

Investigating In-Service Teachers' Workplace TPACK Development

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Technological, pedagogical and content knowledge (TPACK) provides a theoretical lens which attempts to identify the nature of knowledge required by teachers for technology integration in their teaching. While there have been hundreds of studies that have used TPACK to examine what teachers need to know about technology as part of their classroom practice, there has been little research specifically investigating how we acquire this knowledge, especially in relation to in-service secondary teachers. This paper investigates workplace learning literature in an attempt to provide a theoretical grounding that will enable future investigations to examine the complex context in which professional educators develop individual knowledge within a socially mediated, participatory workplace culture.

A quest to understand teachers' professional knowledge.

The quest to determine what knowledge distinguishes teachers from content experts has long been an area of academic investigation (for example, see: Kayser, 1916). Of particular note in this field of research is Shulman's (1986) delineation of teachers' professional knowledge as pedagogical content knowledge (PCK). The PCK framework differentiates teachers from content experts as expert teachers have a balanced blend of pedagogical knowledge (PK) and content knowledge (CK) collectively labelled pedagogical content knowledge (PCK) in contrast to content experts' deference to CK. Shulman's (1986) conception of PCK has been utilised in different educational contexts (for example, see: Bennett & Dewar, 2012; Benson & Brack, 2009; Berliner, 1988), particularly in the education of Science teachers (for example, see: Loughran, Mulhall, & Berry, 2004) and has contributed to our understanding of teachers' professional knowledge.

More recently, Koehler and Mishra (2005) re-considered Shulman's PCK framework in an attempt to understand how the increasing use of digital technologies in schools might impact on the development of teachers professional knowledge. In doing so, they proposed two questions:

- 1) What do teachers need to know about technology?
- 2) How can teachers acquire this knowledge?

In an attempt to answer their first question, Mishra and Koehler (2006) expanded the PCK framework through the addition of technological knowledge (TK). In doing so, Mishra and Koehler (2006) proposed that good teaching with technology involves a balanced combination of technological, pedagogical and content knowledge or TPACK. Mishra and

Koehler (2006) represented their TPACK framework as three overlapping circles, with each circle representing a component of teachers' professional knowledge. This framework resulted in seven potential forms of teachers' professional knowledge with the aspirational TPACK positioned at the nexus of these circles. Bounding these different forms of knowledge is the context in which teachers' acquire and exhibit their knowledge as shown in Figure 1.

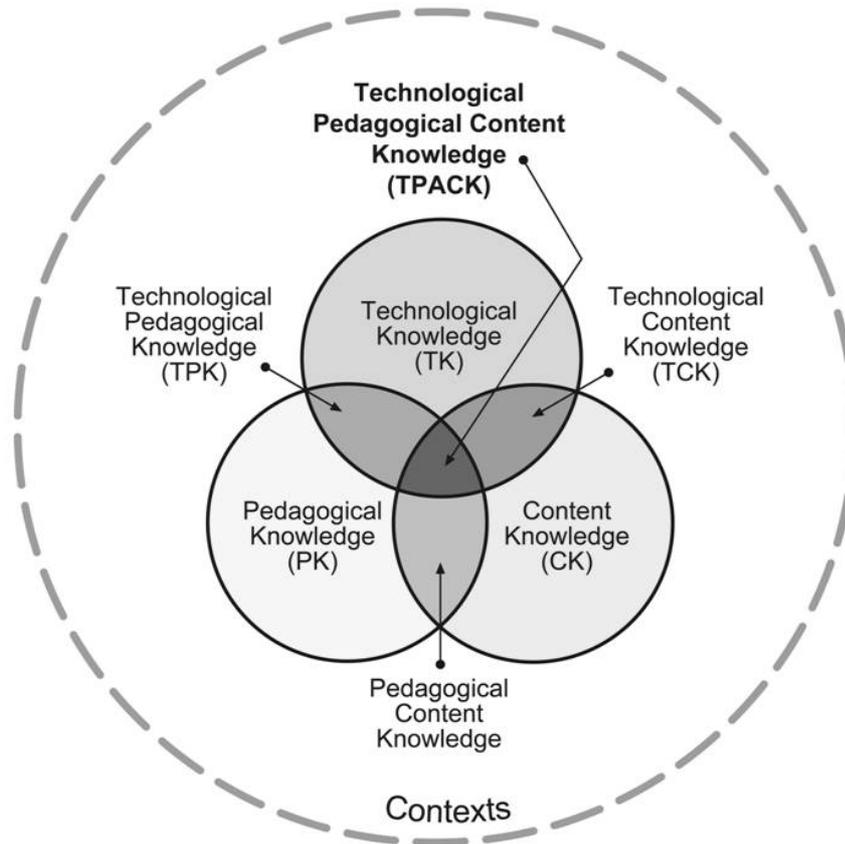


Figure: 1. The TPACK framework from <http://tpack.org/>

The impact of the TPACK model has been profound and has been used in hundreds of studies examining teachers' professional knowledge (Graham, 2011), with the majority of these using surveys to measure the extent of teachers' TPACK (Jordan & Dinh, 2012). With such a proliferation of TPACK based research, it comes as little surprise that there is marked variation in the contexts in which investigations have examined TPACK and include international examinations of the TPACK development of pre-service teachers (for example, see: Albion, Jamieson-Proctor, & Finger, 2010), distance educators (for example, see: Archambault & Crippen, 2009) and primary teachers (for example, see: Chai, Ling Koh, Tsai, & Lee Wee Tan, 2011). In Australia the most recent, large-scale use of TPACK was in the nationally funded Teaching Teachers for the Future (TTF) project. While these investigations have made valuable contributions to our understanding of the interplay between forms of professional knowledge in a variety of settings, in-service teachers' TPACK acquisition in their workplaces remains an under-explored context (for example, see: Jordan & Dinh, 2012).

One reason why TPACK acquisition and development (and PCK before it) has proven so

difficult to measure is that knowledge must be acquired and exhibited in a specific context. Given the multifarious settings in which secondary school teachers' work, TPACK may look different in each instance. Included in the idea of context are such things as the school environment, the physical features of the classroom, the availability of technology, the demographic characteristics of students and teachers including prior experience with technology, the particular topic being taught and the preferred instructional methods of the teacher (Kelly, 2008). The effect of context is that TPACK is "unique, temporary, situated, idiosyncratic, adaptive, and specific and will be different for each teacher in each situation" (Cox, 2008). The complexity involved in investigating TPACK acquisition in such changeable environments may explain why researchers have shied away from examining in-service teachers' TPACK development in their workplaces.

The remainder of this paper explores the suitability of a range of workplace learning theories that could be used to investigate the situated contexts in which in-service teachers develop TPACK.

Understanding teachers' workplaces as the context for TPACK development.

The workplace context in which in-service teachers continue to develop and refine their TPACK remains under-represented in research literature (for example, see: Jordan & Dinh, 2012). To better understand teachers' workplaces as the context for TPACK development, it is necessary to have a detailed understanding of workplace learning theories. Hager's (2005) extensive critical assessment focuses on workplace learning in educational settings and, as such, is particularly relevant when assessing the suitability of theoretical frameworks to understand how in-service teachers' acquire TPACK in their workplace. Finalising his critique of workplace learning theories, Hager (2005) concludes that there are:

Four major criteria for assessing workplace learning theories are how well they:

1. View such learning as a process.
2. Take account of the social, cultural and political dimensions.
3. Reflect (re)construction metaphors.
4. Avoid single factor or universally applicable explanations. (Hager, 2005, p.843)

In order to apply these criteria to current theories of workplace learning in a meaningful way, it is valuable to understand the similarities and differences between workplace learning theories relevant to in-service teachers' TPACK development. The following review highlights two research traditions that dominate the workplace learning literature with theorists generally subscribing to learning in a workplace via an acquisitional or participatory perspective.

Providing a sense of the development of the history of academic investigations into workplace learning, Hager (2005) highlights the continuously growing body of workplace learning literature from the 1970's which he positions in two categories. Hager (2005) argues that early accounts of workplace learning "were strongly influenced by the [concept of] learning as a product..." (p.829) in which knowledge was considered as an individually acquired novel attribute. In contrast, more recent accounts of workplace learning focus "more on learners developing [knowledge] by actively engaging in the processes of workplaces" (Hager, 2005, p. 829). These two categories mirror many aspects of the learning metaphors of

acquisition and participation that Sfard (1998) argued underpin much educational thought. While both the acquisition and participation categories of workplace learning have contributed to understandings of workplace learning, to better understand in-service teachers' TPACK development in their workplaces requires both the acquisition and participation collections to be examined in greater detail to allow for evaluation against Hager's (2005) four criteria outlined above.

Many of the early theories of workplace learning focused on the notion of knowledge as a product that can be acquired by individuals. Such ideas stemmed from the fields of organisational psychology, action learning, experiential learning and management theory (for example, Argyris and Schön (1974, 1978); Schön (1983, 1987); Marsick and Watkins (1990)). Despite variations in these early workplace learning theories, Hager (2005) claims that these concepts have a range of common features:

1. They centre [on] individual learners.
2. They focus mainly on the rational, cognitive aspects of work performance
3. Work performance tends to be conceived as thinking or reflection followed by application– this is especially evident in Schön's work.
4. Learning itself is taken for granted and not theorised or problematized. This means in practice that, as Elkjaer (2003) points out, it tends to assume that workplace learning is formal learning, thereby traditionally associated with the acquisition metaphor.
5. The social, organisational and cultural factors in workplace learning and performance are downplayed. (Hager, 2005, pp. 832-833)

If one accepts Hager's (2005) summary of early workplace learning theories and examines their range of common features it becomes clear that those that adopt knowledge development from an acquisitional perspective "do not fare well against most of the criteria" (Hager, 2005, p. 843). The individual, rational and cognitive aspects of work performance common to these theories takes little account of the social, cultural and political dimensions that may be argued as important aspects of workplace learning. As such, it can be suggested that early workplace learning theories may be of little assistance when trying to understand the socially mediated contexts in which in-service teachers' develop TPACK in their school workplaces. It is worthy to note that the majority of investigations into TPACK take little account of the workplace setting in which in-service teachers continue to develop and refine their professional knowledge; however, research studies too often consider TPACK as an individual attribute or possession. This approach has attracted criticism from researchers such as Bereiter (2002) who argued that many forms of research investigating learning too often carry with them unreflective assumptions about what such learning is like, instead rely on the 'common-sense' or 'folk theory' perspective of learning dominated by the acquisition perspective.

In contrast to these acquisitional theories of workplace learning another conception of workplace learning theories is evident in the literature. These theories broadly recognise that workplace learning and performance are embodied phenomena that are shaped by social organisational and cultural factors that extend beyond individuals. Key theorists from this perspective include Lave and Wenger (1991), Engestrom (2001; 1999), Billett (2001) and Eraut (2000). Given the body of research indicating the growing importance of collaborative knowledge development in schools (for example, see: Butler, Lauscher, Jarvis-Selinger, & Beckingham, 2004; Feldman, 1994; Garmston & Wellman, 2013; Krajcik, Blumenfeld, Marx, & Soloway, 1994; Musanti & Pence, 2010; Wilson & Berne, 1999; Zottmann et al.,

2013) it is not surprising to find “that the participation [theorists] ha[ve] been extremely influential” (Hager, 2005, p. 844).

Lave and Wenger (1991) and Wenger (1998) have made important contributions to the conception of participatory workplace learning through their development of notions such as legitimate peripheral participation and Communities of Practice (CoP). These concepts provide a stark contrast to the view of learning as acquisition and emphasise learning through relationships:

Whether propositions or skills, their specifically relational account views the novice as learning how to function appropriately in a particular social, cultural and physical environment. This means that the learning (‘situated learning’) is something outside of the individual’s head, or even body. (Hager, 2005, p. 833)

As an alternative to Lave and Wenger’s (1991) conception of workplace learning within a CoP, Engestrom (1999, 2001) views workplaces as activity systems. These systems are comprised of a range of components including items such as workplace rules, the division of labour and mediating artifacts (Engestrom, 1999). Engestrom suggests that learning occurs as work proceeds within such activity systems because the activity systems continually throw up contradictions and tensions that need to be resolved by workers.

In this sense, Engestrom’s (1999, 2001) activity systems approach has certain dimensions that are similar to Lave and Wenger’s (1991) situated learning perspective and together these two frameworks stimulated “a surge of ... research and conceptual innovation on learning at work” (Hager, 2005, p. 834). Included in these conceptual innovations is the expansive-restrictive continuum (Fuller & Unwin, 2003, 2004) for analysing the incidence and quality of workplace learning. This framework was intended to specifically remedy the deficiencies that Fuller and Unwin (2003) identified in Lave and Wenger’s (1991) account of workplace learning, namely, that it does not include place for formal qualifications from educational institutions for novice workers. As such, Fuller and Unwin’s (2003) expansive-restrictive continuum centres on two sets of features: those relating to organisational context and culture, and those to learning opportunities arising from various forms of participation in workplaces.

While it might be questioned whether all learning at work occurs from the contradictions and tensions within an activity system or CoP, this participatory account of workplace learning finds places for social, organisational and cultural factors within a system that the acquisition and process metaphors of learning and individualistic frames of learning do not address and thus provides an alternative framework through which in-service teachers’ workplace TPACK development can be considered. Despite this caveat, when using Hager’s (2005) four criteria to assess these participatory theories of workplace learning, their strength arguably lies in the first two standards that accounts for learning as a process while also taking the social, cultural and political dimensions of the workplace into consideration.

It is open to interpretation, for example how well the CoP notion and the legitimate peripheral participation framework that preceded it is in accord with the (re)construction metaphor. While the transition of legitimately peripheral new-comers to old timers who more fully participate in the CoP might well be seen as a form of communal reconstruction, Lave and Wenger’s (1991) account of this phenomenon “has little to say about the learning by the individual learner that underlies the reconstitution of their personal identity from that of novice to full participant” (Hager, 2005, p. 843). Hager’s (2005) critique of this component of the CoP framework has been identified by others, including Elkjaer (2003) who argues that

the participation metaphor in Lave and Wenger's work "deals with learning at the organisational level, but ... at the expense of a description of the actual learning process – *how* does learning come about through participation?" (p.488). Therefore, the participatory conception underpinning these theoretical frameworks provides an alternative perspective to teachers' workplace TPACK development; however, this perspective in isolation still presents challenges to researchers wishing to examine professional knowledge development in this context.

Billett's attention to participation through the social and the individual provides an account of expertise located in the dynamic activities of social practices:

It proposes how individuals come to know and act by drawing on cognitive, sociocultural and anthropological conceptions, and through an appraisal of the ontological premises of domains of knowledge. The inter-psychological processes for developing expertise are held to be constituted reciprocally between the affordance of the social practice and how individuals act and come to know in the social practice. (Billett, 2001, p.432)

In developing his account of workplace learning, Billett (2001) problematizes the notion that expertise is a capacity of an individual and locates it instead in particular domains of knowledge and social practice. In relation to in-service teachers' TPACK development, this could translate to an individually held, possibly tacit understanding about the subtle interplay between TK, PK and CK; however, the exhibition of this knowledge occurs in a socially mediated, participatory workplace culture in which growing importance of collaborative knowledge development is recognised. The interplay between individual acquisition and communal participation influencing knowledge development in workplaces has been argued from a theoretical perspective.

Eraut (2000) provided such a theoretical justification when arguing for the retention of individual cognitive and tacit forms of knowledge whilst accepting that they are always deployed in a situated way. Thus, as Hager (2005) point out, "Eraut can be seen as warning that accounts of workplace learning in the second category should not jettison all of the resources of the first category" (p.835). Similarly, Beckett and Hager (2002) indicated that while some aspects of workplace learning can be understood at the level of the individual, but other elements of the same learning is inherently at the level of the group or community of practitioners and they argue that both perspectives should be kept in sight in attempts to examine workplace learning.

The above discussion has located workplace learning in traditions which either construct learning as acquisitional in nature or as socially mediated as a process. While the differences between these traditions have been highlighted, it has also been pointed out that a third group of researchers including Billett (2001), Beckett and Hager (2002), Eraut (2000) and Hager (2005), suggest that nuanced investigations into workplace learning should take both theoretical traditions into account.

To make further sense of these matters and to contextualise these themes in this investigation, the focus will move to a more detailed investigation of the suggestions made by those who advocate for researchers to consider both individual and communal considerations of workplace knowledge development.

Individual and communal considerations of workplace learning theories: implications for research.

This paper seeks to develop an understanding of the ways in which workplace learning theories might help to illuminate the contexts and processes in which in-service teachers' develop TPACK. The preceding review of workplace learning theories has identified different traditions within the literature. This review has indicated that while there are advantages associated with theories that privilege participation and the social construction of knowledge over acquisitional perspectives, it may be short sighted for one perspective to jettison the other (Eraut, 2000).

Schoenfield's (1999) perspective adds to the calls for a balanced view in workplace learning research claiming that "the very definition of learning is contested, and that assumptions that people make regarding its nature and where it takes place are also widely contested" (p.6). As Winch (1998) claims, there are many, diverse cases of workplace learning each subject to "constraints in a variety of contexts and cultures" (p.85). This level of constraint therefore prohibits both context and culture from being considered in a general way.

It is noteworthy for this investigation examining TPACK development in school workplaces that Winch's (1998) conceptualisation of 'contexts and cultures' is at a micro level. While it may be the case that the majority of school workplaces share a common macro context, or as Wenger (1998) describes as a global CoP, they each have unique and particular contextual and cultural factors at the micro or local level.

Indeed, Hager (2005) suggests, it might not only be a mistake to think about workplace learning in terms that are too closely linked to learning in formal classrooms, "it may also be inappropriate to think that all workplace learning is of one kind" (p.836). This suggestion echoes Eraut's (2000) argument, highlighted earlier, which contends that individual cognitive and tacit forms of knowledge are always deployed in a situated way thereby highlighting the need for researchers to not only consider the macro – micro context in which research is conducted but also the balance between examinations of individually acquired knowledge and the knowledge developed through social participation in workplaces.

Conclusion

Examinations of teachers' professional knowledge have been ongoing and have recently reflected the increasing prevalence of digital technologies in teachers' practice. The TPACK framework has provided a valuable lens through which researchers have been able to examine teachers' knowledge. Despite the proliferation of empirical research using TPACK, in-service teachers' development of TPACK in the context of their workplace remains under represented in the research literature. Highlighting the complex context in which professional educators work and learn, this paper has provided a review of the dominant theories in workplace learning to provide a backdrop against which in-service teachers' TPACK development can be more clearly comprehended. Further research incorporating acquisitional, participatory and (re)construction perspectives outlined in this paper is required to understand how teachers' acquire TPACK in their workplaces.

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