

Developing a Skillful and Adaptable Workforce: Reappraising Curriculum and Pedagogies for Vocational Education

Author

Billett, Stephen

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Stephen Billett

12.1 Changing occupational and workplace requirements

Changes in occupational practices, such as the digitalization of work, the specific requirements for workplace performance and the needs of working life, such as available work, how work is conducted and work practices, periodically prompt reappraisals of the goals and processes of vocational education (Billett, 2006). In the contemporary era of digitalization, there is a growing governmental concern about vocational education achieving what is been referred to as 21st century skills: emphasizes the importance of i) complex problem-solving, ii) critical thinking, iii) creativity, iv) people management and v) coordination (Nokelainen, Nevalinen, & Niemi, 2018). Emphasized also is the development of the knowledge required to participate in work that has become increasingly digitized (Harteis, 2018a). A related change is that up until recently vocational education has primarily been concerned with developing occupational capacities and mainly assisting young people move into the world of work and specific occupations. Yet, now there is a strong focus on making those young people job ready—able to meet the requirements of the specific workplace in which they find employment, which is a different education goal. So, for instance, the use of technology and the impact and requirements for digitalizes work differs across workplaces.

Consequently, as work requirements change, then vocational education needs to respond accordingly. These changes include: i) addressing the specific requirements of workplaces as well as ii) developing occupational competence, which has been the key focus for much of vocational education; iii) learning knowledge that is difficult to directly experience (i.e. conceptual and symbolic knowledge) required for what is often referred to as ‘knowledge work’, and currently, digitized work (Hamalainen, Lanz, & Koskinen, 2018; Harteis, 2018a; Nokelainen et al., 2018; Schneider, 2018); iv) developing adaptive occupational capacities as the requirements for work and work performance are constantly changing; v) the importance of students to become active and intentional learners for their initial preparation, and vi) also that ongoing development across working life. All of this, and, currently, the impact of digitalization raises fresh problems for education (Harteis, 2018a).

A way forward for vocational education is to adopt curriculum and pedagogic practices that are aligned with achieving these kinds of outcomes. This includes appraising: what constitutes effective educational experiences, both within educational institutions and workplaces, ordering and reconciling these two sets of experiences, educational interventions to generate the capacities that vocational education students need to be effective in specific workplaces and preparing them to become active and intentional learners across their working lives. Achieving these outcomes includes considering what constitutes the existing and emerging requirements for occupational and workplace performance (i.e. the knowledge that needs to be learnt) and aligning these with the curriculum and pedagogic practices that vocational education institutions can advance and the kinds and quality of engagement that students need to adopt and practice.

The case made in this paper is, firstly, to set out some key changes that are occurring within contemporary workplaces. These are held to be fivefold. Firstly, as being ‘job ready’ on graduation is now increasingly a priority, a focus on how students can be made ready for work on graduation, as well as for occupational preparation. Secondly, educational processes need to understand and respond to specific needs of occupations in action (i.e. addressing the specific needs of workplaces) to assist students. That is, there is a need to assist students understand and respond to the specific requirements of workplaces as well as being occupationally prepared. Thirdly, with the broader use of electronic technology (i.e. digitized work), new regimes of management, production and service work are eventuating that require increasing levels of symbolic and conceptual knowledge (Schneider, 2018), appropriate educational interventions need enacting to assist students develop these kinds of knowledge (Hajkowicz et al., 2016). Fourthly, is developing adaptability within students so that they can adapt and respond in effective ways to the challenges they encounter beyond graduation (Ericsson & Lehmann, 1996). That is, preparing students to be active adaptable and interdependent learners. Fifthly, although much of this educational project is directed towards initial occupational preparation, increasingly, individuals need the capacities to engage with and continue their intentional learning—continuing education and training—across lengthening working lives (Organisation for Economic Co-operation and Development, 2006).

In response to these changes, curriculum and pedagogic practices within vocational education needs to include organizing and engaging students in authentic experiences, albeit in educational institutions or workplaces, and intentionally integrating the two kinds of experiences (Billett, 2015). Identifying pedagogic practices likely to generate adaptability within students is a related consideration. That adaptability is likely based on having effective disciplinary knowledge (Alexander & Judy, 1988; Gelman & Greeno, 1989) and familiarity with its application in different work settings. Yet, as much of the conceptual

and symbolic knowledge required for contemporary digitized work cannot be experienced directly through sensory engagement (Harteis, 2018a), it may require specific kinds of interventions to promote its development (Vosniadou, Ioannides, Dimitrakopoulou, & Papademetriou, 2002). Also, across all of these considerations is the need to promote the learners' agency to be effective, outward-looking and intentional in their engagement in activities and interaction from which they learn (Goller, 2017). Finally, the changing nature of work requires most in the workforce to refresh, advance and even change their occupational, making continuing education a requirement for working adults (Billett, Dymock, & Choy, 2016). These curriculum and pedagogic responses are proposed as how to vocational education can proceed with developing skillful and adaptable workers.

Each of these issues is now addressed in sections headings those associated with: i) key changes reconfiguring the goals for and processes of vocational education and ii) responsive curriculum and pedagogic practices.

12.2 Key changes reconfiguring the goals for and processes of vocational education

As noted, there are a range of changes for occupational and workplace requirements that have direct implications for the provision of vocational education. These include a focus on job readiness as well as occupational preparation; addressing the specific needs of workplaces; accessing and learning the kinds of conceptual and symbolic knowledge required for digitized processes such as Manufacturing 4.0 (Hamalainen et al., 2018), and the need to develop adaptable skills to respond to the changing requirements for occupational practice and specific workplace performance. This leads to a consideration of the blending between initial and continuing education. Added here also is the need to engage learners and have them come to value and engage in vocational education and the occupations it serves.

Job readiness as well as occupational preparation

The traditional role of vocational education in the modern era has been to prepare people for working life and specific occupations (Billett, 2011b). This role has seen a focus on identifying occupational requirements and then working to prepare graduates to meet them. Representatives of workers, professional associations and licensing bodies for many occupations have been involved in informing national curricula measures for vocational education. Consequently, external have come to play a key role in not only informing what content should be taught, but also the kinds of assessments students will be subjected to and the need to meet occupational requirements. However, increasingly, employers, governments, community and students are expecting that vocational education graduates should be 'job ready' (Billett, 2015). That is, able to smoothly transition to and effectively perform in specific workplaces. This is a particularly tough goal for vocational education and demanding upon graduates. There are key differences between curriculum and experiences that are designed to meet the needs of occupational requirements and regulations, and those associated with addressing the requirements of specific workplaces. Moreover, there are structural difficulties because we do not know where these graduates will end up being employed, and their situated performance requirements. So, this growing emphasis and expectation that students from vocational education will be able to move smoothly into employment in a specific workplace requires a different set of educational goals and processes than those associated with readiness for an occupation. This requirement extends to knowing something of the variations of occupational practice and the rationales for those variations and their consequences for work performance. Fundamentally, it is about developing adaptive capacities within vocational education graduates. So, this change warrants a significant reconsideration of educational goals and processes.

Educational goals

Education is an intentional process. That is, it is guided and driven by specific kinds of intentions (e.g. goals, aims, objectives) that should be the product of a range of contributions and insights, balancing amongst these contributions and selecting and generating kinds of intents (Marsh, 2004). The degree of specificity for educational processes varies from being wide and open to being highly job specific. The latter often occurs in preparation for occupations as there are specific occupational requirements advanced by industry bodies that need to be met are captured as national standards, occupational competences or national curriculum documents. What electricians, nurse assistants, builders transport workers are required to perform is thereby mandated and even regulated by these requirements. Yet, to understand the relationship between these

occupational requirements and those for specific workplaces, it is helpful to consider occupational preparation in terms of it comprising the canonical occupational knowledge and also the situational requirements for performance (Billett, Harteis, & Gruber, 2018). That is, firstly, the knowledge comprising what those practicing the occupations need to know, do and value. Knowing refers to factual, conceptual, propositional and causal knowledge. Being able to secure goals is achieved through procedural knowledge that ranges from being highly specific procedures (to achieve individual tasks) through to strategic procedures required for planning and evaluating work activities (Anderson, 1982; Ericsson & Lehmann, 1996). There is also a consideration of value—the dispositional qualities of interest and intentionality that is central to how individuals undertake their work. It is, together, these three forms of knowledge that underpin effective work performance, and what some referred to as expertise (Ericsson, Hoffman, & Kozbelt, 2018).

Requirements of situational performance

Yet, and secondly, beyond the canonical occupational knowledge is also what comprises the situational requirements that permit job performance in a specific workplace/work practice (Billett et al., 2018). Yet, the actual requirements for performance are not premised upon the possession of canonical knowledge alone. Instead, that performance is premised upon what individuals do circumstances in response to specific tasks in those circumstances (Brown, J. S., Collins, & Duguid, 1989; Gruber & Harteis, 2018). It is the range of situational factors, including the kinds of tasks, clients, patients, available equipment, location et cetera that shapes situational performance, even what counts as errors and their costs (Bauer, Leicherb, & Mulder, 2016; Rausch, Seifried, & Harteis, 2017). So, the ability to perform in and through work is related to the actual circumstances in which individuals practice that occupation (Billett, 2001). There is no such thing as being an occupational expert per se. Instead, it is the ability to respond to routine and nonroutine problem-solving in a situation that is relevant to individuals' work performance.

These requirements are shaped by the specific manifestations of occupational practice and to be addressed and will comprise specific kinds of educational intents and processes. So, vocational educational intents need to include experiences that can assist students come to learn something of the variations of occupational practice and diverse kinds of workplace performance associated with their occupations. Underpinning this, is the development of adaptability in students. That is, the ability to extend what they have learnt in one situation to be applied to tasks, goals and circumstances other than those in which it was learnt. Securing the adaptation of what has been learnt in educational programs and institutions is a perennial question (Lobato, 2012; Volet, 2013). Certainly, to be countenanced as 'education', what is learnt should not

be restricted to the circumstances of its initial learning. This is never more the case than in vocational education where the key focus is on preparing people to apply what they have learnt in workplaces and work practices.

Consequently, challenge for vocational education is to find ways of understanding something of the diversity of situational requirements and expose students to instances of that diversity and allow them to understand something of the range of requirements arising from it. Engagements and partnerships with local employers and industry representatives, those from professional bodies are likely to clarify these requirements. Those kinds of engagements and outcomes are also hallmarking for what constitutes mature vocational education systems. That is, those outcomes that are not wholly premised upon what happens in the vocational education institution, but how what occurs outside of the 'school' is able to be engaged with and be responsive.

Securing 'hard to learn' knowledge (e.g. digital knowledge)

Much existing and 'future work' is likely to be increasingly reliant on conceptual and symbolic knowledge (Barley & Batt, 1995; Hull, 1997), such as that required for digitalized work (Hamalainen et al., 2018; Schneider, 2018). That is, the knowing that must be mediated through concepts and symbols as it cannot be directly expressed or experienced. Much of this is associated with understanding is premised on knowledge that is opaque and difficult to access and, therefore, learn (Harteis, 2018a). Across human history, and increasingly, this kind of knowledge is that which we used to represent complex things that cannot be easily stated or represented. Consequently, use symbols to denote chemicals, factors such as used in mathematical calculations or physics representations and increasingly are exercised within electronic technology (Vosniadou et al., 2002). Examples here include the growing use of technologies in fields such as banking, clerical work, as well as healthcare (Hajkowicz et al., 2016). This kind of knowledge is often associated with changes in how work is conducted and how individuals come to mediate it. Earlier, Scribner (Scribner, 1985) with great prescience stated that

"hardly have we approach the problem of understanding the intellectual impact of the printing press and we are urged to confront the psychological implications of computerisation" (page 138).

She was drawn to capture and comprehend these changes through considering the cognitive consequences of the introduction of Computer Numerically Controlled (CNC) lathes (Martin & Scribner, 1991). These kinds of lathes comprised a shift away from those operated through and by human sensory processes (i.e. vibrations, noise, smell, sight) to those that integrated traditional machining knowledge with symbolic knowledge and logical skills, that were enacted computers (Martin & Scribner, 1991). These kinds of knowledge are

difficult to learn because they cannot be directly experienced and engaged, nor easily represented and expressed.

What is also noteworthy is that these kinds of conceptual knowledge break with the convention that conceptual knowledge can be declared (i.e. spoken or written down). Indeed, in much of the American literature this kind of knowledge is referred to as declarative. Yet, this form of conceptual knowledge does not lend itself to either being spoken or written down. Therefore, it is difficult for individuals to generate cognitive representations of it. Yet, these forms of knowledge need to be constructed by individuals (i.e. learnt) because they become personal tools to mediate work and learning. These forms of knowledge are not restricted to considerations of electronic technology, but the shift to the use of digitalization brings this form of knowledge centre-stage and considerations of how it can be developed through vocational education. For instance, science education and educators have long struggled with identifying the most effective ways of representing this kind of knowledge for students to come to understand science and physics. Concerns about force, vectors, stress on physical components et cetera need to be understood through systems that require this kind of conceptual knowledge.

However, there is a need to identify pedagogic practices that comprise practical ways of seeking to make these forms of knowledge accessible so they can be engaged with, construed and constructed with by learners. And it is these that need to become part of the educational considerations.

Adaptability and interdependence

As the requirements for contemporary work changes, it is necessary for workers of all kinds to adapt in responding to transforming circumstances and challenges (Ericsson & Lehmann, 1996). All of this is important because as the PIAAC data indicates all classes of contemporary workers engage in extensive and frequent non-routine problem-solving and adaptability is central to the capacity to respond to non-routine problem-solving (Organisation for Economic Co-operational and Development, 2013). These are qualities that are broadly reported across countries and all classifications of workers (Australian Bureau of Statistics, 2013). Responding to occupational challenges workplaces, in addressing clients' problems and needs requires the capacities to adapt occupational knowledge to meet those requirements (Ericsson & Lehmann, 1996).

The means to respond to these changes is often associated with interdependence (Rogoff, 1990). That is, through working and learning with others and in ways in which reciprocity is commonplace. Through interaction with others, much can be gained from those interactions and shared learning arises in ways that is reliant upon the contributions of others and objects. So, rather than being based on cleverness alone (i.e. the ability to manipulate knowledge), the ability to engage with others and artefacts is required to respond to such

challenges. This is because the knowledge required to effectively learn resides outside of individuals and they must gain it from the social world. As we know, the knowledge required for occupational practices does not rise within individuals. Individuals need to engage with others who possess that knowledge or artefacts that can mediate that knowledge for them. Yet, in terms of change, the interdependence between the workplace and the worker both comes to the fore. The workplace requires workers have the capacity to respond to new challenges and generate new procedures and practices to achieve the goals of the workplace (Billett, 2014a). Without the actions of the workers, the workplace would become moribund and unable to advance. Yet, workers need the workplace, the contributions it provides and its role in continuing to develop that knowledge that are so central to being able to respond to emerging and novel challenges.

Fundamentally, this means that core capacities for contemporary workers are: i) the ability to adapt to new challenges and novel circumstances, and ii) to engage interdependently to secure that knowledge. Consequently, more than possessing a body of occupational knowledge, and understandings of its need to be applied in different ways, are the attributes of adapting that knowledge to meet emerging challenges and new situations.

Continuing education and training

With the constant change of knowledge required for work it has become increasingly apparent that even the most effective initial occupational preparation will not equip individuals for lifetime of work. Instead, workers need to continue to actively learn across their working lives. Therefore, beyond vocational education being primarily concerned with initial occupational preparation is now increasingly important to consider the ongoing development of that knowledge through continuing education and training (CET) (Billett et al., 2016). There are a range of factors shaping the growing need for CET provisions within contemporary workforces. These include the: i) ageing populations in many countries requiring workers to sustain their employability over a longer period of time, ii) constant need for developing further and up skilling individuals' knowledge, iii) often quite specific requirements for responding to the changing nature of work, iv) availability of opportunities for practicing occupations and v) emergence of new occupations it is not surprising that there is a growing interest in continuing education and training.

Consequently, there is a need for appropriating existing models of CET provisions to meet these needs and, likely in ways that are quite different from provisions of initial occupational preparation. These CET provisions need also to be structured in ways that meet the needs of working adults. These needs include ease of access for adults with work and family commitments as well

as CET, relevance to individuals learning requirements, and to be administratively easy. However, these models need to be effective and applicable by those who use them, and not based upon those that work for school age young people. Instead, the kinds of CET programs likely to be endorsed are those that are based in educational institutions. Increasingly, vocational education students are having access to practicum experiences and means by which these can be enriched and integrated into the students' overall program.

Together, these six sets of concerns are some of the key challenges for contemporary vocational education. In the next section, the discussion focuses on curriculum and pedagogic practices that are responsive to these sets of concerns.

12.3 Responsive curriculum and pedagogic practices

The above raise questions about the kinds of curriculum and pedagogic practices that can support occupational competence, job readiness, adaptability and sustain employability across working life. These issues are addressed in the following sections that offer seven considerations: i) institutional-based activities that insight authentic work experiences, ii) organizing and providing workplace experiences, iii) intentionally and actively integrating students' experiences; iv) educational processes promoting adaptability, v) securing hard to learn knowledge, vi) promoting learning agency, and vii) provisions of continuing education and training.

Institutional-based activities that incite authentic work experiences

The provision of experiences in educational institutions that are similar to those associated with the circumstances of their application has been long understood as being important for robust learning (Raizen, 1991). It follows that for the development of occupational capacities, it is important to provide students with authentic experiences of the occupations for which they are being prepared to participate. Below, it is been suggested that it is important to provide students with workplace experiences and then reconcile what they have learnt in workplace settings with the goals of their vocational education courses. However, it is not always possible for students to secure workplace experiences. Whereas some countries and occupations have very strong traditions of providing workplace experiences, others do not. It is very common in Germany for vocational students to engage in significant amounts of work experiences, whereas over one of their borders in the Netherlands there is not such a strong tradition of providing students with work experiences (de Bruijn, Billett, & Onstenk, 2017) and in France there is a cultural sentiment separating work

from education (Veillard, 2015). Indeed, the Netherlands in their vocational education and applied science universities there is a strong emphasis on providing what is referred to as hybrid experiences within those institutions (Zitter, Hoeve, & de Bruijn, 2017). That is, students are provided with simulation or project work that is similar to the kinds of activities that comprise the occupational practice. Likewise, in Singapore were many of the postsecondary education institutions (i.e. the polytechnics and the Institute for Technical Education) also use project type activities within the institutional setting. For instance, in one of the polytechnics, the information technology students engage in the tasks of assisting other students with setting up their laptops and tablets with the polytechnics systems and then engage in a helpdesk and troubleshooting when students have problems. That is, the students are engaging in authentic activities associated with information technology tasks. Of course, with the increasing requirements for competence with digitally-enacted forms of work it becomes necessary for the educational experiences and teaching processes to encompass those requirements as (Petri Nokelainen, Nevalainen, & Niemi, 2018) propose.

There are two broad considerations here: curriculum and pedagogy. In terms of curriculum—the activities that are organized for students and their sequencing—consideration of shared or individual projects associated with the field of study, simulated activities (e.g. training restaurants, IT help desks) can provide students with educational activities that are closely linked with their intended occupation. This approach to curriculum engages students in the kinds of goal-directed activities that are associated with that occupation and, therefore, have high levels of authenticity associated with the knowledge targeted for them to learn. Also, these kind of projects and simulated activities engage students in a way that more passive forms of education are unlikely to be able to achieve. That is because the students are put in the ‘driver’s seat’: they must make decisions and complete actions and then monitor and evaluate those actions. We know that this kind of engagement and kind of thinking and acting is what is required for developing the higher-order capacities required for many occupations.

So, these kinds of experiences are important educationally and the more they can be made authentic in terms of the kinds of activities and interactions they comprise the more likely that students will generate the understandings, procedures and dispositions associated with occupational practices. That will assist them learn that knowledge in ways encouraging utilization, recall, and are also aligned with performing occupational tasks upon graduation.

In terms of pedagogic practice, the teachers’ ability of to use narratives, storytelling and verbalize the kinds of knowledge that needs to be learnt using instances from practice is likely to be tickly helpful for students to learn and recall what has been taught (Billett, 2014b). Activities that emphasize the utilization of the knowledge outside of the circumstances in which is being taught

will assist students learn about the applicability of that knowledge and assist them through providing experiences which are not able to be directly engaged by them.

Organizing and providing workplace experiences

Currently, in many countries, vocational education systems are increasingly organizing and providing workplace experiences to assist students learn the kinds of knowledge that they require to effectively practice their preferred occupation. Important goals outlined above are associated with securing canonical occupational knowledge and understanding variations of that knowledge and how they apply in different workplace circumstances, the need for workplace experiences becomes pre-eminent. Workplace experiences provide access to: i) authentic activities and interactions; ii) richly contextualized experiences that engage students in multisensory ways and provides clues and cues about how they need to engage in their work; iii) purposive goal-directed activities that are aligned with the kinds of knowledge that students need to learn for their intended occupations; iv) engaging students in goal-directed activities that require them to resolve problems and through them learn; v) securing episodic experiences from which important causal and propositional links are developed; and the ability to monitor the activities in which they engage (Billett, 2015). These work-based experiences are much more than complementing those that students have within educational institutions. Instead, they make specific kinds of contributions and sources of knowledge that might not be found outside of them. Also, as the activities and interactions are authentic the cognitive consequences are likely to be of the kind that assist learners develop capacities that they can recall, utilize and further develop. Rogoff and Lave (1984) captured the cognitive consequences of such activities with the phrase that activity structures cognition.

Of course, the kinds, extent and quality of the work experiences that students secure is dependent on those activities and interactions they can engage in and how they engage in workplaces, their duration, variation and the degree by which students are guided and supported in workplace settings as they engage in occupational goal-directed activities. Moreover, there is a risk that if poor or inappropriate practices are being enacted, these are what students will be exposed to and potentially learn (Billett, 1995). So, the quality and appropriateness of these experiences may differ from setting to setting which provides uneven and potentially unhelpful experiences for students. Yet, it is difficult for educators to influence the organization and provision of workplace experiences for their students which are normally subject to the imperatives of workplaces. Yet, much can be done by vocational education institutions and their teachers to intentionally augment students' workplace experiences and

integrate them effectively in students' educational program. This is discussed next.

Intentionally and actively integrating students' experiences

Workplace experiences provide learning opportunities that are often quite different than those that can be provided through vocational education institutions and can secure specific kinds of learning. But, as noted, there can be inherent limitations in those experiences. Consequently, there is a need not only to include these experiences within the provision of vocational education, but also find ways of integrating those workplace experiences and the learning derived from them into the vocational program (Cooper, Orrel, & Bowden, 2010). At one level, the concern is to organize and provide experiences in ways that helps students' development of occupational capacities. Yet, at another level, the aim is to engage students in ways that maximize their learning from them and to integrate that learning with what they is being learnt through participation in their vocational education course (Orrell, 2011). So, again, there is need to consider both curriculum (i.e. the provision of experiences) and pedagogies (i.e. utilization of those experiences). The findings of a large tertiary teaching project on the integration of workplace experiences identified some of the curriculum and pedagogic practices that could be adopted (Billett, 2011a). In Table 1, below issues associated with the intended (i.e. what is designed and planned), enacted (i.e. what occurs with implementation) and experienced (i.e. what students experience and learn) curriculum are set out. These were derived from a national project comprising studies from across a range of occupational disciplines in tertiary education institutions.

Table 1: curriculum considerations for integrating workplace experiences (Billett 2015)

Intended curriculum: <i>what is planned</i>	Enacted curriculum: <i>what is implemented</i>	Experienced curriculum: <i>what students experience and learn</i>
being clear about what is to be learnt through workplace experiences	augmenting or maximising available opportunities (e.g. appropriate settings)	Students' interest and readiness central to their engagement and learning in practice settings, and reconciling it with their coursework
aligning experiences provided for students with the intended learning outcomes	considering options other than supervised placements to secure experiences	immediate concerns (e.g. performing in practicum) focus of students' interest
aligning the duration of experiences with educational purpose (e.g. orientation vs skill development)	accounting for students' readiness (e.g. interest, capacities, confidence) when selecting and enacting experiences	early and staged engagement in practice settings boosts many students' confidence to re-engage and learn effectively
intentionally sequencing preparatory experiences to secure, consolidate and reconcile learning from practice experiences	additional or specific experiences may be needed for student cohorts (e.g. overseas students)	challenges to personal confidence and competence can be redressed by effective group processes, including sharing of experiences.

In this table, there are sets of considerations for how the intended curricula might be organized to optimize the integration of students' experiences in work settings. Also, there is a set of practices associated with the implementation of the curriculum (i.e. the enacted curriculum) that can inform practices and priorities associated with its enactment. Then, and perhaps most importantly, are a set of considerations about how students will come to understand and engage with what has been implemented and experienced by them (i.e. the experience curriculum).

Beyond these curriculum considerations are also processes associated with pedagogic practices that could be used to augment students experiences by assisting them integrate and reconcile the experience says they have had in work settings with those that comprise the curriculum being enacted. In Table 2, below are set out some suggestions that arose through the national study on what kind of pedagogic interventions might occur before, during and after workplace experiences. What can be seen here is the importance of preparatory activities prior to students engaging in work settings, and then interventions to promote student learning during their workplace experiences. It was also found that having interventions after the students have experience work practice was

particularly helpful as students had experiences that they could compare, share and critically appraise with other students. These interventions also open up considerations of opportunities for students to develop understandings about the occupational practice, and variations of that practice in action. This phase also has the potential for students to develop understandings about practice in action and develop critical capacities to appraise work situations and the efficacy of kinds of practices. This latter kind of learning is important for ongoing learning that these students will require on graduation and as they continue to confront changes across their working life, and largely learn in the absence of teachers and educational programs.

Table 2: Pedagogic strategies for promoting integration of workplace learning experiences (Billett 2015)

Before workplace experience	During workplace experience	After workplace experience
orient students to requirements for effectively engaging in work practices	direct guidance by more experienced practitioners (i.e. proximal guidance)	facilitate the sharing and drawing out of students' experiences
clarify expectations about purposes of, support in and responsibilities of parties in practice settings etc.	active engagement in pedagogically rich work activities or interactions (e.g. handovers)	make explicit links to, and reconciliations between, what is taught (learnt) in the academy, and what is experienced in practice settings
prepare students to engage as agentic learners (e.g. importance of observations, engagement)	effective peer interactions (i.e. students' collaborative learning)	emphasise the active and selective qualities of students' learning through practice
develop procedural capacities required for tasks in workplace	active and purposeful engagement by the students as learners in workplace	generate students' critical perspectives on work and learning processes
prepare for contestations that might arise		

It follows from the findings of this teaching and learning grant (Billett, 2015), that there are actions that can be taken in the design and implementation of vocational education programs that can assist in the effective provision and integration of students experiences in workplaces with what they are learning in their programs. Perhaps most important, was the interventions that occurred after students had completed their work experiences as these provided opportunities for them to develop knowledge from what they had experienced and could engage with and learn from other students' experiences vicariously and critically. An element of the pedagogic practices outlined here is to assist students be able to adapt what they have learnt through these experiences to other

circumstances and settings. That is, to promote their ability to adapt that knowledge. This is quite central to robust educational outcomes and specific considerations of how this adaptability might best be generated.

Educational processes promoting adaptability

As noted, a fundamental concern for the outcome of education per se is the ability of students to adapt what has been learnt within educational programs to circumstances outside of and beyond them. This is a key issue for vocational education, with its focus on preparing students to apply their knowledge in workplaces upon graduation when they secure employment beyond graduation. It is sometimes referred to as transfer (Mayer, 2001) or the development of transferable knowledge (Royer, 1979). This kind of learning is always not easily derived from direct teaching, but can be guided in its development (Brown & Palinscar, 1989; Palinscar & Brown, 1984). Instead, other kinds of experiences are often required, albeit supported by teacherly practices to promote adaptability, such as reciprocal teaching and learning (Palinscar & Brown, 1984), guided learning rather than teaching in classrooms (Brown & Palinscar, 1989; Collins, Brown, & Newman, 1989) and workplaces (Billett, 2000).

Here, a key curriculum goal is the development of understandings and practices (i.e. informed principles and practices) that promote adaptability. That is, identifying and assist in students develop understandings and procedures that will assist them adapt what they know, can do and value to changing or other circumstances. This can be realised in several ways, one of which is having students share their experiences of different work and identifying what is common across the enactment of that occupation (i.e. the canonical knowledge of the occupation) and what is to specific work settings (i.e. situational requirements). So, to take an example, student nursing assistants might experience nursing in a whole range of health care settings (i.e. different kinds of wards) and then be asked to identify those aspects of nursing practice that are common to all those settings, and those that are specific to just one or some of them. The former can be taken as being the canonical knowledge of nursing assistants, and the latter nursing practices that are peculiar to specific kinds of wards or clinical settings. What they would learn from this experience is that there are concepts, procedures and dispositions that are common to nursing and then variations of them that are relevant to specific nursing circumstances.

It is the combination of developing canonical occupational knowledge alongside the understandings of variations and situational requirements that can provide a basis for using occupational knowledge adaptively. By, engaging with other students to compare their experiences of work settings, albeit facilitated by the teacher, it opens up a range of options and possibilities that permit them to realise that there are variations in that practice, and for what reasons

and how these might be accommodated within enactment of the occupation. Consequently, providing opportunities for students to engage in sharing, discussion and dialogue are likely to be important, as, if possible, students rotating through different kind of work settings and circumstances of occupational practice. Even then, those experiences alone may be insufficient unless there is the opportunity to consider, discuss and extend knowledge about those practices. Also, it may be necessary to guide that process of identifying canonical and situated instances of nursing practice. So, for instance, the teacher might provide a list of nursing competencies and asked students to appraise these against their own experiences. That is, identifying what is canonical and what is situated requirements.

This concern with adaptability is fundamental to the educational project. Education institutions and their programs have been established not just for learning that is relevant to them but need to be applicable to circumstances and activities that are distinct from those enacted in educational institutions. Consequently, focusing on strategies that seek to extend the applicability of what students come to know, do and value is likely to be a crucial consideration in vocational teaching. This is particularly relevant in the contemporary era where change in workplace and occupational requirements, occurs so frequently.

Securing 'hard-to-learn' knowledge (e.g. digital)

A growing element of contemporary work is to engage with tools and artefacts that are premised on digital knowledge (Harteis, 2018a). As indicated above, the increased use of conceptual and symbolic knowledge as part of workplace performance requirements, now extends to this kind of knowledge. It has increased with the use of electronic technology and the digital systems that shape work activities (Schneider, 2018). This kind of electronically-mediated work is lessening need for the direct use of tools that must be manipulated manually and the importance of ergonomic capacities such as deftness of hand movements (Harteis, 2018a). It is noteworthy that, however, there are three concerns associated with learning conceptual and symbolic knowledge. Firstly, they are sometimes quite difficult to capture and represent in written form (e.g. force, electronic systems, information processing). Secondly, they can be difficult to access because there is no direct engagement with them (e.g. they cannot be directly experienced). Thirdly, these kinds of knowledge are often difficult to be taught, and therefore need to be learnt through processes of guidance and, experiences that make this knowledge explicit. Science education has long struggled to address the problem of developing conceptual knowledge in school classrooms (Diakidoy & Kendeou, 2001; Novak, 1990; Vosniadou et al., 2002). That is, how can students learn concepts that they cannot directly experience. Literature from that field suggest the importance of making that knowledge explicit in some ways and able to be experienced or engage with or

even visualised (i.e. represented in some way) and then having students construct meaning from those explicit representations. That is, actively engage students in the construction of the conceptual knowledge.

For vocational education, more broadly, the kinds of pedagogic divisions and practices required for developing conceptual knowledge are as follows. Firstly, consideration needs to be given to the kind of experiences and forms of learner engagement that are most likely to be able to represent that knowledge, on the one hand, and, on the other, have processes that students come to engage with it. It has been suggested (J. S. Brown et al., 1989) that students engaging in developing a conceptual model of the task is important as this provides the learner with:

- an advanced organiser for attempting to execute the task;
- bases to utilise feedback, hints and corrections during interactions;
- an internalised guide for independent practice by successive approximations; and
- a conceptual model which can be updated (Collins et al., 1989)

It is these kinds of considerations that can be particularly helpful for students to construct these ‘hard to learn’ kinds of knowledge that are required for digitised work. This development can also be underpinned by the provision of authentic activities that deliver concrete instances of how that knowledge needs to be utilised and for what purposes and these activities also assist with indexicality (i.e. the construction of knowledge in ways that permits its utilisation and recall). So, a key consideration is making accessible and explicit the conceptual and symbolic knowledge that is so central to digitised work and workplaces. This kind of access can be provided using stories, analogies, explanations, and illustrations by teachers drawing upon specific instances of practice that exemplify and illustrate the concepts being used.

So, these kinds of pedagogic practices that are important assisting the development of this important, but difficult to access, knowledge.

Promoting learning agency

Throughout the discussions above is the enduring focus on learner engagement. We are reminded here that education provisions are nothing more than an invitation to change. How students take up the invitation is ultimately fundamental to the effectiveness and success of educational provisions. So, student engagement and agency are central to effective vocational education, and how graduates come to adapt their knowledge on the world of work beyond that education and engage in the kind of effortful learning that is required to have a long productive working life (Goller, 2017). So, the issue of learning agency becomes quite central here. It is that agency that shapes the focus, intensity and direction of students’ learning. However, there are some considerations associated with promoting learning agency that are outlined briefly here.

Firstly, student readiness (i.e. their ability to engage activities), and an awareness of their readiness is essential starting point for encouraging students to be proactive, interdependent and directed in their activities and learning. Secondly, having goals and processes that attract and sustain student engagement seem to be important. That is, having activities that are relevant, interesting and worthwhile to them. Central here is the idea of developing a strong sense of subjectivity associated with the occupation that incites students' effortful engagement in their learning. So, an important goal is to assist students come to recognize their occupation as their vocation (i.e. something that they come to associate with and engage).

Consequently, and fourthly, selecting and providing educational experiences that engage learners and they be interested in engaging effortful is likely to be required for the kinds of learning needed to become adaptable occupational practitioners. Part of that curriculum and pedagogic process is to place them in the circumstances where they must take responsibility for their thinking and acting, and learning. That is, putting them in the driver's seat, so to speak, because it is important that they engage in the thinking and acting required for the tasks set for them, rather than these being done by somebody else. Of course, guidance and support are provided by teachers, but fundamentally, the focus is on the agency and interdependence of learners. Practical consideration for developing these capacities is having students evaluating their peers' processes and outcomes and this kind of activity can develop the kinds of evaluative and critical capacities that people need to effectively monitor and evaluate their own work practices.

So, there are a set of activities that can be used to intentionally promote student learning agency, and these are central to many of the considerations raised above.

12.4 Developing a skillful and adaptable workforce in the era of digitalization

It has been proposed above that changes in occupational, workplace requirements and working life prompt a reappraisal of the goals and processes of vocational education. A broader view of curriculum and pedagogies need to be considered, engaged with and enacted to accommodate changes in educational goals for vocational education. These include addressing the specific requirements of workplaces as well as developing occupational competence; learning knowledge that is difficult to directly experience conceptual and symbolic knowledge required for digitized work and workplaces. Throughout, the importance of students to become active and intentional learners for their initial

preparation, but also that ongoing development across working life. It is proposed here that a way forward is to adopt curriculum and pedagogic practices that are aligned with achieving these kinds of outcomes. This includes a consideration of what constitutes effective educational experiences (both within educational institutions and workplaces), ordering and reconciling these two sets of experiences, the use of educational interventions that can generate the kinds of capacities within vocational education students and assisting students become active and intentional learners across their working life. Educational interventions are likely to be required to address the growing elements of occupational 'hard to learn' knowledge that is required for much of contemporary work (Harteis, 2018b). Promoting learner agency and interdependence is likely to be an important educational outcome, not just for immediate employability, but for learning across working life.

To do this requires a consideration of what constitutes the existing and emerging requirements for occupational and workplace performance and then aligning these with the kinds of curriculum and pedagogic practices that vocational education institutions need to advance and the kinds and quality of engagement that students need to adopt and practice. These concerns are not just about individuals' personal learning, they extend to the efficacy of work practices, workplaces and communities and learning required for digitized work.

References

- Alexander, P. A. & Judy, J. E. (1988). The interaction of domain specific and strategic knowledge in academic performance. *Review of Educational Research*, 58(4), 375-404.
- Anderson, J. R. (1982). Acquisition of cognitive skill. *Psychological Review*, 89(4), 369-406.
- Australian Bureau of Statistics. (2013). Programme for the International Assessment of Adult Competencies (Australia 2011-2012) In A. B. o. Statistics (Ed.), *Cat 42280.0*. Canberra.
- Barley, S., & Batt, R. (1995). *The new crafts: The rise of the technical labour force and its implication for the organisation of work*. Retrieved from Philadelphia, PA: University of Philadelphia, National Center on the Education Quality of the Workforce.
- Bauer, J., Leicherb, V., & Mulder, R. H. (2016). On nurses' learning from errors at work. In S. Billett, D. Dymock, & S. Choy (Eds.), *Supporting learning across working life: Models, processes and practices*. Dordrecht: Springer.
- Billett, S. (1995). Workplace learning: its potential and limitations. *Education and Training*, , 37 (5), 20-27.
- Billett, S. (2000). Guided learning at work. *Journal of Workplace Learning*, 12(7), 272-285.

- Billett, S. (2001). Knowing in practice: Re-conceptualising vocational expertise. *Learning and Instruction, 11*(6), 431-452.
- Billett, S. (2006). *Work, Change and Workers*. Dordrecht: Springer.
- Billett, S. (2011a). *Curriculum and pedagogic bases for effectively integrating practice-based experiences*. Strawberry Hills: Australian Learning and Teaching Council.
- Billett, S. (2011b). *Vocational Education: Purposes, traditions and prospects*. Dordrecht: Springer.
- Billett, S. (2014a). Interdependence on the boundaries between working and learning. In C. Harteis, A. Rausch, & J. Seifried (Eds.), *Discourses on professional learning: On the boundary between learning and working*. Dordrecht: Springer.
- Billett, S. (2014b). *Mimetic learning at work: Learning in the circumstances of practice*. Dordrecht: Springer.
- Billett, S. (2015). *Integrating Practice-based Experiences into Higher Education*. Dordrecht: Springer.
- Billett, S., Dymock, D., & Choy, S. (Eds.). (2016). *Supporting learning across working life*. Dordrecht: Springer.
- Billett, S., Harteis, C., & Gruber, H. (2018). Developing occupational expertise through everyday work activities and interaction. In K. A. Ericsson, R. R. Hoffman, & A. Kozbelt (Eds.), *Cambridge Handbook of Expertise and Expert Performance* (2nd Ed.) (pp. 105-126). New York: Cambridge University Press.
- Brown, A. L. & Palinscar, A. M. (1989). Guided, cooperative learning and individual knowledge acquisition. In L. B. Resnick (Ed.), *Knowing, learning and instruction, Essays in honour of Robert Glaser* (pp. 393-451). Hillsdale, N.J: Erlbaum & Associates.
- Brown, J. S., Collins, A., & Duguid, P. (1989). Situated Cognition and the Culture of Learning. *Educational Researcher, 18*(1), 32-34.
- Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing and mathematics. In L. B. Resnick (Ed.), *Knowing, Learning and Instruction: Essays in honour of Robert Glaser* (pp. 453-494). Hillsdale, NJ: Erlbaum & Associates.
- Cooper, L., Orrel, J., & Bowden, M. (2010). *Work integrated learning: A guide to effective practice*. London: Routledge.
- de Bruijn, E., Billett, S., & Onstenk, J. (Eds.). (2017). *Enhancing teaching and learning in the Dutch vocational education system: Reforms enacted*. Dordrecht: Springer.
- Diakidoy, I.-A. N., & Kendeou, P. (2001). Facilitating conceptual change in astronomy: a comparison of the effectiveness of two instructional approaches. *Learning and Instruction, 11*, 1-20.
- Ericsson, K. A., Hoffman, R. R., & Kozbelt, A. (Eds.). (2018). *Cambridge Handbook of Expertise and Expert Performance* (2nd Ed.). New York: Cambridge University Press.
- Ericsson, K. A. & Lehmann, A. C. (1996). Expert and exceptional performance: Evidence of maximal adaptation to task constraints. *Annual Review of Psychology, 47*, 273-305.
- Gelman, R. & Greeno, J. G. (1989). On the nature of competence: Principles for understanding in a domain. In L. B. Resnick (Ed.), *Knowing, learning and instruction: Essays in honor of Robert Glaser* (pp. 125-186). Hillsdale, NJ: Lawrence Erlbaum Associates.

- Goller, M. (2017). *Human Agency at Work: An Active Approach towards Expertise Development*. Wiesbaden: Springer Fachmedien.
- Gruber, H. & Harteis, C. (2018). *Individual and social influences on professional learning: Supporting the acquisition and maintenance of expertise*. (Professional and Practice-based Learning, Vol. 24). Cham: Springer.
- Hajkowicz, S., Reeson, A., Rudd, L., Bratanova, A., Hodggers, L., Mason, C., & Boughen, N. (2016). *Tomorrow's digitally enabled workforce: Megatrends and scenarios for jobs and employment in Australia over the coming twenty years*. Canberra. Retrieved from <https://data61.csiro.au/en/Our-Research/Our-Work/Future-Cities/Planning-sustainable-infrastructure/Tomorrows-Digitally-Enabled-Workforce>
- Hamalainen, R., Lanz, M., & Koskinen, K. T. (2018). Collaborative systems and environments for future working life: Towards the integration of workers, systems and manufacturing environments. In C. Harteis (Ed.), *The impact of digitalisation in the workplace: An educational view* (Vol. 21, pp. 25–38). Dordrecht: Springer.
- Harteis, C. (2018a). Machines, change, work: An educational view on the digitalization of work In C. Harteis (Ed.), *The impact of digitalization in the workplace: an educational view* (pp. 1-10) (Professional and Practice-based Learning, Vol. 21).. Cham: Springer.
- Harteis, C. (Ed.) (2018b). *The impact of digitalization in the workplace* (Professional and Practice-based Learning, Vol. 21). Cham: Springer.
- Hull, G. (1997). Preface and Introduction. In G. Hull (Ed.), *Changing work, Changing workers: Critical perspectives on language, literacy and skills*. (pp. 3-39). New York: State University of New York Press.
- Lobato, J. (2012). The actor-oriented transfer perspective and its contributions to educational research and practice. *Educational Psychologist*, 47(3), 232-247.
- Marsh, C. J. (2004). *Key concepts for understanding curriculum*. London: RoutledgeFalmer.
- Martin, L. M. W., & Scribner, S. (1991). Laboratory for cognitive studies of work: A case study of the intellectual implications of a new technology. *Teachers College Record*, 92(4), 582-602.
- Mayer, C. (2001). Transfer of concepts and practices of vocational education and training from the centre to the peripheries: the case of Germany. *Journal of Education and Work*, 14(2), 189-208.
- Nokelainen, P., Nevalainen, T., & Niemi, K. (2018). Mind or machine? Opportunities and limits of automation. In C. Harteis (Ed.), *The impact of digitalization in the workplace: An educational view* (pp. 13-24) (Professional and Practice-based Learning, Vol. 21). Cham: Springer.
- Nokelainen, P., Nevalinen, T., & Niemi, K. (2018). Mind all machine? Opportunities and limits of automation. In C. Harteis (Ed.), *The impact of digitalisation in the workplace: An educational view* (Vol. 21, pp. 13–24). Dordrecht: Springer.
- Novak, J. D. (1990). Concept maps and vee diagrams: Two metacognitive tools to facilitate meaningful learning. *Instructional Science*, 19, 29-52.
- Organisation for Economic Co-operation and Development. (2006). *Live longer, work longer*. Paris: OECD.
- Organisation for Economic Co-operational and Development. (2013). *OECD skills outlook 2013: first results from the Survey of Adult Skills*: OECD, Paris.

- Orrell, J. (2011). *Good Practice Report: Work integrated learning*. Retrieved from <https://www.voced.edu.au/content/ngv%3A51931>
- Palinscar, A. S. & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction, 1*(2), 117-175.
- Raizen, S. A. (1991). *Learning and work: The research base. Vocational Education and Training for youth: Towards coherent policy and practice*. Paris: OECD.
- Rausch, A., Seifried, J., & Harteis, C. (2017). Emotions, coping and learning in error situations at work. *Journal of Workplace Learning, 29*(5), 374-393.
- Rogoff, B. (1990). *Apprenticeship in thinking – cognitive development in social context*. New York: Oxford University Press.
- Royer, J. (1979). Theories of the Transfer of Learning. *Educational Psychologist, 14*, 53-69.
- Schneider, M. (2018). Digitalization of production, human capital, and organizational capital. In C. Harteis (Ed.), *The impact of digitalization in the workplace* (pp. 39-52). Springer.
- Scribner, S. (1985). Knowledge at work. *Anthropology and Education Quarterly, 16*, 199-206.
- Veillard, L. (2015). University-corporate partnerships for designing workplace curriculum: Alternance training course in tertiary education. In L. Filliettaz & S. Billett (Eds.), *Francophone perspectives of learning through work: Conceptions, traditions and practices*. Dordrecht: Springer.
- Volet, S. (2013). Extending, broadening and rethinking existing research on transfer of training. *Educational Research Review, 8* (1), 90-95.
- Vosniadou, S., Ioannides, C., Dimitrakopoulou, A., & Papademetriou, E. (2002). Designing learning environments to promote conceptual change in science. *Learning and Instruction, 11*(4-5), 381-419.
- Zitter, I., Hoeve, A., & de Bruijn, E. (2017). A Design Perspective on the School-Work Boundary: A Hybrid Curriculum Model. *Vocations and Learning, 9*(1), 111-131.