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Indigenous Knowledge (IK) and Technological Pedagogical Content Knowledge (TPACK): Starting a Conversation

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Abstract: This paper examines educational technology integration in relation to Indigenous Knowledge (IK). In particular, we home in on Mishra and Koehler's (2006) Technological Pedagogical Content Knowledge (TPACK), a popular way to conceptualize teacher knowledge in the 21st century, and consider how TPACK may or may not "fully situate or account for technology integration within a tribal consciousness" (Adcock, 2014, p. 115). Adopting an Indigenous Métissage research sensibility and drawing on educational technology research and scholarly literature, we consider IK in relation to TPACK, and TPACK in relation to IK. We conclude that IK needs to be foregrounded in educational technology contexts, including the recognition that orality and Indigenous language traditions hold critical pedagogical understandings; that Technological Knowledge (TK) should include the understanding that technology is culture-mediating; and that TPACK be placed in an ongoing, respectful conversation and ethical relation with local ancestral Indigenous Knowledge so that teachers and students can begin to "tell a new story" about technology in relation to education, culture and well-being.

Preface

We set out to write this paper for several reasons. First, as a collaborative teaching team delivering a large undergraduate course for preservice teachers in educational technology, we try to continually improve and refine our own teaching knowledge and practice, mindful of the diversity of today's K-12 classroom contexts in Canada. Second, we recognized the need to reconsider our materials and approach when working with preservice teachers who are enrolled in our faculty's Aboriginal Teacher Education Program (ATEP)¹. ATEP works "to create an environment inclusive of Aboriginal ways of knowing and learning" (University of Alberta, 2022) and foregrounds local resources, community Elders, and Indigenous languages. Third, and most importantly, we see this paper as the start of a conversation where we – as settlers and as members of an academic institution – strive to interrogate our own ways of knowing. We are thankful for the guidance and generosity of Dr. Patricia (Patsy) Steinhauer as we come to witness how our instruction is complicit in the ongoing colonization of Indigenous lands and peoples, and look forward to a long, meaningful relationship as we continue to provoke unsettling conversations in preservice teacher formation and ourselves. While this paper is simply a summary of previous research on Indigenous knowledge and TPACK, it has already inspired profound conversations around technology, relational ethics, and the complexity of different Indigenous knowledge systems, grounded in an intimate set of relationships, language, and

¹ From ATEP's website: "Aboriginal is used in the name of the Aboriginal Teacher Education Program as a reflection of the current terminology encoded in the Constitution of Canada. Section 35(2) of the Constitution Act states: In this Act, "aboriginal peoples of Canada" includes the Indian, Inuit and Métis, peoples of Canada".

protocols for coming to learn. Near the conclusion of the paper, Dr. Steinhauer has graciously provided a brief description of her experience of the process and her thoughts about what we are attempting to do.

Introduction

[T]he wingéd one [Raven] and the fourlegged [Coyote] ask the human beings to consider renarrativizing the current privileging of digital technology as the predominant technology storyline in education and [Eurocentric²] education as the predominant educational storyline of knowing/doing/being/becoming. (Cole & O’Riley, 2012, p. 18)

For some, digital technology is “a two-edged sword” (Allen, Resta & Christal, 2002), “a Trojan horse,” “a loaded term” (Adcock, 2013), “a kind of Trickster” (Patterson, 2003), or even “a profound threat” (Traxler, 2019) to traditional values, tribal histories and ways of knowing. While some Indigenous leaders may “wonder whether [their] values can survive among all those hard drives and megabytes,” others hold that “the best [Indigenous] education today combines a solid curriculum in [Indigenous] culture and local reservation or urban issues with instruction...assisted by educational technology. The best [Indigenous] education reminds people of who they are culturally while simultaneously taking them into the future” (Simonelli, 1993, p. 13). In their plea to “renarrativize the current privileging of digital technology as the predominant technology storyline in education”, Cole and O’Riley (2012, p. 18) suggest “restorying and remapping the technological practices and know-how of Indigenous Peoples and other ecological ethnicities as well as the interdependence of humans and more-than-humans” (p. 30).

One approach toward restorying current technological practices in schools is through Indigenous Métissage (Donald, 2012), a research sensibility that “braids parallel perspectives together to show that our individual preoccupations with certain artifacts, places, and colonial constructs are really part of a larger collective and difficult understanding of those concerns” (p. 549). Indigenous Métissage is “about relationality and the desire to treat texts – and lives – as relational and braided rather than isolated and independent” (Donald, 2012, p. 537). It involves embarking on transcultural dialogues committed to ethical relations, hermeneutic imagination and the situatedness of place. Indigenous Métissage intends to reveal and deconstruct “colonial frontier logics...that have clouded our thinking” (p. 549), and in the process, tells a new story.

Crucial to building transcultural ethical relations is maintaining a disposition of *epistemic humility*. In philosophy of science, the term epistemic humility refers to a disciplinary habit of mind for conducting all empirical inquiry, specifically a scientist’s capacity to acknowledge the limits and fragility of their own perceptions, knowledge, and truth claims, and secondly, the practice of “actively regulat[ing] their epistemic conduct by recognising and appropriately responding to the complex economy of confidence upon which their activities and projects rely” (Kidd, 2017, p. 15). Epistemic humility as a dispositional virtue has recently found traction in feminist and postcolonial theory, and refers to one’s “ability to embrace the fallibility of one’s knowledge and, more broadly, [to adapt] one’s ways of thinking (in) the world, in light of an encounter with difference” (Vizcaíno, 2021, p. 7). Especially for settlers, “who have been immersed in the thinking of modernity/coloniality, [epistemic humility is needed in order] to engage in a truly open (decolonial) dialogue with interlocutors” from Indigenous cultures (p. 7).

In this paper, we engage Mishra and Koehler’s (2006) Technological Pedagogical Content Knowledge (TPACK) framework, a popular way to conceptualize (school) teacher knowledge in the 21st century. Adopting an Indigenous Métissage research sensibility, we explore TPACK as an artifact reflecting the “the predominant technology storyline in [Eurocentric] education” and consider how this epistemic model may or may “not fully situate or account for technology integration within a tribal consciousness” (Adcock, 2014, p. 115). In the spirit of Indigenous Métissage and epistemic humility, we reflect on the meanings of educational technology integration in relation to both ancestral Indigenous Knowledge (IK) and TPACK’s universalist, Eurocentric logic.

We began our inquiries by identifying relevant peer-reviewed literature by searching ERIC using the following terms: “TPACK OR technological pedagogical content knowledge” AND “Indigenous or aboriginal or american indians or first nations”. Our search yielded six articles in academic journals of which only two were relevant: Gumbo (2020); and Lewthwaite, Knight, and Lenoy (2015). We expanded our search to Google Scholar and located other relevant scholarly articles that also fit our criteria. Of the articles identified, three proposed new formulations of TPACK in an attempt to include IK. Below, we introduce TPACK and its origins. We then consider what is meant by Indigenous Knowledge, with a focus on IK as a knowledge domain for Indigenous as well as non-Indigenous teachers; followed by an overview of TPACK. The balance of the paper reports on the literature of

² While the term “western” is used by many of the scholars we read for this paper, in all instances we are substituting it with the term Eurocentric to clarify the origin of settlers who colonized the Americas. We make one exception: because Ntšekhe, Terzoli & Thinyane (2014) integrate the term in their TPACK remodel, we retain the term in that instance only.

IK, TPACK and technology integration in schools; discusses implications; and offers possible next steps for continuing IK/TPACK dialogues.

Background

What is Technological Pedagogical Content Knowledge?

[TPACK] allows teachers...to move beyond oversimplified approaches that treat technology as an “add-on” instead to focus again, and in a more ecological way, upon the connections among technology, content, and pedagogy as they play out in classroom contexts. (Koehler & Mishra, 2008, p. 67)

TPACK is a conceptual framework developed by Punya Mishra and Matt Koehler (2006) to help teachers understand how their professional knowledge domains—technological (TK), pedagogical (PK) and content (CK)—intersect to effectively engage student learning with technology. TPACK is based on a landmark essay on teacher knowledge by educational psychologist Lee Shulman (1986). Shulman opens his essay with a concern that contemporary teacher education has become too focused on “pedagogy” to the exclusion of building advanced subject area knowledge. He demonstrates that “the sharp distinction between knowledge and pedagogy does not represent a tradition dating back centuries” (p. 7) and suggests the current situation represents a pendulum swing in need of correction. Shulman calls for a “more coherent theoretical framework” to understand the complexities of teachers’ understandings and knowledge practices (p. 9). He sketches several forms of teacher knowledge including Pedagogical Knowledge (PK), Content Knowledge (CK), Pedagogical Content Knowledge (PCK) and Curricular Knowledge. For example, Curricular Knowledge includes a solid grasp of:

the full range of programs designed for the teaching of particular subjects and topics at a given level, the variety of instructional materials available in relation to those programs, and the set of characteristics that serve as both indications and contraindications for the use of particular curriculum or program materials in particular circumstances. The curriculum and its associated materials [texts, software, programs, visual materials, single-concept films, laboratory demonstrations] are ... the tools of teaching. (p. 10)

It is worth noting that Shulman’s Curricular Knowledge very explicitly includes what Mishra and Koehler (2006) would later call Technological Knowledge (TK). Shulman (1986) also admits his domain list is hardly inclusive.

Beyond “content, pedagogy and curriculum” knowledge, he says,

there are clearly other important domains of knowledge as well, for example, of individual differences among students [including knowledge of their backgrounds], of generic methods of classroom organization and management, of the histor[ical, social, cultural and philosophical foundations] of education, and of school finance and administration, to name but a few. (p. 10)

Ultimately, Shulman does not propose a formal teacher knowledge framework. Instead he recommends mobilizing a series of “case method” based research strategies towards that end, specifically, by gathering descriptions of a wide range of exemplary instructional events, then organizing and analyzing these “examples of specific instances of practice” as knowledge prototypes, precedents and parables for teachers and teacher educators (p. 11).

Mishra and Koehler (2006) adopt only the first three of Shuman’s teacher knowledge domains—PK, CK and PCK—as a springboard to formulate their TPACK framework (Figure 1.). These three along with the other four teachers knowledge domains of TPACK are rehearsed below in the words of Koehler and Mishra (2008):

- *Content Knowledge (CK)* is teachers’ knowledge about the subject matter to be learned or taught. (p. 63)
- *Pedagogical Knowledge (PK)* is teachers’ deep knowledge about the processes and practices or methods of teaching and learning. They encompass, among other things, overall educational purposes, values, and aims.
- *Pedagogical Content Knowledge (PCK)* is consistent with and similar to Shulman’s idea of knowledge of pedagogy that is applicable to the teaching of specific content. Central to Shulman’s conceptualization of PCK is the notion of the transformation of the subject matter for teaching....PCK covers the core business of teaching, learning, curriculum, assessment and reporting....[PCK also includes] an awareness of common misconceptions and ways of looking at them, the importance of forging connections among different content-based ideas, students’ prior knowledge, alternative teaching strategies, and the flexibility that comes from exploring alternative ways of looking at the same idea or problem are all essential for effective teaching. (p. 64)

Before continuing, it is worth noticing that Koehler and Mishra’s description of PCK encompasses an exceptionally broad range of teacher knowledges, including knowledge domains that Shulman had carefully separated out, such as curricular knowledge. With their addition of technological knowledge (TK) as a new teacher knowledge domain, Mishra and Koehler underline the importance of technology to 21st century learning but also its relationship to 21st century knowledge domains more generally.

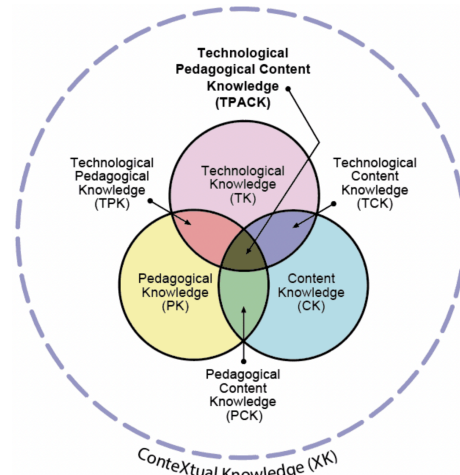


Figure 1. TPACK revised to reflect Mishra's (2019) Contextual Knowledge (XK)

The balance of TPACK (see upper portion of Figure 1.) is devoted to teachers' knowledge of technology and its intersections with the other teacher knowledge domains:

- *Technology [or Technological] Knowledge (TK)* is always in a state of flux—more so than the other two core knowledge domains in the TPACK framework (pedagogy and content)...[TK] requires a deeper, more essential understanding and mastery of information technology for information processing, communication, and problem solving than does the traditional definition of computer literacy. (p. 64)
- *Technological Content Knowledge (TCK)*...is an understanding of the manner in which technology and content influence and constrain one another. Teachers need to master more than the subject matter they teach; they must also have a deep understanding of the manner in which the subject matter (or the kinds of representations that can be constructed) can be changed by the application of particular technologies. Teachers need to understand which specific technologies are best suited for addressing subject-matter learning in their domains and how the content dictates or perhaps even changes the technology—or vice versa.
- *Technological Pedagogical Knowledge (TPK)* is an understanding of how teaching and learning can change when particular technologies are used in particular ways. This includes knowing the pedagogical affordances and constraints of a range of technological tools as they relate to disciplinarily and developmentally appropriate pedagogical designs and strategies. To build TPK, a deeper understanding of the constraints and affordances of technologies and the disciplinary contexts within which they function is needed. (p. 65)
- *Technology, Pedagogy, and Content Knowledge [or Technological Pedagogical Content Knowledge] (TPACK)* is the basis of effective teaching with technology, requiring an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones. (p. 66)

Mishra (2019) recently added one more knowledge domain to TPACK by situating the whole framework in a broader form of knowledge which he calls Contextual Knowledge (XK). He describes XK as a teacher's organizational and situational knowledge, which includes "everything from a teacher's awareness of available technologies, to the teacher's knowledge of the school, district, state, or national policies they operate within" (p. 77). Here, Mishra makes no mention of cultural knowledge or contexts.

In another publication, Warr, Mishra & Scragg (2019) present a new framework, "Five Discourses of Design" reasoning that, "despite its prevalence, TPACK has not led to wide-spread change in educational technology use...because we have not paid enough attention to how educational technology works at a systems and culture level" (p. 2558). They clarify the relationship of a technology's design to culture: "changes in design affects factors in both directions: from artifact to culture and from culture to artifact" (p. 2561). Their definition of culture—a "pattern of shared basic assumptions that allows groups to perceive and interpret the world in similar ways, develop and communicate meaning, and transmit values to new group members"—is very broad but promising. However, their example of a cultural consideration in educational design—"Perceptions of technology, schools, or education broadly" (Warr et al., 2020, p. 623)—clearly misses the unique cultural contexts that characterize Indigenous knowledge. Further, "culture" is portrayed as an intellectual or linguistic construct (e.g., "Vision and mission statements, communication norms [such as] perception of technology, open mentality, values, mind-sets" (Warr et al., 2019, p. 2560) rather than problematized as classrooms that gather children with diverse worldviews, embodied

customs, and lived identities and language-based knowledge systems that belong to particular social groups and are passed down through generations.

What is Indigenous Knowledge (IK)?

Marie Battiste (2005), a Mi'kmaw educator and Professor Emerita, University of Saskatchewan, describes Indigenous Knowledge as “an adaptable, dynamic system based on skills, abilities, and problem-solving techniques that change over time depending on environmental conditions” (p. 6). Importantly, “Indigenous Knowledge Systems do not encompass a singular body of knowledge but reflect many layers of being, knowing, and methods of expression” (Settee, 2011, p. 439). Not only are Indigenous knowledge systems as diverse as the people and places in which they are practiced; they are also imbricated in an ethical and ontological relationality within place.

Today, there are nearly 500 million Indigenous people worldwide, belonging to 5,000 + distinct groups, speaking some 4,000 unique languages, and practicing distinctive cultural traditions that are tied to ancestral lands, across at least 90 countries. Of the estimated half a billion Indigenous people, 1.6% are in North America (Cultural Survival, 2021). According to Canada's 2016 Census, Indigenous Peoples—First Nations, Métis and Inuit—represent 4.9% of the population in Canada (Statistics Canada, 2019) and more than 70 languages. Each of these languages points to an intimate, land-based, and interconnected understanding of the world that is unique and that resists the colonizing ubiquity of the English language. Orality and Indigenous languages are integral to Indigenous Knowledge Systems that embody and reflect the unique wisdom of place, of community, of cultural histories. As Patricia Steinhauer, a Cree Professor of Education from Saddle Lake First Nation, describes:

[T]here is precise knowledge and multidimensional intelligences [involved in Indigenous languages] that cannot be articulated in the unidimensional nature of English....The word kihkipiw in nêhiyawêwin [spoken Cree language] could be related to the beginning translation processes of sitting with something sacred, sitting with sacred knowledge, sitting in a sacred circle. I like to think of kihkipiw as a learning context or an Indigenous learning community, one that has physical and spiritual contexts and—if we can consider that even a little bit further—a ceremonial context of learning guided by Natural Laws. So, in this understanding, kihkipiw comes with a very ancient and rigorous system. Another understanding that is so important in this relational reality is an interconnected understanding of our kinship to all things. (P. Steinhauer in Steinhauer, et al., 2020, p. 74-75)

These resonant connections within Indigenous knowledge systems between language, relations, and multidimensional layers of being, knowing, and expressing suggest that the question, “What is Indigenous Knowledge?” is in need of a critical opening. This is, in part, to acknowledge the immense plurality of Indigenous knowledge(s), each with their own languages, worldviews, stories, practices, and relationships. It is also to challenge what is presumed by the word “knowledge”:

The question “What is Indigenous knowledge?” is usually asked by Eurocentric scholars seeking to understand a cognitive system that is alien to them. The greatest challenge in answering this question is to find a respectful way to compare Eurocentric and Indigenous ways of knowing and include both into contemporary modern education. Finding a satisfactory answer to this question is the necessary first step in remedying the failure of the existing First Nations educational system and in bringing about a blended educational context that respects and builds on both Indigenous and Eurocentric knowledge systems. (Battiste, 2005, p. 1)

Asked from the vantage of a Euro-western epistemological paradigm, “What is Indigenous knowledge?” already suggests that knowledge can be possessed, accessed, represented, and archived as in a text book. To inquire, “What is Indigenous knowledge?” is both an expression of interest in coming to know Indigenous knowledge practices, processes, ceremony, and relations, and an expression of the epistemological limitations of one's own conceptual understandings of what knowledge and learning can be.

As we review the collection of articles below about IK possible relations to and discords with TPACK, we are mindful of these tensions. We acknowledge that:

1. Each article is a limited expression of a particular Indigenous Knowledge system;
2. Each author's language choices express an incommensurate tension between their own ways of knowing and Eurocentric colonial histories from their particular context, for example, the term “tribal” in an American education system;
3. The authors—and we—are cognizant of the shortcomings and epistemic violence of even attempting to represent IK in an academic paper, yet understand the necessity of “first steps” (Battiste, 2006, p.1) towards provoking reflection in current practices, even within the limitations of English language.

Below, we consider how researchers located in other Indigenous Knowledge contexts—in the United States, in Australia, in South Africa—have grappled with the relationship of IK and TPACK. Our interest is how we—Indigenous and non-Indigenous/settler researchers and teacher educators in Canada—may learn from these IK and TPACK dialogues to help inform our own conversations.

Technology Integration, TPACK and IK

According to Trey Adcock of the Cherokee Nation (2014), teachers of Indigenous learners integrating technology in their instruction “must...be sensitive to the cultural contexts of the tribal community” (p. 114). He points out that trying to develop a “singular framework for understanding the role technology is playing in American Indian education” would be difficult because of the diverse cultural histories and practices across tribal communities. He considers several existing frameworks as possible candidates, including TPACK.

Effective integration of educational technologies is highly dependent upon the extent to which a teacher is able to accommodate context within the dynamic equilibrium of the TPACK model. The inclusion of context and digital equity into the TPACK model encourages a pedagogy that can foster a critical consciousness among students, with the aid of technological tools. (p. 115)

Ultimately Adcock concludes that “while TPACK is a useful model for thinking about the intricate relationship between technology, content and pedagogy, it does not fully situate or account for technology integration within a tribal consciousness” (p. 115). Like the other frameworks he reviews, Adcock nonetheless believes that TPACK provides “a foundation for better understanding the ‘digital ecology’ that Native tribes are...develop[ing] for themselves and their students” (p. 117) and can suggest important directions for future research.

In their chapter on “Equity-centered approaches to educational technology”, Garcia and Lee (2020) consider “the role that educational technology has played in both addressing and perpetuating disparities in achievement” (p. 247) and how digital technologies have been mobilized in schools to address learning inequities needs among historically marginalized populations, but with varying success. They suggest that digital technologies have been oversold as an “educational panacea” that will magically transform children’s and youth’s learning experiences. While Garcia and Lee appreciate Koehler and Mishra’s (2009) “attempt to address [equity] concerns with an explicit focus on the relationships and interactions between Technology, Pedagogy, and Content Knowledge ..., [TPACK unfortunately] does not take into consideration larger sociopolitical factors that created these ‘gaps’ in the first place” (p. 250).

Shonfeld et al. (2021) recently proposed a model for cross-cultural alignment in digital learning environments. While their model does not explicitly include TPACK, they nonetheless point to the framework as an important way for teachers to understand the complexity that new media technologies bring to teaching and learning today. They add that, “for teachers to support their indigenous and culturally diverse students’ learning, not only do they need to surround their TPACK with culturally responsive practices ... but, more importantly, culturally sustaining practices” (p. 2159).

Revising TPACK

Several scholars have forwarded specific revisions to TPACK in an effort to address the decided lack of attention to IK. Working in Australia, Lewthwaite, Knight, and Lenoy (2015) characterize TPACK’s “Contexts” (=Contextual Knowledge or XK in the current TPACK) as “generally ‘ambiguous’ and fraught with ‘multiple meanings’” (p.79). Their empirical study of Aboriginal and Torres Strait Islander students in a Remote Area Teacher Education Program (RATEP) demonstrated the need to unpack TPACK’s contextual knowledge. At times, the (student) teachers were focused closely on geographical, linguistic, political, cultural and social dimensions of their home communities, and on the intersections of these, as they contemplated which technologies fit best in their teaching and learning with Indigenous students. Lewthwaite et al. proposed a reinterpretation of TPACK that privileges students’ prior knowledge, abilities, personality and home life (Biggs, 1993) . To accomplish this, they added a “third dimension” to the model, and suggested that Context (XK) should always come first (Figure 2.):

In essence, we have inverted the TPACK model privileging the background of “Contexts” as [XK in early TPACK models]. Repeating [one (student) teacher’s] claim, “There is need for an inverted curriculum [in RATEP] in all I do; that is, ensuring that we ensure the curriculum is based upon the needs and interest of minorities, in this case our Indigenous [RATEP] students.” (Lewthwaite, Knight, & Lenoy, 2015, p. 79)

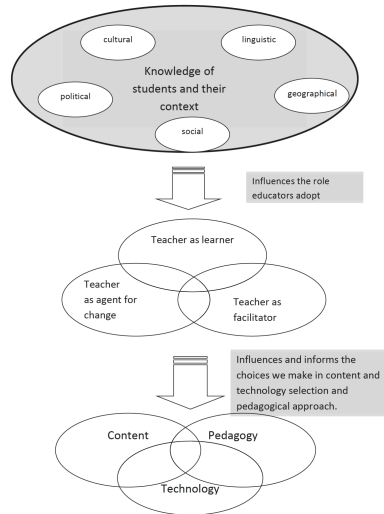


Figure 2. “Reconsidering TPACK” (Lewthwaite, Knight, & Lenoy, 2015, p. 81)

Based in South Africa, Ntšekhe, Terzoli & Thinyane (2014) propose another version of I-TPACK³ to “valorise IK, specifically of the African variety” and to “promote cultural sensitivity” (p. 281). Citing Shulman’s (1986) commentary on PCK, Ntšekhe et al. (2014) worry that IK is necessarily relegated to “background knowledge;” they also suggest that the “framing of IK within ‘contexts’ [in TPACK shares] the danger of rendering this knowledge invisible” (p. 281). Their solution is to add a fourth overlapping knowledge circle for Indigenous Knowledge (Figure 3.). Ntšekhe et al.’s aim with I-TPACK, which they admit will take years to realize, is to:

- minimise potential ‘cultural disconnects’ brought by the devaluing of IK.
- encourage learning that emphasises inward (i.e. endogenous) thinking.
- create positive synergies between IK and Western [Eurocentric] knowledge systems. (p. 282)

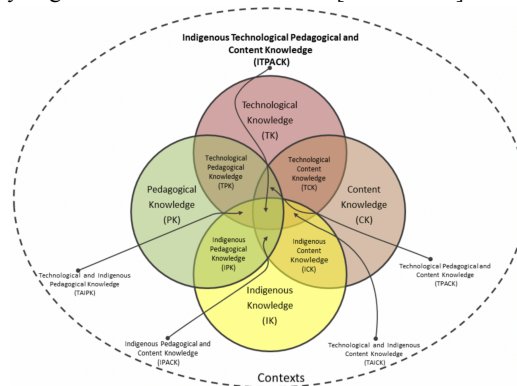


Figure 3. Ntšekhe, Terzoli & Thinyane (2014)’s I-TPACK

Also located in South Africa, Gumbo (2020) applauds Ntšekhe et al.’s (2014) “attempt to indigenise TPACK” (p. 72) with I-PACK. However, Gumbo says their I-PACK “falls short in acknowledging the possible connections and divergences between the two knowledge systems, i.e., indigenous knowledge and Western knowledge” (p. 81). Instead, he proposes INDANDWEST-TPACK (Figure 4.). INDANDWEST-TPACK features PK and CK, and thus PCK, expanded to include Indigenous Knowledge, Western Knowledge along with their connections and disconnections to “ensure the non-preference of one knowledge system over the other and treat them equally” (p. 81). His approach takes a step toward Indigenous Métissage by juxtaposing two knowledge systems and attempting to reckon with them “as relational and braided rather than isolated and independent” (Donald, 2012, p. 537). Meanwhile INDANDWEST-TPACK depicts TK or technological knowledge as entirely untouched by both Indigenous and Western knowledge systems, as if to suggest that Technological Knowledge is wholly acultural.

³ The ‘I’ in I-PACK is pronounced as ‘ee’ to honour isiXhosa, the Bantu language of the Xhosa.

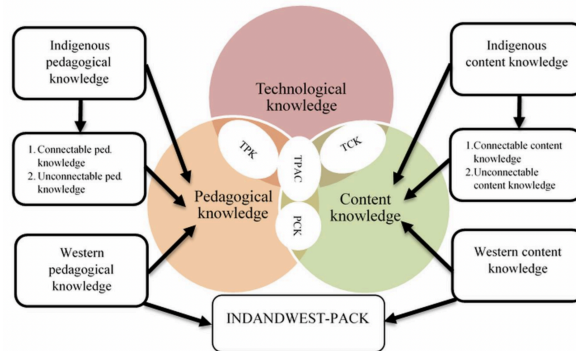


Figure 4. Gumbo's (2020) INDANDWEST-TPACK

Technology as culture mediating

Missing from each of the three TPACK revisions is a critical consideration of the often invisible but significant contributions that all technologies make to culture formation, stabilization and change. To borrow from educator and media ecologist Neil Postman (1995), technology can be thought of as “the command centre of epistemology” (1985, p. 78) that scaffolds and organizes (cultural) knowledge forms. Recognition of the intimate relationship that exists between technology and knowledge aligns with Shulman’s (1986) suggestion that educational technologies are the “*materia medica* of pedagogy, the pharmacopeia from which a teacher draws” (p. 10), a passage overlooked by Mishra and Koehler (2006) in their original formulation of TPACK. So while technological knowledge (TK) is certainly a key form of teacher knowledge in the 21st century, technology must also be critically reckoned with as the formative undergirding of knowledge forms.

Others who have reflected on Indigenous Knowledge and technology in schools have also recognized the close, formative relationship they share. For example, in their explorations of the unique challenges that computing technology in schools may pose to North American Indigenous Peoples, Bowers, Vasquez and Roaf (2000) argue that “computers are a culture-mediating technology [and that] teachers must understand how computers amplify certain cultural ways of knowing and how they reduce or eliminate others” (p. 193). For them, the issue is not whether teachers teaching in Indigenous educational contexts should use—or not use—digital technologies; rather it is a question of the teacher choosing technologies thoughtfully and with sensitivity to possible cultural contraindications.

A similar concern for the fate of Indigenous Knowledge in the wake of digital technologies is echoed more forcefully by Traxler (2019).

The concept of *epistemicide* encapsulates a...profound threat...to indigenous communities and highlights the impact of alien epistemologies, usually European ones, buried inside language, technology and learning, on indigenous cultures. OER [Open Educational Resources], a specific and much vaunted technology for educational development in Africa, has been critiqued as information imperialism and alerts us to be on our guard against pedagogic imperialism as we build our foundations for learning. (p. 16)

Every technology is a kind of Trojan horse (itself a technology) that quietly imports a new knowledge form or episteme to the unsuspecting inhabitants of the city of Troy. So on the one hand, technologies are “cultural artifacts” (Cole, 1996) that mediate the formation and sustaining of cultures in manifold ways. For example, Goulet and Goulet (2014) describe technology as “cognitive mediators” that fulfill a culture mediating role in learning contexts:

Our thinking is directed, shaped, and supported by sources in our culture. Cognitive mediators are the tools used to assist and extend thinking, to make sense of the world, and to support memory. They allow a person to have an understanding of the world that sense alone cannot provide, because mediators facilitate the “intermingling of ‘direct, natural, phylogenetic’ and ‘indirect, cultural’ aspects of experience” (Cole, 1996, p. 119). A person can learn about fishing by doing it (using tools developed by previous generations), by reading about it (using a cultural sign system), or by talking to a fisher (using a person as a cognitive mediator). Sport fishing differs from fishing for sustenance or as a way of making a living. The cultural practice of fishing shapes a person’s concept of fishing, as does the source of learning – for example, studying fishing in a biology text or learning by doing it on the water with a more experienced person. (p. 47)

On the other hand, the powerful culture-forming and -sustaining capacities of technologies can also mean that Indigenous Knowledge practices may be compromised by the introduction of new technologies that are not aligned with local values, wisdom traditions and ways of knowing. For example, reflecting on the importance of web-based apps for teaching and revitalizing Indigenous languages in Canada, Herman, Daniels, Lewis, and Koole (2022) also advise consideration of the risks:

Loss of control over traditional knowledge (i.e., how it is used, by whom, and when) is a serious issue. Some stories, for example, should only be told in certain seasons; some knowledge should only be shared within a ceremony. In addition to inappropriate use, sometimes traditional knowledge and practices are commoditized by people outside the community. (p. 133)

Care, thoughtfulness and deep respect is needed when sharing knowledge that is sacred. Such an ethic can run counter to a media environment that promises instant, 24-hour-a-day/7-day-a-week access to information.

It is thus critical that teachers' Technological Knowledge (TK) includes an understanding of how technology mediates cultural knowledge. Digital technologies are not neutral. They embed values, and when used, they reify new practices by altering—in sometimes powerful ways—how we act, relate to and think about our world. “Every piece of technology is an expression of cultural and social frameworks for understanding and engaging with the world” (Lewis et al., 2020, p. 21). The changes new technologies mobilize may or may not be aligned with local IK practices and ways of knowing—except by chance or by design. Most teachers are not in a position to design their own educational technology, but they can be mindful about a technology's alignment with local culture, and adapt their own and their students' use of the technology accordingly. Inevitably, as de Alvarez and Dickson-Deane (2018) suggest, educational technology developers also need to become more aware of and responsive to the cultural backgrounds of their user: “When creators of technology tools make an effort to match the cultural mindset of the intended users, and use that as the foundation for creating new designs, the technology makes sense to the users and enhances their experience” (p. 346).

Honouring Indigenous Language Systems—“It's Not the Name but The Meaning”

Ninaskomtinawaw kakiyaw ewetomin. (Thank you for this invitation to come be part of your work). My name is Patsy Steinhauer, I am Saddle Lake Cree and part of Amiskwaciyinywak. My parents are Genevieve and late Walter Steinhauer, Saddle Lake Cree. I am a descendant of Chief Papastew on my maternal side and Henry Bird Steinhauer on my fathers side. I give deep gratitude to my lineage.

I wanted to first thank each of you for your courage in taking up this work. Although I am not a cultural knowledge holder, I recognize that I must meet my responsibilities as an Indigenous scholar and therefore I stand with you in this effort to work towards a re-narrativization and reorientation of education as it relates to technology. It is most vital we acknowledge the importance of cultural protocol as a first step. Together we can come to understand what this entails. Furthermore, I recognize there is much to contextualize and my hope is to do so through language. In a technological context I recognize the function and form of a computer language and/or communication is sophisticated and complex. To gain proficiency and mastering such a language takes much training and skill. It is here I invite you into nehiyawewin - Cree language and thought. My late Lakota Uncle Lionel Kinuwna said, “we have to stop minimizing our Indigenous languages.” The idea of nehiyawewin automatically recognizes language and thought to be interconnected. The interconnectedness invites a sophisticated consciousness as central to the operating system. This means there are many ethical systems that inform and part of the way one views reality and the universe. The key is to recognize an internal wise and ancient informed operating system that respects dimensions beyond the physical realms.

To add to the conversation on TPACK I would like to look at the Cree word for eye—miskîsik. The word translates to eye and shares kinship to a red currant berry locally found in the muskeg. The root word for eye is kîsik which translates to sky or even implies the heavens. The meaning encompassed in this word holds medicinal wisdom and deeper meanings that involve spirit and the heavens. I would rely on those who know, ketayhk (Cree Elders), to provide us this wisdom and insight of the interconnected intelligent operations of miskîsik. In my scholarship, I work closely with many Cree language mentors who speak about the kinship meanings in the language. My Aunt Judy Brule describes a “witnessing” in a spiritual felt form of additional Cree words that share kinship to kîsik and miskîsik. These words are all related and provide a deeper meaning and understanding beyond a word that in an English language context typically references only the physical dimension.

Another important context we must consider is place. Place, physically and figuratively, where wisdom and intelligence resides. My Hawaiian mentor Manulani Meyer speaks about place, specifically acknowledging the ancient spiritually informed cultural practices of peoples who over hundreds and even thousands of years develop intimate knowledge and relationships creating an expertise developed over time. Stories, legends, sacred understandings have deep spiritual meanings in their local homelands and/or communities. This is sacred territory and must be given the proper protocol, recognition and understanding. Again, I must acknowledge that I am not a cultural knowledge holder and do my best following protocols to help understand and acknowledge Indigenous intelligences. We only speak about what it is we know and been given. Therefore, writing instead of experiencing

these articulations becomes challenging and can be misinterpreted. I think about nohkom Mary Moniyas, Maskwacis Cree, who says, “You won’t learn this in any book. You have to come here and be with us.”

So, I think we are at a good starting point. Again, I thank you for this work and I look forward to our next steps in thinking about technology and how it engages with Indigenous thought systems. For now we will continue to recognize and acknowledge that wisdom is internally and individually situated and informed. The meaning is ethically and value based on inherent wisdom, blood memory and experience. Nehiyaw word meanings are multidimensional and provide deep meanings that become challenging to translate. This will be our work ahead—together. Ay hiy ninaskomtinawow kakikyaw.

Conclusion

Coyote and Raven believe that sharing the tech time/space in education with Indigenous and other other/ed technological knowledges and practices might support a more robust and complex technological literacy in education needed in our rapidly changing world. (Cole & O’Riley, 2012, p. 18)

TPACK has potential for use across diverse cultural contexts, but only if it is understood as “relational and braided rather than isolated and independent” (Donald, 2012, p. 537). The relationship between IK and TPACK is a complex story not easily resolved by recrafting a visual model. How and when IK may be situated in the TPACK framework is not only debatable, but highly contextual. Each reiteration of TPACK that would integrate IK runs the risk of obscuring Indigenous knowledge practices by appropriating and instrumentalizing them within a Eurocentric epistemological model. Here, an attitude of epistemic humility is called for to “challenge the univocal character of an abstract universality” and build toward a decolonial future that affirms *pluriversality* that is, a way of being that is “open to contingency and the alterity of other histories and cultures” (Vizcaíno, 2021, p. 9, 10).

Other questions require further consideration; for example, following the emergence of *refusal* as a central tenet of critical Indigenous studies, what are the implications for relationship building between IK and TPACK? *Refusal* describes a practical stance and theory for thinking through “how [Indigenous peoples] (re)build our own house, our own houses” (Simpson, 2011, p. 32). Refusal can take many forms from “focusing attention on Indigenous place-based practices and associated forms of knowledge” (Coulthard & Simpson, 2016, p. 254) to simply refusing integration and the instrumentalizing logic of Eurocentric knowledge systems. Refusal can also be any gesture towards cultural resurgence that asserts epistemological sovereignty at odds with the Eurocentric demand for complete accessibility to all knowledge without barrier (Simpson, 2014). Refusal affirms IK within place-based practices and troubles any model of TPACK that would background or uproot these associated forms of knowledge from their contextual origins.

Reflecting on refusal also helps highlight the possible tensions that may arise when bringing IK and TPACK together. Approaching TPACK from an Indigenous Métissage perspective suggests the need for *ongoing* dialogues—“being pushed and pushing back, a kind of discursive wrestling” (Simpson, 2007, p. 74)—between Indigenous knowledge keepers and proponents of TPACK with a sincere commitment to ethical relations, hermeneutic imagination and the situatedness of place; the hopeful outcome of braiding our stories together would be telling “a better story” (Donald in Lee, 2012). As Taima Moeke-Pickering (2020) recently put it, “if left unchecked, the technology sphere will remain colonized and we must, as Indigenous educators, seek to decolonize technology” (p. 268). On-going cross-cultural conversations may also help teachers teaching with technology to better support and complement local and diverse cultural perspectives and practices for learners, rather than inadvertently undermining them.

References

- Adcock, T. (2014). Technology integration in American Indian education: An overview. *Journal of American Indian Education*, 53(2), 104-121. <https://www.jstor.org/stable/43610478>
- Allen, N., Resta, P. E. & Christal, M. (2002). Technology and tradition: The role of technology in Native American schools. *TechTrends*, 46(2), 50-55. ERIC Number: EJ654214
- Battiste, M. (2005). Indigenous knowledge: Foundations for First Nations. *WINHEC: International Journal of Indigenous Education Scholarship*, (1), 1-17. Retrieved from <https://journals.uvic.ca/index.php/winhec/article/view/19251>
- Biggs, J. (1993). From theory to practice: A cognitive systems approach. *Higher education Research and Development*, 12(1), 73-85. <https://dx.doi.org/10.1080/0729436930120107>.

- Bowers, C., Vasquez, M., & Roaf, M. (2000). Native people and the challenge of computers: Reservation schools, individualism, and consumerism. *American Indian Quarterly*, 24(2), 182-199. <https://www.jstor.org/stable/1185870>
- Cole, M. (1996). *Cultural psychology: A once and future discipline*. Harvard University Press.
- Cole, P. & O'Riley, P. (2012). Coyote and Raven put the 'digital' in technology – Hands up and down to earth. *Transnational Curriculum Inquiry*, 9(2), .<http://nitinat.library.ubc.ca/ojs/index.php/tci>
- Coulthard, G. & Simpson, L. B. (2016). Grounded normativity/place-based solidarity. *American Quarterly*, 68(2), 249-255.
- Cultural Survival. (2021). The issues. <https://www.culturalsurvival.org/issues>
- De Alvarez, M. S., & Dickson-Deane, C. (2018). Avoiding educational technology pitfalls for inclusion and equity. *TechTrends*, 62(4), 345-353. <https://doi.org/10.1007/s11528-018-0270-0>
- Donald, D. (2012). Indigenous Métissage: a decolonizing research sensibility. *International Journal of Qualitative Studies in Education*, 25(5), 533-555. <https://doi.org/10.1080/09518398.2011.554449>
- Garcia, A., & Lee, C. H. (2020). Equity-centered approaches to educational technology. M. J. Bishop et al. (eds.), *Handbook of Research in Educational Communications and Technology* (pp. 247-261). https://doi.org/10.1007/978-3-030-36119-8_10
- Goulet, L. M., & Goulet, K. N. (2014). *Teaching each other: Nehinuw concepts and Indigenous pedagogies*. UBC Press.
- Herman, C., Daniels, B., Lewis, K., & Koole, M. (2020). Awakening sleeping languages in Saskatchewan with culturally appropriate curricula and technology. In J. Traxler & H. Crompton (eds.), *Critical Mobile Pedagogy: Cases of Digital Technologies and Learners at the Margins* (pp. 123-135). Routledge.
- Kidd, I. J. (2017). Confidence, humility, and hubris in Victorian scientific naturalism. In J. van Dongen, & H. Paul (eds.), *Epistemic Virtues in the Sciences and the Humanities* (pp 11-26). Boston Studies in the Philosophy and History of Science, vol. 321, Springer International Publishing. https://doi.org/10.1007/978-3-319-48893-6_2,
- Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, 9(1), 60–70. <https://citejournal.org/volume-9/issue-1-09/general/what-is-technological-pedagogical-content-knowledge>
- Lee, V. (2012, November 19). To tell a better story: Dwayne Donald and aboriginal perspectives in education. *Illuminate: Faculty of Education Magazine*. <https://illuminate.ualberta.ca/content/tell-better-story-dwayne-donald-and-aboriginal-perspectives-education>
- Lewthwaite, B. E., Knight, C., & Lenoy, M. (2015). Epistemological considerations for approaching teaching in an on-line environment Aboriginal and Torres Strait Islander teacher education program: Reconsidering TPACK. *Australian Journal of Teacher Education*, 40(9), 63-85. <https://doi.org/10.14221/ajte.2015v40n9.4>
- Lewis, J. E. (Ed.) (2020). Indigenous protocol and artificial intelligence position paper. *The Initiative for Indigenous Futures and the Canadian Institute for Advanced Research (CIFAR)*. <https://doi.org/10.11573/spectrum.library.concordia.ca.00986506>
- Mishra, P. (2019). Considering contextual knowledge: The TPACK diagram gets an upgrade. *Journal of Digital Learning in Teacher Education*, 35(2), 76-78. <https://doi.org/10.1080/21532974.2019.1588611>
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054. <https://doi.org/10.1111/j.1467-9620.2006.00684.x>
- Moeke-Pickering, T. (2020). The future for Indigenous education: How social media is changing our relationships in the academy. In S. Cote-Meek, & T. Moeke-Pickering (Eds.), *Decolonizing and Indigenizing Education in Canada* (pp. 267-277). Canadian Scholars.
- Ntšekhe, M., Terzoli, A., & Thinyane, M. (2014). Towards building an indigenous knowledge platform to enable culturally-sensitive education underpinned by technological pedagogical and content knowledge (TPACK). *Proceedings of the e-Skills for Knowledge Production and Innovation Conference 2014*, 275- 284. Cape Town, South Africa. Retrieved from <http://proceedings.e-skillsconference.org/2014/e-skills275-284Ntsekhe821.pdf>
- Patterson, M. (2003). *First Nations in cyberspace: Two worlds and tricksters where the forest meets the highway*. Doctoral dissertation. Carleton University, Ottawa, Ontario.
- Settee, P. (2011). Indigenous Knowledge: Multiple Approaches. *Counterpoints*, 379, 434–450. <http://www.jstor.org/stable/42980913>

- Shonfeld, M., Cotnam-Kappel, M., Judge, M., Ng, C. Y., Ntebutse, J. G., Williamson-Leadley, S., & Yildiz, M. N. (2021). Learning in digital environments: a model for cross-cultural alignment. *Educational Technology Research and Development*, 69(4), 2151-2170. <https://doi.org/10.1007/s11423-021-09967-6>
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4-14. <https://doi.org/10.3102/0013189X015002004>
- Simonelli, R. (1993). The path of Native American education: Where tradition and technology meet. *Technos*, 2(3), 12-17.
- Simpson, A. (2007). On ethnographic refusal: Indigeneity, ‘voice’ and colonial citizenship. *Junctures*, 9, 67-80. <https://junctures.org/index.php/junctures/article/view/66>
- Simpson, A. (2014). *Mohawk Interruptus: Political life across the borders of settler states*. Duke University Press.
- Simpson, L. B. (2011). *Dancing on our Turtle's back: Stories of Nishnaabeg re-creation, resurgence, and a new emergence*. Arbeiter Ring Press.
- Statistics Canada. (2019). Aboriginal peoples in Canada: Key results from the 2016 Census. Government of Canada. <https://www150.statcan.gc.ca/n1/daily-quotidien/171025/dq171025a-eng.htm?indid=14430-1&indgeo=0>
- Steinhauer, E., Cardinal, T., Higgins, M., Madden, B., Steinhauer, N., Steinhauer, P., Underwood, M., Wolfe, A., & Cardinal, B. (2020). Thinking with Kihkipiw: Exploring an Indigenous theory of assessment and evaluation for teacher education. In S. Cote-Meek, & T. Moeke-Pickering (Eds.), *Decolonizing and Indigenizing Education in Canada* (pp. 73-90). Canadian Scholars.
- Traxler, J. (2019). Only connect: Indigenous digital learning. *Interaction Design and Architecture(s) Journal*, 41, 7-23. http://www.mifav.uniroma2.it/inevent/events/idea2010/doc/41_1.pdf
- University of Alberta. (2022). *About ATEP*. <https://www.ualberta.ca/aboriginal-teacher-education-program/about-atep/index.html>
- Vizcaíno, R. (2021). Did you listen? Zapatismo and epistemic decolonization. *Transmodernity: Journal of Peripheral Cultural Production of the Luso-Hispanic World*, 9(6), 1-17. <https://doi.org/10.5070/T49653484>
- Warr, M., Mishra, P., & Scragg, B. (2019). Beyond TPACK: Expanding technology and teacher education to systems and culture. *Society for Information Technology & Teacher Education International Conference*, 2233–2237. <https://www.learntechlib.org/primary/p/208009/>
- Warr, M., Mishra, P., & Scragg, B. (2020). Design theory. *Educational Technology Research and Development*, 68, 601–632. <https://doi.org/10.1007/s11423-020-09746-9>