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TPCK: WHAT HAPPENS WHEN THE ‘T’ IS ALSO THE ‘C’?

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Abstract
The Technological Pedagogical Content Knowledge (TPCK) framework developed by Mishra and Koehler has received ongoing attention since its introduction in 2006. It is seen by many as most useful when considering teaching practice, and the development of pre-service and in-service teachers. The intention of this paper is to make a contribution to thinking around and understanding of the TPCK framework, particularly in relation to technology and teaching in the technology discipline.

An aspect of this is the definition and conception of technology presented in the framework. It is suggested that especially in the case of technology education, there is benefit in considering and exploring broader and specific notions of technology to gain a fuller conception of what the ‘T’ in TPCK might include. Considering features and differences of the range of areas within the technology teaching area is a useful way to examine possibilities and implications of such.

Also viewed as important and of interest in relation to the technology discipline is the potential of the ‘T’ also being the ‘C’ within the TPCK model for technology teachers. It is suggested that these points have relevance and raise possibilities and implications for pre-service and in-service technology teacher training and development.

Introduction
Teaching with technology has received a great deal of attention in the community, schools, and academic literature. Since its introduction in 2006, the Technological, Pedagogical, Content Knowledge (TPCK) framework developed by Mishra and Koehler has played a useful part in its consideration. This paper examines teaching of the technology discipline through the lens of the TPCK framework alongside broader and specific notions of technology, and considers the implications of this for pre-service and in-service teacher education and development.

TPCK
In a Presidential Address at the 1985 annual meeting of the American Educational Research Association, Lee Shulman, Professor of Education at Stanford University, illustrated and questioned some striking contrasts between teacher evaluation standards of the time and those of the latter part of the preceding century. The change over the 110 year period that he identified and examined was from teachers being assessed with an almost exclusive focus upon requisite content knowledge in 1875, to one in the 1980’s that only evaluated their pedagogical knowledge (Shulman, 1986).

Shulman (1986) argued that knowledge of both areas was “needed by teaching professionals” (p. 13), and with a focus on student teacher development suggested for these knowledge areas to “blend properly”, equal attention needed to be given to the “content aspects of teaching” and the “elements of the teaching process” (p. 8). The identification of the two areas and their ‘blending’ was important as it both highlighted and specified an interrelationship between the domains. Shulman (1986) described the
area of overlap as “knowledge of the structure of one’s subject, pedagogical knowledge of the domain, and specialised curricula knowledge” (p. 13). In a subsequent paper in the following year, Knowledge of teaching: Foundations of the new reform, Shulman further developed these conceptions and posited that if it was “to be taken seriously” a revision of teacher education and scholarship would be required. In this revised approach, “an emphasis on pedagogical content knowledge would permeate the teacher preparation curriculum” (Shulman, 1987, p. 20).

Nine years later, building on this concept and challenge, and responding to the increasing availability of technologies for teaching, Punya Mishra and Mathew Koehler presented the technological, pedagogical, content knowledge (TPCK) framework (Mishra & Koehler, 2006). The TPCK framework presents relationships between the pedagogical and content fields of knowledge identified by Shulman (1986), and introduces the element of technology knowledge. These fields of knowledge are presented as overlapping circles to emphasise “the complex interplay of these three bodies of knowledge” (Mishra & Koehler, 2006, p. 1025).

The figure below is a later iteration of the TPCK framework which was renamed TPACK for the sake of convenience in discussion. It has been included in place of the original diagram as it acknowledges, and indeed communicates, that “teachers operate in diverse contexts of teaching and learning”, a point which is especially pertinent to the focus of this paper (Mishra & Koehler, 2009, p. 62).

![TPACK framework](image)

**Figure 1**
TPACK framework (Mishra & Koehler, 2009, p. 63).

Within the TPCK framework, Mishra & Koehler (2006, pp. 1026, 1027) define Content Knowledge (CK) as “knowledge of the actual subject matter that is to be learned or taught, Pedagogical Knowledge (PK) as generic, but “deep knowledge of about the processes and practices or methods of teaching and learning, and Technology Knowledge (TK) as knowledge that includes the “skills required to operate particular technologies” and knowledge about ‘standard’ and ‘more advanced’ technologies used for teaching. Mishra and Koehler (2006), argue that “productive technology integration
in teaching needs to consider all three issues not in isolation, but rather within the complex relationships in the system defined by the three key elements” (p. 1029). They suggest, and it follows that in order to do so, there is a need to examine these components “in pairs: pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and all three taken together as technological pedagogical content knowledge (TPCK)” (Mishra & Koehler 2006, p. 1027). Examining all of these relationships is beyond the scope of this paper, the focus and topic of interest in this case is the pairing of technology knowledge and the content knowledge (TCK) of the technology discipline.

The ‘T’ in TPCK and conceptions of technology
Repeating and then expanding on the definition provided above, to elucidate their conception of Technology Knowledge (TK), Mishra and Koehler (2006, p.1027) present TK as knowledge about what they describe as “standard [teaching] technologies”, and “more advanced [teaching] technologies”. Examples provided of the former include “books, chalk and blackboard”, and of the latter, “the Internet and digital video” (Mishra & Koehler, 2006, p. 1027).

Despite this somewhat inclusive conception of teaching technologies being presented, the discussion in much of the literature in response to the TPCK model and TK more specifically, tends to focus on ICTs alone (see Angeli & Valanides, 2009; Archambault & Barnett, 2010). Perhaps this is not surprising as many when asked what they consider technology to be, they will provide examples of the latest ICT related technologies such as smart phones, iPads, or cloud computing. The requirement of teachers to use ICTs, the challenge being experienced with such a shift, the increasing prevalence of ICTs in schools, at home, and in the workplace, as well as the expectations of students, parents, schools, education departments and governments across the world are other and significant likely reasons (AITSL, 2012; Baskin & Williams, 2006; BECTA, 2004; Enochsson & Rizza, 2009).

Angeli and Valanides (2009) justify their separation of ICTs from other technologies suggesting that if the TPCK is to be of greatest use “as an analytical framework for guiding and explaining teachers’ thinking about technology integration in teaching and learning”, there is a need for it to have greater specificity. They assert that the TPCK model, essentially the conception of ‘TK’, is ‘too general’ in its current form, and propose the introduction of a strand they describe as ‘ICT-TPCK’ (p. 157).

While the author sees potential value in distinguishing ICT from other technologies for some purposes, and welcomes this distinction because it invites and creates a space for a discussion about broader notions of technology, it is suggested that much of the power and beauty of this framework is its inclusiveness, and that this is necessary because of the complexity and diversity that exists in education, this latter point being highlighted by Shulman (1986). Many teachers use both digital and non digital technologies in their teaching, and to treat them separately would seem less than ideal. Also, this inclusive definition and holistic conception of technology maximises the flexibility and applicability of the framework. These points are particularly important for those involved in technology education because ‘TK’ can include a very broad range of technologies, as many technology key learning areas are focussed on, and use for teaching purposes, other technologies, such as those defined by Arthur (2009).
Conceptions of technology
In his well-cited book *The nature of technology: What it is and how it evolves*, Brian Arthur provides us with three definitions of technology which can be used to satisfy and purposefully meet a range of circumstances and needs including teaching and writing about technology education. Arthur’s first definition would be familiar and compatible with many others’ notions, identifying technology as a “means to fulfil a human purpose”, including a “method or process or device”. Secondly, he defines “technology as an assemblage of practices and components”, as “collections ... of individual technologies and practices.” This presents technology in a plural sense and examples of this type including “electronics or biotechnology”. Thirdly, he presents technology in a general sense, “as the entire collection of devices and engineering practices available to a culture”, the whole collection of all technologies that have ever existed past and present” (Arthur, 2009, p. 28).

These definitions and their arrangement are helpful for this discussion because they illustrate the extent of what can be and is considered technology, and they provide a frame which affords a clearer examination of technology and more specifically teaching technologies in relation to the TPCK model.

Identifiable and specific TPCK knowledge set for technology teachers
As stated previously, Mishra and Koehler (2006, p. 1026) define Content Knowledge (CK) as “knowledge about the subject matter that is to be learned or taught”. For the technology discipline at secondary school level in NSW, this subject matter includes a set of subjects grouped under the banner of Technological and Applied Studies (TAS). The TAS discipline areas are varied and include studies of Agricultural, Design, Food, Graphics, Industrial (e.g. Wood, Metal), Information and Software, Marine and Aquaculture, and Textiles Technology. In the senior years this list expands to include specific strands of Engineering, Software Design and Development, and a range of Vocational Education and Training (VET) subjects (NSW BoS, 2012).

If we consider TK in the technology teaching discipline given the great range of learning areas listed above, many questions arise. What conception of technology is useful for technology teachers? Do technology teachers have and/or need an identifiable and specific TPCK knowledge set? If so, what might the differences be between each of the areas within the discipline? What are the implications for pre-service technology teacher education?

It is suggested that all teaching areas should be thought about as specific cases in reference to the formulation of the TPCK as each have unique features. It is also suggested that there is value in considering each of the discipline areas within and under the technology banner separately, as although they are bound together by the common theme of technology, each has foci and characteristics that makes teaching them quite distinct.

Differences between each of the areas within the technology discipline
The following excerpts from a sample of NSW year 7-10 TAS syllabi intend to provide a sense of each discipline’s content knowledge (CK), and for clarity and simplicity, do not include the many other generic skills and foci that are part of these subjects.
“The study of Agricultural Technology ... develops knowledge, understanding and skills in the management of plant and animal enterprises, the technology associated with these enterprises and the marketing of products” (NSW BoS, 2003a, p. 4). To satisfy syllabus requirements students will engage in practical experiences for at least 50% of class time, some of these require certification, permits and licences (p. 17).

An example of core content is students will “Learn to: use agricultural equipment, machinery and techniques correctly and safely” and “perform procedures in the management of plants and animals” (p. 21).

Another example to consider is that of Industrial Technology in which “students develop knowledge relating to current and emerging technologies in industrial and domestic settings...[including] the interrelationship of technologies, equipment and materials used in a variety of settings and develop skills through hands-on interaction with these in the design, planning and production of practical projects” (NSW BoS, 2003b, p. 8).

In this case it is expected that practical experiences will account for the majority of class time (p. 151). Amongst a range of objectives students “learn to: safely use hand and power tools, materials, finishes and equipment” (p. 154).

What happens when the T is also the C?
The examples above present cases where technology content (C) being taught can also be the technology that is used for teaching (T). That is, taking the example in Figure 2, it can be assumed that before the student operates the tractor, the teacher would teach how to use this agricultural machinery, a technology, correctly and safely, by demonstration. In so doing, the tractor/agricultural machinery is the technology used for teaching (T). Similarly, in Figure 4, students working with and learning about the technologies of plywood and a hand saw would be taught using these technologies.

The situation where the teaching technology is part of the subject matter is not unique to the technology discipline. For example in a similar case, McRory (2008, p. 196) cites an observed instance from science teaching where Niess (2005) argues that the technology of a computer based laboratory pH probe “is part of the science itself...[and that] “students could learn [and be taught] science both by using the tool and by learning about the tool”.

The point is, however, that many if not most disciplines do not feature the matching of the T and the C. In many disciplines the teaching technology used might be a whiteboard and marker, presentation software, a learning management system, a classroom, each of these potentially having no relationship with the content. These teaching technologies are readily identified, drawing on Arthur’s inclusion of ‘methods or processes being technologies, others that could be considered include teaching methods/approaches. In this case, an example where the T is also the C could be where an approach such as role play is used for teaching drama. In fact, in this instance, one might argue that the T is the C and the P as well. Some might say that a framework where everything can be the same is without value. The inverse is argued as the framework reveals these instances and provides a mechanism for their explanation, and a lens through which we might examine them.

**Implications for pre-service and in-service technology teacher training and development**

The implications for pre-service teacher preparation and in-service teacher development from this discussion are potentially numerous. The usefulness, and/or perhaps the necessity of viewing, designing, and building these programs, even conceiving teaching itself using the TPCK framework is one of these. Particularly in the case of technology teaching, having a mechanism, a framework, a lens, to consider the elements of TPCK, especially where they may match, would seem very valuable for gaining and constructing understanding, and explaining what technology teachers do.

Support for this suggestion comes from Schmidt et al (2009, p. 125) who suggest that the TPCK framework is useful for both “thinking about what knowledge teachers must have to integrate technology into teaching and how they might develop this knowledge”, and “for measuring teaching knowledge” in given content areas. An example to consider this is in relation to the Australian National Professional Standards for teachers. It is suggested that being able to apply the TPCK descriptors to the standards could be a helpful way to categorise, analyse, and organise them for development programs and other purposes.

To exemplify, within these standards, under the heading of ‘Professional knowledge’, the first item is “know students and how they learn” which can be described as PK. The
second is “know the content and how to teach it, this covers all three areas and is therefore TPCK. Under the heading, ‘Professional practice’, the next group of standards is “Plan for and implement effective teaching” which is TPK (AITSL, 2012). The AITSL standards include other items which have not been included in this example, however, the notion is illustrated, the TPCK framework can easily be applied and used to categorise, examine, and explain teaching related matter. Harking back to Shulman (1986, 1987), it is assuring that both pedagogy and content knowledge have their place in the Australian teaching standards.

The Teaching Teachers for the Future (TTF) project, an Australian government funded initiative involving all 39 teacher education institutions is an example where the TPCK framework has been deemed valuable for teacher development. Its aim is to enable all pre-service and in-service teachers, as well as school leaders, “to become proficient in the use of ICT in education” (DEEWR, n.d.). The digital resources produced as a part of the project have been “created following the TPACK learning framework.” Also, the Project has found that “TPACK provides a schema for thinking about and implementing in classrooms the complex relationships between these three elements of the learning program and helps teachers to ensure that their planning is comprehensive and integrated” (DEEWR, n.d.).

Recognition of the three areas of knowledge and their pairs is important for pre-service technology teacher preparation. Just as Angeli and Valanides (2009) found with ICTs, being technology savvy does not automatically equal teaching with technology savvy, it is suggested that possessing content knowledge of other technology areas does not automatically equate with being able to use these technologies effectively for teaching. The implications for pre-service teacher preparation become obvious when viewed through the TPCK lens. Preparation must include consciousness of the three areas of knowledge, and development of the three areas as linked and related bodies of knowledge and skill.

**Conclusion**

The TPCK framework has been shown to be useful for examining, considering, and conceiving teaching and teacher education and development, and more particularly the identification of the character and needs of teaching the technology discipline and preparing for such. While it is not a unique case, teaching the technology discipline is suggested to be the most common instance where the T is also the C, and given this, warrants specific investigation and treatment for pre-service and in-service teacher education and development. Broader and holistic conceptions of technology are suggested as ideal and appropriate for the TPCK framework and considerations of teaching with technology.

**References**


Information Technology and Teacher Education International Conference, 1053–1059.