is that WIL is an umbrella term - it covers a range of approaches for integrating theory with the practice of work. Patrick et al (2009) mention that while the most common approach is work placements, other strategies such as industry-engaged project work, work-environment simulations and virtual activities are also included. Smith (2012) for example, disagrees with Patrick et al (2009) by arguing that WIL is not synonymous with work experience or work-based learning. The basis for this disagreement is that neither work experience nor work-based learning explicitly require students to learn, apply or integrate theoretical/canonical/disciplinary knowledge to the practical context of the work situation in the way that WIL does.

Du Plessis (2015) reminds us that WIL implies alignment between work and education and so while WIL is not necessarily restricted to the workplace (as in the case of work-based learning), work-based learning is one possible learning modes through which WIL can be facilitated. In positing that WIL requires a sharper definition than an 'umbrella term', Oliver (2015) proposes that WIL be defined as a range of learning tasks which either resemble those actually expected of working graduates, or are aligned to the physical/digital spaces where professional work takes place.

Despite the reason for confusion and disagreements indicated above, all the definitions presented here thus far do not limit WIL to only work-based learning in real workplace settings. However, many others do (e.g., Cooper, Orrell & Bowden, 2010; Emslie, 2011; Smith, 2012), appearing to conflate WIL and work-based learning despite the arguable distinction between these. This presents a third tension around the definition of WIL.

Some researchers refer to approaches involving preparation for work placement as a stage of WIL. Nagarajan and McAllister (2015) refer to both on and off-campus WIL components, acknowledging that WIL extends beyond just work placement activities. They recognise that the relevance and application of on-campus learning to workplace settings is needed by students prior to their entering work placements. In agreement, are Martin and Hughes (2009) who state that equipping students with disciplinary content knowledge, critical thinking skills and exposure to the profession are in fact aspects of an early stage of WIL.

Many researchers focus on integration across academic/theoretical learning and practical application, in their definition of WIL. Atchison, Pollock, Reeders, and Rizzetti (2002, p. 3) for example, describe WIL programs as educational programs that combine learning and its workplace application with recognition that such integration may or may not occur in industry and may be real or simulated. More explicitly, Orrell (2011, p.1) defines WIL as the 'intentional integration of theory and practice knowledge' and indicates that 'a WIL program provides the means to enable this integration and may, or may not, include a placement in a workplace, or a community or civic arena'. Echoing this sentiment, Winberg et al (2011) state that integration of theory and practice in student learning can occur through a range of WIL approaches, other than formal or informal work placements.

In terms of how this pedagogical approach is expressed, Blom (2014) indicates three ways: Learning **for** work – vocationally orientated/career focused learning intended for inducting entrants to their chosen vocation/profession; Learning **at** work – the range of modalities at workplaces which enhance knowledge and competency integration; and Learning **through** work –engagement of students in particular work-related tasks as part of the curriculum, to solve problems related to work in real life. This layered view of WIL is echoed by Billett (2009) who reminds us that curriculum, pedagogic and epistemological responses are in fact required, before, during and after students WIL placements in order to integrate these experiences towards achieving their full educational value.

According to Stuckey, Hofstein, Mamlok-Naaman, and Eilks (2013), science should prepare students towards further training and subsequent employment. They remind us that a new aspect of science literacy presented during the 1980's but which is sometimes implicit in the definition of science literacy, is the vocational dimension. Young (2013) suggests that curriculum theory needs to address the question of what students are entitled to learn, whether it be at primary or secondary school, university or a vocational programme aimed at increasing employability. The Work-Integrated Learning: Good Practice Guide by the SA Council for Higher Education acknowledges the need for professional education to look both ways. University teachers of application-oriented subjects such as Engineering, Education, and Medicine, or who teach subjects such as Physics for Engineering, Education and Medicine should be guided by both scientific disciplinary knowledge, as well as knowledge for professional practice (Winberg et al, 2011).

Scientific meanings operate at a level that is general and context-independent. The danger of them being learned in a practical setting like a work placement, is that they may end up being tied to that specific context and their transferability to other contexts may be lost. Thus, one viewpoint is that scientific knowledge should first be acquired for what it is, so that it can provide the knowledge base for problem-solving in professional practice. The challenge that this poses for students, is that this foundational knowledge is usually obtained from studying academic subjects which students often fail to understand the relevance of and have difficulty transferring into the workplace (Winberg et al, 2011). This further supports the need for identifying epistemic mechanisms towards strengthening students' ability to apply theoretical knowledge in the workplace.

While it is true that compared to general education programmes, WIL involves specific curricular, pedagogical, and assessment considerations, these only differ in certain respects. One aspect which WIL curricula requires engagement with is 'philosophies of education, theories of teaching and learning, and educational research findings– particular WIL modality' (Winberg et al, 2011, p.14). A successful strategy for WIL curriculum design and implementation to ensure students focus on theory-practice integration for connecting disciplinary learning with workplace application is by 'designing learning activities that require the integration of disciplinary and workplace-relevant knowledge and skills' (p,15).

However, there is paucity of knowledge regarding scaffolding mechanisms towards such integration in WIL curriculum prior to work placement, and we contend that lessons may be learned from how this is approached in school science curriculum. This is because, like teaching and learning during pre-WIL placement at vocational institutions, work experience is not yet available to be drawn into the school science learning experience but levels of cognitive demand beyond basic recall and comprehension such as application, still require scaffolding in order to empower learners.

There are many curricular modalities which can be drawn on in developing a WIL programme. In addition to workplace learning, these include work-directed theoretical learning (WDTL), problem-based/oriented learning (PBL) and project-based learning (PJBL) (Winberg et al, 2011). It terms of WDTL, WIL programmes include theoretical components which should be aligned with practical or practice-based components through teaching and learning activities that bring theory and practice together in meaningful ways. These include the use of authentic examples/case studies from the world of professional practice.

PBL has as its main objective, the acquisition of an integrated knowledge base for application to analysis and solution of problems. (Boud & Feletti, 1997). Few academic programmes in SA have adopted PBL in its purest form. Problem-oriented learning is more common and it involves the inclusion of real world scenarios for problem-based activities and assessments. PJBL stimulates learning through projects. While the projects may be 'real' projects in the workplace, they are more commonly simulated with the learning takes place in the educational institution. As with the case of problems, projects 'are a means of engaging students in complex, work-related issues, through which they develop and transfer skills and knowledge.

THEORETICAL FRAMEWORK

Maton (2009) flags segmental learning (learning a isolated ideas/skills strongly tied to context of acquisition), as a pressing concern in educational debates. Since this kind of learning problematizes students' knowledge-building through it limiting transfer of ideas/skills to new contexts such as everyday life, future studies or work (Maton, 2014). The issue of cumulative learning on the other hand, 'where new knowledge builds and integrates past knowledge, is becoming increasingly salient' (Maton, 2009, p. 43). Cumulative learning involves new workplace knowledge building on and integrating previous knowledge and is thus desirable for realising the educational benefits of WIL. Legitimation Code Theory responds to the question of how to enable cumulative learning at school and university.

The LCT approach to education, knowledge and practice is rapidly growing (Maton, 2014). LCT extends from social realism which recognises knowledge as being both based on an external reality, and socially constructed (Macnaught, Maton, Martin and Matruglio, 2013). It extends and integrates the approaches of Bernstein and Bourdieu (Maton, 2014). The LCT epistemic-pedagogic device models the social fields of production, recontextualisation and reproduction as being governed by a range of logics, and creating an arena which is the site of struggle for power by different social groups (Maton, 2014).

The multidimensional toolkit of LCT includes semantics, which has the organising principles of semantic gravity and semantic density. In social practices such as education, semantic gravity is the degree of context-dependence of meaning while semantic density is the degree of condensation of meaning (Maton, 2014). Semantic density and gravity work together to frame the knowledge practices through semantic codes and profiles. A range of semantic codes are possible due to both semantic gravity and semantic density existing along continua of strengths For example, at different times science lecturer talk or student responses to assessment may have stronger or weaker semantic density depending on how many meanings are condensed in their language. References that are more contextualised have stronger semantic gravity compared to those which are more decontextualized and thus have weaker semantic gravity. Due to the potential for semantic shifts between relatively higher and lower strengths of semantic gravity and density over time, it is possible to plot semantic profiles (Macnaught et al, 2013) of lecturers' talk or students' written reflections, for example.

In a semantic profile of talk or writing, the potential of upward and downward semantic shifts creating a semantic wave over time, is recognised as being powerful for cumulative knowledge-building. Semantic flatlines (regions of minimal or no semantic shift) on the other hand, suggest the author/speaker is stuck in a limited semantic range (Macnaught et al, 2013) and they constrain knowledge-building. Uncovering mechanisms for extending semantic range is central both to learning and fostering a society that is more inclusive and far-sighted (Maton, 2014).

RESEARCH DESIGN

The research design was guided by the following 2 research questions, which draw from the rationale for the study:

- How does South African school science curriculum align to WIL precepts?
- What are the mechanisms for epistemic shifts between theory and practice, in the SA school science curriculum?

A major feature of qualitative studies is enquiry, and traditional routes include case study. Case study is one of the main types of naturalistic inquiry, and involves investigating a specific instance/phenomenon in its real-life context

(Cohen et al, 2007). While generalisability of case studies is limited, this does not impact on its relevance to the current study's context-specific foci of South African school science curriculum alignment to WIL precepts, and mechanisms for epistemic shift. Furthermore, case studies have noteworthy strengths such as being grounded in reality, speaking for themselves, being capable of serving multiple audiences and being steps to action (such as in education policy-making) (Cohen et al, 2007).The case in this study is the SA school Physical Sciences Curriculum and Assessment Policy Statement or CAPS (South Africa. DoBE, 2011) which school physical sciences teachers are mandated to deliver. In South Africa, Physical Sciences is the optional Grade 10-12 school science subject which includes physics and chemistry.

The research method of document analysis is strongly applicable to qualitative case studies (Bowen, 2009). Documents are distinct from interviews and observation etc, in that the documents being analysed already exist before the research necessitates their use as data (Miller and Alvarado, 2005). Although often used to complement other methods (e.g., for the purpose of triangulation), document analysis can also be used as a stand-alone method, for example in specialised qualitative research (Bowen, 2009; Miller & Alvarado, 2005) such as the current curriculum policy study.

The document analysis of the SA Curriculum and Assessment Policy Statement (CAPS) for physical sciences (DoE, 2011) in this study involved iterative cycles which combine elements of content and thematic analysis. Bowen (2009, p. 32) describes content analysis as 'a first-pass document review, in which meaningful and relevant passages of text or other data are identified' and goes on to discuss data reduction by highlighting that 'the researcher should demonstrate the capacity to identify pertinent information and to separate it from that which is not pertinent'. Subsequent thematic analysis of pertinent documentary data involves a careful and more focused re-reading/review of the data for the purpose of coding data towards constructing categories to uncover themes relevant to answering the research questions.

RESULTS AND DISCUSSION

Preparation for Workplace andCareer

Preparation for the world of work is a key feature of WIL literature and more directly evident, through such terminology as occupational competence (Billet, 2009), vocational education, work placements, work-placed learning, work-based learning and work-readiness (Winberg et al, 2011). The CAPS: Physical Sciences (DoBE, 2011) does not stipulate work placement, and so does not align to WIL in that regard. However, the curriculum policy highlights that one of the general aims of the SA curriculum is to facilitate the transition of learners from education institutions to the workplace. Furthermore, it states that a specific aim of physical sciences is to prepare learners for employment and that learners who study this subject 'can have improved access to professional career paths related to applied science courses and vocational career paths' (p. 8). It also makes multiples references to a range of industry types (as will be discussed later) to which specific science content is relevant. There is thus some alignment in this regard.

Theoretical Knowledge

A common feature of all WIL programmes is that they include theoretical components (Winberg, 2011). In the Physical Sciences CAPS document, detailed of the theoretical knowledge constitutes the major section of the document. There is thus strong alignment in this regard.

Practical Skills

WIL literature tends to include a strong focus on skills. The physical sciences CAPS refers to a range of technical skills such as measuring, observing and comparing. One column running throughout the content section of the document (labelled Content, Concepts and Skills) lists specific skills in relation to the various content topics. Interestingly, Lichfield et al (2010) reveal that while technical skills are viewed as important, some employers believe the basis for their recruitment relates more to generic professional attributes. This is because employers they could train new graduates in technical skills, but to do so for more generic professional attributes would to be too difficult. Generic professional attributes are referred to in some literature as 'soft skills'(e.g., Winberg et al, 2011, p. 19) and in others as non-technical competencies (e.g., Martin and Hughes, 2009). There have been numerous studies across the world to ascertain the most important non-technical competencies. Some commonly desirable attributes according to Martin and Hughes (2009), are listed together with the results around indicators of alignment from the Physical Sciences CAPS in Table 1.

TABLE 1: Commonly desirable graduate attributes (Martin & Hughes, 2009, p.20) matched to indicators of alignment in the Physical Sciences CAPS document

Attribute	CAPS indicator
The ability and willingness to learn	Physical Sciences prepares learners for future learning, specialist learning (p.8)
The ability to prioritise tasks and organise effectively	to produce learners that are able to organise and manage themselves and their activities responsibly and effectively (p. 5)
The ability to take responsibility and make decisions and The ability to solve problems	identify and solve problems and make decisions using critical and creative thinking'; 'demonstrate an understanding of the world as a set of related systems by recognising that problem solving contexts do not exist in isolation (p. 5)
The ability to communicate interpersonally	communicate effectively using visual, symbolic and/or language skills in various modes (p.5); Teachers of Physical Sciences should be aware that they are also engaged in teaching language across the curriculum (p. 14)
The ability to work as a team	work effectively as individuals and with others as members of a team (p. 5)

An additional aim in the Physical Sciences CAPS (South Africa. DoBE, p. 5) is to develop learners who use science and technology effectively and critically showing responsibility towards the environment and the health of others'. This resonates with the competency theme of 'professional ethics' referred to by Martin and Hughes (2009, p. 38). The results indicate strong alignment between strongly desirable graduate attributes and the Physical Sciences CAPS and that the CAPS has a strong focus on technical skills as well.

Theory-Practice Integration

Effective WIL curricula are ones which ensure that students focus on the integration of theoretical knowledge and practice (Winberg, 2011). Some aspects of WIL related to theory-practice integration are assessment and contextualisation, for which the alignment of the Physical Sciences CAPS will now be discussed. According to (Winberg, 2011), it is important that assessment tasks be developed around disciplinary knowledge *and* its transfer to the world of work. This is echoed in the Physical Sciences CAPS, which emphasises the acquisition *and* application of knowledge and skills in ways that are meaningful to students own lives. The CAPS further outlines both pen-and-paper assessments (such as tests) as well as practical assessments as being compulsory, and that application activities are required across all cognitive levels for all the knowledge areas (DoBE, 2011).

In terms of student WIL placements, authentic professional contexts serve as learning environments in which students engage in meaningful workplace activities that support integrative learning (Winberg, 2011). As indicated earlier, the epistemological usefulness of workplaces is explained in terms of their potential for accommodating both theory and practice (Choy, 2009). One of the general aims of the SA curriculum is the promotion of knowledge in local contexts while maintaining sensitivity to global imperatives (DoBE, 2011).

Following through with the issue of local contexts, the Content, Concepts and Skills section of the CAPS makes reference to a range of 'everyday life' contexts related to specific content. Some examples include the mention of kitchenware produced from polymers (in the organic chemistry section) and the relative amount of work done when a trolley is pushed vs when car tyres turn without slipping (in the mechanics section). These exemplify the categories of household items and transport respectively, and other similar categories of the emerging from the analysis of the curriculum include food, household chemicals, environment and medicine. These reveal the integration them of everyday-context. Further to everyday-contexts, the theme of workplace-contexts related to specific content, concepts and skills frequently arises in the CAPS. Exemplar categories include the mining, fertiliser, energy and medical industries. The CAPS thus provides rich opportunity for theory-practice integration via a range of categories in the themes of everyday-contexts and workplace-contexts.

Mechanisms for Epistemic Shifts Between Theoretical Knowledge and Practical Application, in the SA School Science Curriculum

Maton (2014, p. 106) reveals that 'Enabling cumulative learning is central to education' and that 'mastering semantic gravity is a key to cumulative learning'. Considering the previous section on the CAPS theory- practice integration themes, it becomes evident that they allow for contextualising of theory (increase in semantic gravity) or theorising of context (decrease in semantic gravity). Through their contribution towards shifts in semantic gravity, the everyday-context and workplace-context integration themes are thus epistemic shift mechanisms which contribute to knowledge building. While the Physical Sciences CAPS is delivered without work placements in school, its otherwise strong alignment to WIL precepts and the rich range of specific options it involves as epistemic shift mechanisms provide a foundation for more nuanced pre-placement work-directed theoretical learning in science courses at vocational institutions. This empirically informs improved scaffolding towards work placement as called for by Nagarajan and McAllister (2015). Furthermore, the notion of semantic waving between theoretical knowledge and practical application offer insight into science vocation pedagogy (in terms of lecturer talk for example) and assessment criteria (of student reflections for example) related to powerful knowledge-building via cumulative learning by students.

CONCLUSION

In considering the range of definitions for WIL, this paper highlights the reasons for its descriptions as a(n) provisional, chameleon, umbrella and sensitizing concept. While acknowledging that there is cause for confusion and contestation around what WIL includes, the paper also surfaces some of its core tenets: preparation for workplace/career, inclusion of theoretical knowledge, inclusion of technical and non-technical practical skills; and theory-practice integration. Document analysis of the South African Physical Science CAPS reveals that it is strongly aligned to the key tenets of WIL. From a legitimation code theory perspective, the strong alignment of the curriculum policy to WIL tenets allows for a range of specific semantic shifting opportunities between decontextualized science theory and contextualised practical knowledge. The results of the study provide insight into the epistemological contribution of work integrating learning, suggesting a complimentary relationship between theoretical learning and work-integrated learning which goes beyond the notion of the former simply including the latter as a stepping stone towards work-readiness. The study has the potential to inform science vocation pedagogy and assessment criteria.

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