TPACK and Educational Interactions – Pillars of Successful Technology Integration

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Abstract: It is important to understand what drives the success of technology integration in educational settings, because learning in schools with technology develops the students' capacities to participate fully in the digital age. Educated students, in turn, can transform our societies through innovative scientific discoveries. Recently, the Technological Pedagogical Content Knowledge (TPACK) framework has emerged as a theoretical framework needed for understanding the teacher's integration of digital technologies into teaching. Educational interactions, in turn, have been emphasized as a critical component of the educational practices, processes and contexts. However, these two concepts have been studied and developed rather independently. This paper reviews both educational interactions and the TPACK framework. Against this background, we outline and propose an integrated framework that combines two approaches and allows providing a better understanding of technology-based education, especially at the micro level of the classroom.

Introduction

Digital technologies are spreading rapidly across the globe, and different technologies have become integral parts of everyday life. Also, educational institutions have recognized the potential to improve learning in classrooms with technologies along with the importance of developing the capacities of their students to use technologies to participate fully in the digital age (Fraillon, Ainley, Schulz, Duckworth & Friedman, 2019). Adding technologies into the classroom remains a challenging process and researchers have been trying to understand and explain how best to achieve this in education for over 30 years (Petko, Prasse & Cantieni, 2018). In discussing the process, most literatures usually point to interrelated factors surrounding the technology, users and contexts (e.g., Bingimlas, 2009; Ertmer, 1999; Drent & Meelissen, 2008; Tay, Lim & Lim, 2013).

Notably, teachers occupy a significant position in the technology integration process and several educational technology frameworks have been developed (Bower & Vlachopoulos, 2018) with the intent to help education stakeholders as well as improve the complex process. Recently, the Technological Pedagogical Content Knowledge (TPACK) framework has emerged as a noteworthy tool for understanding effective teaching with technology and thus, an important theoretical foundation for technology integration research. Hundreds of studies have utilized the TPACK framework to explore teachers' technology use in classroom settings (Phillips, 2017). However, the TPACK framework has also been criticized for not explicitly addressing context and actors (Porras-Hernández & Salinas-Amescua, 2013; Rosenberg & Koehler, 2015). More so, Bower and Vlachopoulos (2018), argued that technology integration frameworks rarely provide explicit and substantial consideration of the interactions between students and teachers. Therefore, this paper reviews both educational interactions and the TPACK framework. Against this background, we outline and propose an integrated framework that combines two approaches and allows providing a better understanding of digital educational environment and success in classroom.

Technology Integration into Teaching and Learning

Vygotsky (1979) stressed that it is impossible to separate learning from its social context. Hence, learning is an integral and inseparable aspect of social practice (Lave & Wenger, 1991). Learners learn from various sources, settings, and interactions—from humans or objects (e.g., books)—and through technologies (Okita, 2012). Therefore, learning is always constituted through a situated interaction of learners, teachers, and technologies (Mercer & Littleton, 2007). Based on these assumptions, we collected and investigated a range of existing artifacts

and factors and their relationships that influence successful technology integration, especially at the micro level of the classroom where behaviors of students, teachers, and technologies interact to provide learning opportunities (Webb, 2013). In this section, we summarize the research on educational technology integration. Educational technology integration models generally focus on the individuals, the specific characteristics of the context, and the innovation to predict future use (Straub, 2009). We have structured our literature review based on these factors.

Role of the Teacher

Teachers are central to the success and sustainability of technology integration for instruction (Ng & Nicholas, 2013) and thus, they are the most important agents in shaping education for students and bringing innovation to educational practices (Solheim, Ertesvåg & Dalhaug Berg, 2018). Consequently, it is expected that teachers gain skills and knowledge of effective instructional practices that incorporate meaningful uses of technology (Ertmer 1999). Furthermore, much of the effect of teachers and classrooms on student learning is seen in the interactions that take place between teachers and students (Hamre et al., 2013). Therefore, we begin by reviewing teacher competence and teacher-student interactions.

Teacher Competence

Several researchers emphasized teachers' competencies as an essential part of successful technology integration (Crompton, Olszewski & Bielefeldt, 2016; Tay et al., 2013; Redecker & Punie, 2017). Teacher competence, in turn, comprises cognitive, skill-based, and affective components that depend on the learning environment and contextual factors (Binkley et al. 2012; Caena 2014; European Commission 2018; Redecker & Punie, 2017). The TPACK framework similarly highlights areas of competence that teachers in this ever-changing digital era need to have to take full advantage of digital learning environments. TPACK is developed from the knowledge constructs (pedagogical and content knowledge, or PCK) modeled by Shulman (1986). In the PCK model, an integration of content knowledge (CK) and pedagogical knowledge (PK) culminates in how subject knowledge is taught to the learner. Koehler and Mishra (2006) advance the PCK model by introducing the knowledge of integrating technology, which answers the question of how to apply technology in the teaching of a subject. The TPACK framework consists of three key components of teachers' knowledge: content (CK), pedagogy (PK), and technology (TK) and the interaction between and among them. According to Koehler and Mishra (2009), PCK is similar to Shulman's (1986) idea of the knowledge of pedagogy that is applicable to teaching specific content. TCK, in turn, is an understanding of how technology and content influence and constrain one another. TPK is an understanding of how teaching and learning can change when technologies are used in particular ways. TPACK thus represents an understanding of how to teach with technology.

Evidence has shown that many teachers lack the TK needed to use technology effectively, which in turn limits their potential impact (Hinostroza, 2018). Although teachers need to be confident and competent technology users, they also need to understand how to incorporate technologies purposefully into learning plans and curricula to personalize, engage, and create an interactive atmosphere for the student (Tsai & Chai 2012; Willis, Lynch, Fradale, & Yeigh, 2019). This is suggestive of the fact that effective practices using technology blends with the teacher's other knowledge: that is, all types of knowledge constructed by the teacher, such as those developed from years of teaching experience, the subject taught, the students' characteristics and needs, along with devices. Earlier studies have emphasized teacher attitudes, perceptions, and personal factors as critical drivers of technology integration within the classroom (Aldunate & Nussbaum, 2013; Almerich, Orellana, Suárez-Rodríguez & Díaz-García, 2016; Salinas, Nussbaum, Herrera, Solarte & Aldunate, 2017; Tondeur, Aesaert, Prestridge & Consuegra, 2018). Accordingly, teacher competence is an experience-based and emotionally-affected mix of competence that also involves values, attitudes, and a certain mindset. Likewise, Joo, Park and Lim (2018) allude that the teachers' TPACK affects teacher self-efficacy and influences the teacher's perceived ease of use, along with the perceived usefulness of technology in the classroom. Self-efficacy and perceived usefulness of technology, in turn, affect teachers' intention to use technology. In other words, teachers who have high levels of TPACK might find it easier to use technology and would also perceive using technology as a helpful teaching tool. Hence, in the high satisfaction classroom, the teacher is pedagogically and emotionally engaged, which appears in the form of organized learning activities, flexibility, and creativity in instruction as well as enthusiasm and positive feelings regarding the classroom (Kangas, Siklander, Randolph & Ruokamo, 2017). Signifying that during the technology integration process, teachers might need to overcome second-order barriers, including their beliefs about technology and teacher-student roles, curricular emphases, and assessment practices (Ertmer, 1999).

Teacher- Student Interactions

According to Houssaye (1988), all teaching and learning situations can be defined as an interaction between two of the three points of a triangle: the teacher, the learner, and knowledge. This kind of triangle highlights the specific interrelationships and interactions between a teacher, student, and content in a given pedagogical situation (Friesen & Osguthorpe, 2018; Page 2015). The interactions between a learner and teacher are essential, for instance, to assess current understanding and design appropriate approaches, along with stimulating critical reflection and diagnosing misconceptions (Anderson & Garrison, 1998; Kostiainen et al., 2018; Larson, 2000). The teacher-learner interactions also comprise emotional, organizational, and instructional domains (Hamre et al., 2013). Thus, the teacher is responsible for facilitating and orchestrating interactions to enhance student learning (Anderson, 2004). Research has indicated that learners are most motivated to learn when teachers support their need to feel competent, positively related to others, and autonomous (Hamre et al., 2013). Therefore, the primary role of the teacher is to facilitate the student's active, partly self-regulated sharing of thoughts: for example, by asking open-ended questions and providing more opportunities for reflection (Dukuzumuremyi & Siklander, 2018; Muhonen, Rasku-Puttonen, Pakarinen, Poikkeus & Lerkkanen, 2016). Hence, students become empowered learners primarily through their teachers' interaction and instruction (Hamre et al. 2013; Houser & Fymier, 2009), and the resultant learning opportunities created (Karvonen, Tainio & Routarinne, 2018). Thus, the learner-teacher relationship is dual in nature; it takes both the form of interaction between the teacher and learner and of the bond between the learner and the teacher via developed teaching materials (Anderson 2004; Page 2015). Teaching materials can be static and nonresponsive or interactive multimedia, such as audio or video recordings, computer software, or other multimedia technologies and content that are constantly refreshing and updating (Lonn, Teasley & Krumm, 2011). Technologies, for instance, provide avenues that enable learners to interact and capture experiences in both physical and social realms and make learning more experiential and multifaceted (Ting 2013). Therefore, it is also important to note that student-teacher interactions are tied to a specific context (van Es & Sherin, 2002). As a result, a teacher never just gives a lesson; rather, in most cases, the classroom interaction is designed and planned with the specificity of students and context in mind (Friesen & Osguthorpe, 2018).

Role of the Learner

Amid the ongoing discussion of technology integration in education, the learner is recognized as not only a stakeholder but also as the focus of the learning or teaching process (Koole, 2009). In other words, the reason the teacher intentionally chooses the pedagogy or technology suitable for specific content is to enable the learner to obtain a clear understanding of the subject. Consequently, in the student domain, we observe distinct features of context (classroom and school) and actors (teachers and students), and their actions influence the learning goals.

Woods and Baker (2004) argued that learners have opportunities for four potential realms of engagement: a teacher, learners, content, and environment. In each of these realms, the learner can ignore an engagement or engage in interactive communication. Anderson and Garrison (1998), in turn, suggested six types of interaction: learner-teacher, learner-content, teacher-content, learner-learner, teacher-teacher, and content-content. These interaction classifications allude to the fact that interactions between one learner and others are important in investigating and developing multiple perspectives and understanding course content (Anderson, 2004; Kurucay & Inan, 2017; Okita, 2012). Thus, learners learn together with their peers and their teachers; they learn while collaborating and doing (Illeris, 2009; Lonn et al., 2011; Moore, 1989). Learners may move within different physical and virtual locations, participate and interact with other people, information, and systems (Koole, 2009). Thus, requiring an environment that is learner-centered and technology-rich where students are actively engaged and take ownership of their learning (An & Reigeluth, 2011).

Characteristics of the Context

Teaching and learning do not happen in a vacuum. These processes are affected by the world in and beyond the classroom. Bronfenbrenner (1994), suggested that the interactions between the individuals and their environment can be categorized into various systems, also known as an ecological system, that shape their development over time. This ecological system consists of five rings of interconnected systems: microsystems, mesosystems, exosystems, macrosystems, chronosystems. The microsystem is the immediate environment (e.g. family, school, peer group, and workplace). The mesosystem is a system of microsystems. The exosystem, in turn, is the linkages and processes taking place between two or more settings. The macrosystem consist of micro-, meso,

and exosystem (i.e., characteristics of a given culture, belief systems, material resources and opportunity structures). The chronosystem encompasses change or consistency over time in the characteristics of the person and environment.

Equivalently, several studies have indicated that effective technology integration in education using the TPACK framework should consider context. Angeli and Valanides (2009) extend the TPACK with the inclusion of two features: knowledge of context and knowledge of students. Porras-Hernández and Salinas-Amescua (2013) likewise identified from previous TPACK literatures four main characterizations of context: namely, student characteristics, classroom and institutional conditions for learning, and teachers' epistemological beliefs. Thereafter, the latter extended the TPACK framework by outlining context (scope) in three dimensions (micro, meso, and macro) and the knowledge construct of the actors (teachers and students). Another discussion on context and its impact on teachers' technology integration is seen in the study by Koh et al. (2014), who explained the context in terms of teachers' beliefs (intrapersonal), school (cultural or institutional), technology (physical), and peers (interpersonal). In addition, the model by Chai, Koh, Lim and Tsai (2014) describes context as consisting of five levels (micro, meso, macro, chrono and exo) and at each of the levels, different education stakeholders (actors) exert some amount of influence on the process of technology integration, which affects the teacher's TPACK. These efforts to modify the TPACK framework reveal that careful consideration of context in research is necessary in order to fully understand the technology integration process. Indicating further, that context can either support or hinder teaching and learning with technology. Typically, these hindering and supporting factors of meso and macro levels are described in terms of the types of resources (e.g., equipment, time, training, support) that are either missing or available in teachers' implementation environments (Drent & Meelissen, 2008; Ertmer, 1999; Tay et al., 2013). Thus, comparing these dimensions of context, it infers that the meso and macro context levels directly influence teachers' decisions on how they integrate technology (Cheah, Chai & Toh, 2018), and the impact of such influence is reflected on what happens in the classroom or the micro level (Kim, Hannafin & Bryan, 2007).

Innovation in Education

Researchers have noted that innovative teaching flourishes when the school culture is collaborative and supportive in terms of peer support and sharing (Shear al., 2011). Therefore, teacher-teacher interactions may encourage teachers to take advantage of knowledge growth and discovery, both in their subject areas and within the scholarly community of teachers (Anderson 2004). Teachers' improvement in classroom interaction is dependent on both the teacher's own strong knowledge of classroom interaction and that of their colleagues (Solheim et al., 2018). Therefore, professional development programs need to be sensitive to teachers' individual and collaborative learning experiences to support teachers in the natural context (Rytivaara & Kershner, 2012).

Although teachers are key drivers of innovation, organizational capacity to exploit innovations is also needed (Wilcox & Lawson, 2018). Amponsah, Kwesi and Ernest (2019) enumerated multiple factors, such as workload, lack of teaching and learning resources, remissness of creative learning, social-cultural influences, and objectives stated in the curriculum might inhibit creative teaching and learning in schools. Therefore, the main elements of innovative digital schools are visions of school, leadership, the practice of the teaching community, innovative and creative pedagogical practices, school-level knowledge practices, and digital resources (Ilomäki & Lakkala, 2018). Chai et al. (2014) emphasized that teachers, students, curriculum designers, heads of departments, school principals, ministry officers, software designers, parents, and industry partners all contribute to the technology integration. An effective technology integration with teaching and learning is therefore dependent on successful interactions between the leadership team, community, technical support personnel, and key users—teachers and students (Ng & Nicholas, 2012). Hence, communication and dialogue are important parts of the systemic change process (Joseph & Reigeluth, 2010).

As technology advances, commensurate change is required at institutional levels: for example, changes in procedures, pedagogy, and school culture. One of the most important aspects of the systemic change process is helping stakeholders to evolve their mindset and mental models about education (Joseph & Reigeluth, 2010). Burke et al. (2018) have stated that teachers with constructivist-oriented pedagogical beliefs are more likely to adopt technology than transmission-oriented teachers. Successfully facilitating technology adoption must consequently address cognitive, emotional, and contextual concerns (Straub 2009; Wilcox & Lawson, 2018). In order to foster creativity in schools, teachers must take risks by trying new, learner-centered, and alternative methods in their work (Amponsah et al., 2019).

The Proposed Framework

In the previous section, we presented the main variables, dimensions, and core actors of our conceptual framework. In this section, we will assemble them.

Micro Context Level

First, our proposal for the framework (see Figure 1) suggests that the key actors (teachers and students) are bound within the micro context level (i.e., classrooms and other learning environments). Competent integration of technology is evident at this micro level context, and the actors become objects of knowledge with their unique inner and external contexts (Porras-Hernández & Salinas-Amescua, 2013, p. 231). At this level, the teachers are most relaxed and possess a greater sense of autonomy, which is displayed in the classroom interaction (i.e., interactions among teachers, contents, and learners).

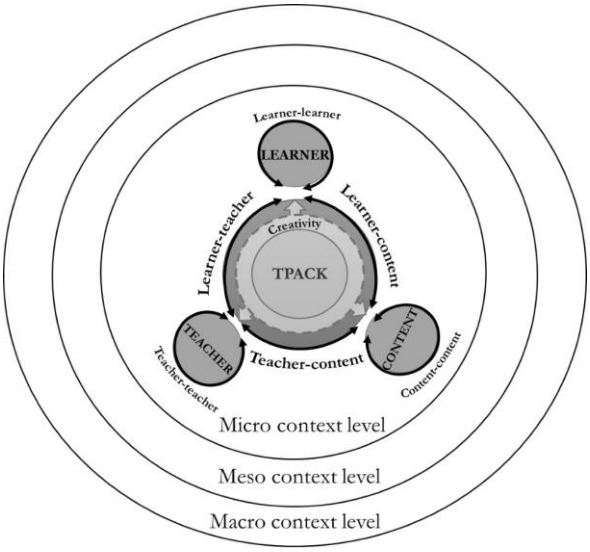

Figure 1: Proposal for the educational technology integration framework

Richards (2007) argued that interaction design in context is the missing link needed to harness new learning technologies more effectively in educational practices. We see that the viewpoint of interaction provides clarity on the actors' domain by highlighting their in-depth relationship to their educational objective. How the teacher frames educational objectives and students' interactions with educational technologies at the micro level affects students' learning. Thus, knowledge building takes place in a learning environment where the behaviors of students, teachers, and technologies interact to provide learning opportunities (Webb 2013).

Meso and Macro Context Level

Our proposal considers the contextual parameters of meso and macro levels, which can influence teachers' professional development and decisions on how they integrate technology (Cheah et al. 2018). For instance, macro level cultural, societal, and technological changes affect the meso level content and context of teaching and learning (Wei & So, 2012). Change is reflected in national policies and curriculum reforms. Education providers, in turn, create local level curricula based on national level policies and curriculum. Also, the current economic situation is reflected in the meso level parameters. Meso level parameters include technology tools and resources, technology training alongside administrative support (Francom, 2016; Ruggiero & Mong, 2015).

Niemi et al. (2012) identified six meso level characteristics of successful technology integration: strategic planning as part of school culture, leadership and management, communication, flexible curricula, methods that facilitate participation and empowerment, and the teaching staff's capacity and commitment. Thus, if the school culture and vision are anti-technology and no technologies are available, teachers' opportunities to integrate technologies into teaching and learning are insufficient (Burke et al., 2018). Continuous professional development

may give teachers the support they need to promote the mastery of skills, along with changing teachers' beliefs regarding technology and pedagogy (Ryan & Bagley, 2015). Professional development efforts should focus particularly on strategies to facilitate changes in teachers' attitudes and beliefs, since those key areas are required when introducing technology at the meso level (i.e., school culture) and developing a sustainable practice (Ertmer et al., 2012). When teachers' comfort and professional competence are relatively high and teachers are working together, they might begin to reimagine and refresh their pedagogy and design new, creative, learner-centered ways to utilize technology (Erbes et al., 2016; Shear et al., 2011). Therefore, it is recommended that professional development programs for teachers should be related to their pedagogical context, include collaboration, be customized for teachers' needs and interests, and stimulate reflective learning (Uerz et al., 2018). Proper technology infrastructure also enhances meaningful integration. Therefore, the technology infrastructure should be robust and capable of supporting new learner-centered educational methods.

Given that the proposed framework is an educational technology integration framework that views technology integration in an educational context, the framework does not consider the exo and chrono context levels. Inasmuch as we recognize that these levels are important and they contribute to shaping learner development over time (especially in informal learning environments), our focus is on shaping the meaningful interactions that occur between the main actors within their immediate learning context of the micro level.

TPACK and Creativity

TPACK is the core of our approach. TPACK can be understood as a teacher's specialized brand of knowledge (i.e., a blend of TK, PK, and CK). Teaching future skills by utilizing new and evolving technologies requires a variety of skills and knowledge that are different from what most teachers understand (Makoe 2012; Redecker & Punie, 2017). Avidov-Ungar et al. (2018), for instance, noted that teachers with both high PK and high TK were able to apply innovative pedagogy in the classroom in a manner that implements innovation, indicating that effective practices using technology requires various types of knowledge. Shulman (1987) argued that the knowledge base for teaching is neither fixed or final, and that the knowledge base remains to be discovered, invented, and refined. Accordingly, we have simplified this knowledge base. We see that TPACK includes knowledge of how to integrate technology in meaningful ways to promote learning and interactions at the micro context level. Teachers choose the appropriate pedagogical and technological tools and adapt them for their student population (Avidov-Ungar et al., 2018). Hence, TPACK culminates in classroom interactions (learner-content, learner-teacher, and teacher-content). We also see that in some forms, TPACK could be applied to the student. Students also need TK and CK. If PK is understood as learning strategies that students apply before and during their learning process, then TPACK is applicable for students as well. Moreover, TPACK does not exclude the fact that the learner is at the center of the learning. At the same time, TPACK also accentuates that technology use in the classroom requires a balance between the curriculum, the students' needs, and human-technology interactions: in other words, knowledge of practical teaching with technology (i.e., a blend of TK, PK, and CK). Therefore, TPACK forms the core of our approach.

Tsai and Chai (2012) emphasized that design thinking can resolve some technology integration issues and create what is desired. In line with Mishra and Henriksen (2018), we see the importance of creativity in repurposing technology tools to make the tools fit pedagogical and discipline-specific learning goals and classroom interactions. Differing resources, the needs of learners, the rapid changes in technologies, and the shifting expectations of society make it impossible to prescribe educational experiences that will be suitable for all circumstances (Albion & Tondeur, 2018). Consequently, teachers need creativity to be able to adapt methods and experiment with new tools. Consider, for example, the interactive whiteboard as an educational tool. The whiteboard is usually placed in the front of the classroom and is therefore usually under the control of the teacher: in other words, framing the nature of student-teacher interaction (Harris et al., 2009). However, if framed differently, an interactive whiteboard can provide opportunities for innovative and active participation from students, either one at a time or in a group activity with several students. Thus, educational technologies such as whiteboards or mobile devices in general can be employed in a wide variety of ways to enhance learning in both formal and informal education. It is essential to select technologies that support meaningful learning experiences. The educational technology itself usually does not determine the way in which it is used and applied to support teaching or learning (Passey 2014). Therefore, purposeful pedagogical design is important. Our proposed framework is pedagogically flexible leaving room for teacher's creativity.

Classroom Interactions

In this framework, we see educational interactions as a multifaceted, context-bound, and process-oriented concept that depends on the learning environment, contextual factors, and the actors involved in the process. The combination and impact of these multifaceted interactions on teaching and learning objectives are tangible, especially within the spectrum of the micro level of the classroom or learning environment. In these interactions, learners participate and interact with other people, information, and systems across diverse learning environments (Koole 2009). Through their interaction with learners, teachers stimulate learners' interest and help students utilize and understand course content (Illeris, 2009; Lonn et al., 2011; Moore, 1989). Hence, we see that the learner's cognitive abilities, memory, prior knowledge, emotions, and motivations play a key role in the learning process (Koole 2009) and that the teacher can, for example, facilitate the student's active, partly self-regulated, sharing of thoughts by asking open-ended questions that allow more students to share thoughts and provide opportunities for reflection (Muhonen et al. 2016). The teachers also have a key role in providing triggers for interaction in collaborative settings (Dukuzumuremyi & Siklander, 2018). The technological tool can enhance this process by providing access to content and information in multiple formats and enabling communication and collaboration among individuals and systems (Koole, 2009). Hence, we see that the orchestration of tools, contents, and methods, along with the constant adaptation to the reality of students and the class dynamic, is an ongoing and collaborative process (Pedro et al., 2018).

Conclusion

In this paper, we have shown various barriers to technology integration that previous researchers have noted, and that the TPACK framework continues to offer a stable foundation for studies of teachers' competence and learner-centeredness in a technology-driven era. Furthermore, we have shown that adding the perspectives of context and interaction can contribute to the enhancement of the TPACK framework's usefulness for bringing change and innovation to educational practices.

Implications and Recommendations for Meso and Macro Context Level

Educational technology integration is much more than simply throwing technology at the classroom and waiting for magic to happen. We suggest the following:

All stakeholders (e.g., ministries and government agencies, curriculum designers, school leaders, technical support personnel, teachers, and students) should work together to improve the practice of technology integration. Thus, educational technology integration should never be a top-down decision, for the reason that such an approach can result in feelings of anxiety and resistance among teachers. Rather, developing common visions and strategies about the role of technology in education with all stakeholders within micro, meso, and macro level contexts is practical. Thus, technology integration should consider the needs of all those who will be involved. At best, this kind of strategy and vision can ensure that resources, such as finances and time, are spent more efficiently.

Without holistic improvements in support (e.g., technical and pedagogical support, availability of infrastructure, policies, time allocated to incorporate new technologies) and training, teachers might struggle to use technologies in the classroom. Therefore, teachers need resources and opportunities to collaborate, experience, and critically reflect on the educational value of technologies at the micro context level. They need examples and hands-on experiences of the usefulness of technology in teaching. Therefore, it is important to develop teacher education curricula. Thus, rather than focusing only on general technology skills development, all three areas—technological, pedagogical, and content knowledge—become strengthened when considering principles of interaction and micro context level factors.

Implications and Recommendations for Micro Context Level

Since the teachers have a certain degree of autonomy to choose the technology that matches their pedagogical needs, the teachers have a key role in bringing change to educational practices. Therefore, we suggest the following:

Teachers at the micro level of the classroom should consider how and for which lessons technology will be used, how it will enhance teaching and learning, and how it will help to achieve learning goals. It is important to pay attention to the processes of social interaction and cooperation, using these processes to structure learning activities

around content and contexts as well as learners' needs and preferences to empower students and promote new ways of working and interacting. Hence, teachers need to be open-minded, critical, and creative thinkers and designers, as well as lifelong learners.

Both the teachers and students need TPACK to be able to work effectively with technology in the classroom. CK and TK are essential to the understanding of, and participation in, education. For students, PK can be understood as learning strategies that students apply before and during their learning process. Teachers know their students' learning styles and needs, and therefore can select and adapt their strategies and methods to accommodate different learning styles and help each student achieve their full potential.

Limitations and Future Research

Our conceptual framework values the micro level context in which teachers exploit different domains of knowledge to frame educational interactions. We argue that continuous interplay between teachers' knowledge and their environment can explain technology adoption and its influence on teaching practices and interactions. Since our framework is a conceptual framework, much remains to be accomplished from an empirical point of view. We recognize that unless a conceptual framework is tested empirically, it may be inadequate for application in practice, representing only a limited, subjective perspective. However, keeping this limitation in mind, our conceptual framework contributes to the body of knowledge in the discipline as it provides an understanding of the role of TPACK and multifaceted interactions in technology integration, especially at the micro context level that is characterized in teaching and learning practices.

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