The relationship between ICT teachers' professional development and TPACK framework for the process of teaching and learning

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Abstract

It has been argued that the role of teachers is central to effective ICT integration in the classroom. So, teachers' professional development is a key element if the successful implementation of ICT in the teachers and learning process to success. However, merely being ICT skilled does not mean effective integration of ICT will take place, rather, if ICT is to enhance and improve learning, integration of ICT requires a close link to pedagogical and content related aspects that teachers must have knowledge about alongside their ICT knowledge. To illustrate this, this paper will discuss the TPACK framework as a useful ICT model for teachers. This paper concludes that if teachers adopt the knowledge suggested in the TPACK framework together with being professional developed, ICT can be integrated into the process of teaching and learning and potentially improve the process of teachers and learning.

Introduction

It has been argued that simply providing ICT resources or acquiring ICT skills does not mean ICT will be integrated into the process of teaching and learning. Since ICT integration requires teachers to employ ICT to enhance the process of teaching and learning, this requires knowledge of how to use it effectively. TPACK framework consists of different types of knowledge, which are integrated as guidance for teachers and their professional development programmes. This article will highlight the relationship between teachers' professional development and TPACK framework.

Literature review

When relevant research concern areas issues such as ICT and its role in learning, ICT policy and change in education, and teachers' ICT practices in classroom, this paper is to focus on teachers and their development as the key factor for effective ICT integration in classroom. This is because ICT in itself will do nothing and requires the intervention of teachers as the key operators for ICT integration in the teaching and learning process (Celik & Yesilyurt, 2013; Tezci, 2009; Cennamo et al. 2010). This article is to consider how teachers should adopt TPACK framework to ensure the best practices in the teachers and learning process. However, The TPACK framework also guides the use of appropriate programmes for teachers' professional development to help them effectively

integrate ICT (Schmidt et al. 2009). So, the next section will discuss teachers' professional development before moving to TPACK framework.

Teachers' professional development

John & Sutherland (2005) set a number of conditions for teachers in order for the pedagogical change to occur. They require teachers to be aware of and understand the importance of linking together the content of teaching, the learning aspect, and the ICT that will be employed. Furthermore, Preston, et al. (2000) highlight other conditions that teachers need to meet in order for ICT to be used appropriately. The first one relates to the importance of teachers having a positive belief toward the effective achievement of the learning objectives when using ICT. For teachers to use ICT for both teaching and learning purposes, the second requirement is related to the necessity of teachers' ability and skills of ICT use, and of accessibility to ICT resources. However, all of these conditions require the necessary intervention from policy makers and any related educational bodies for capable and successful teachers in the teaching and learning process. In their *ICTs in schools* chapter in *The Global Information Technology Report 201*5 Behar & Mishra (2015, p. 73) conclude that "*Our best hope of improving the educational outcomes our children achieve—wherever in the world they may live—lies in improving the capacity of their teachers. The priority for policymakers, therefore, should be to look for solutions that will develop higher capacity teachers. This is true for both those who are just starting out in the profession and those who are already teaching*."

According to Roblyer (2006) the use of ICT can be significant in facilitating pedagogy, not only facilitating the teaching process but also in the learning process, including students' achievement if ICT is integrated into the curriculum. According to research such as (Fitzallen, 2004; Preston, 2004) as students' learning and achievement should be always placed as the highest goals in education, teachers' development in terms of their subject understanding, skills, and knowledge of pedagogy must be met in this regard. Based on the above-mentioned, research in this field such as Fitzallen (2004) and Angeli & Valanides (2009) stresses the need for more professional development in how teachers effectively integrate ICT into the whole process of teaching and learning. In professional development programmes in this area, it is essential that teachers acquire appropriate kinds of knowledge that help them learn how to integrate ICT in order to facilitate learning in a meaningful way (Ertmer & Ottenbreit-Leftwich, 2010). For example, their knowledge in ICT, pedagogy and content must improve in order for them to be aware of how to integrate the best resources they will need to teach their subjects. Cennamo et al. (2010) emphasise that teachers are required to have appropriate knowledge concerning teaching the right ICT for the specific content they teach, involving students in the integration process by using ICT for learning processes, and employing particular ICT through the use of effective teaching strategies that facilitate students' learning. This issue is presented later in more detail in the TPACK framework.

Teachers need to have the skills of deep thinking and deciding what ICT they will use, why and how (Wang, 2008). Wang illustrates this through providing examples such as deciding which tools would be the most appropriate for the objectives of learning, making any required changes and modification on the available resources. The author further suggests that the learning environment enables the engagement of particular learners in the classroom session and/or the existence of teaching and learning methods such as the learner-centred approach. This means that the availability of ICT resources and related resources cannot lead to correct ICT use if teachers lack the ability of the aforementioned requirements.

A report by UNESCO (2009) claims that the expectation of ICT use was its facilitation for learning to be more productive; however, research prior to this report did not show positive results to this expectation. Teachers were found in the Tanzanian study conducted by Mwalongo (2011) to be widely using ICT in their teaching, and their approach of teaching still remained central. However, the use of ICT could make teachers less central (UNESCO, 2002), as students can have the opportunity to work more collaboratively and independently through the use of ICT. Watson's (2001) concern about the most important aspect in education is learning, arguing that the lack of use of ICT in pedagogical aspects is significantly affecting the learning side. The issue here is not about a teacher's knowledge and use of ICT, but rather their knowledge regarding pedagogy. In other words, even if they have strong ICT skills but lack knowledge in their teaching methods, effective integration of ICT cannot happen. This is particularly the case when recognising that most students in the present are fairly ICT knowledgeable as they can access worldwide information and construct their own knowledge.

Hasselbring et al. (2000) argue that the professional development of teachers is more necessary than the availability of ICT resources. For example, regarding the *Enlaces* education ICT programme, although extensive efforts have been made in order to enable teachers to use ICT effectively in their classroom, research reveals ICT for teaching and learning has still been disappointing (Hinostroza et al., 2011; Sanchez & Salinas, 2008). Another example is from Saudi Arabia, where the project of King Abdullah for education development was expected to create a huge change in education, including ICT integration in the process of teaching and learning. However, despite the massive budget and the laptops per student and laptops per teacher, research has revealed the failure of initiatives related to ICT. Some related programmes have been cancelled such as the one laptop per student policy as devices were returned to the Ministry. Researchers such as Tezci (2009) and Albirini (2006) justify this by arguing that the physical provision of ICT in classrooms without teachers' intervention will add no value to the teaching and learning process. It is noteworthy to argue that being equipped does not mean one will be able to use ICT effectively in the process of teaching and learning.

Literature such as the studies of Dogan (2010) and Blackmore et al. (2003) shows that for the success of ICT in education, teachers need to undertake training in ICT to assure their appropriate use for the teaching and learning process. In the Saudi context, Al-Asmari (2008) and AlMulhim

(2014) argue that although teachers are required to integrate ICT into their teaching and learning, and despite different reforms in the education system in this regard, teacher training is poor. Most Saudi teachers require professional training in pedagogy and skills both prior to and in-service (Mansour et al., 2011, cited in Al-Madani & Allafiajiy, 2014).

However, teachers' training courses must not only focus on ICT skills, as it is taught in most universities, but also on how to effectively use ICT in the educational process (Almosa, 2002). According to Ragsdale (1991, cited in Watson, 2001, p. 255) "*knowledge of ICT skills do not mean these skills are always applied. Indeed, acquiring ICT tool skills may be relatively easy but gaining wisdom to use them effectively is not.*" This can be illustrated by Figg & Kamini (2011), who reveal that ICT basic skills are not enough to benefit from when using ICT in pedagogical practice, which means teachers are required to have the ICT skills that relate to pedagogy as well. Teachers also need to understand what, why, and how ICT can be used in their classroom for their teaching and learning processes (Morrisa, 2011).

In addition, research emphasises the need for ICT training programmes during teacher education courses to make them well-prepared to integrate ICT in practice in the future. For example, Koehler & Mishra (2009) and Jaiya (2015) stress on the significance of such courses if students teachers to effectively employ ICT in their future classrooms; and ICT training may include not only knowledge about ICT but also knowledge about the content of the subject they will teach the methods they will employ in their teaching. Training during teacher education, whether in the university before they graduate or in the special programmes before they are appointed as teachers, is a very significant start for them using ICT in their teaching. They can start their careers with confidence and skills to practice the new, effective, and innovative methods of teaching and learning through benefiting from the advantages that ICT can offer them (Kay & Mellar, 1994).

Regarding any type of training and professional development for teachers' ICT integration, the review of literature about teachers and ICT in education conducted by Cox et al. (2003) seems very useful especially in relation to the TPACK framework, which will be presented following this section. The review revealed there is evidence of the necessity of teachers' professional development in order for them to effectively integrate ICT into the process of teaching and learning and consequently improve the attainment of their students. Most teachers, even those who are regarded as more innovative, need to have extensive knowledge, confidence, and awareness of the effectiveness of ICT in education. Therefore, based on their review, they list a number techniques needed in teachers' training in order for teachers to effectively integrate ICT in the process of teaching and learning. They include teachers' need to: be able to refer to their expertise in the subject they teach and choose the relevant ICT resources; be familiar with the advantages of ICT for learning, have confidence through using different ICT resources; be aware of the different ways of teaching and learning when ICT is used; have knowledge of how ICT will help students' deep thinking and understanding when preparing their lesson; and have knowledge of which appropriate pedagogy they will use. These aspects are very crucial as they embody the kinds of knowledge

(technology, pedagogy and content) that are presented in the TPACK framework in the following section.

In their review of literature on ICT professional development, Daly et al. (2009) extracted a number of contributing factors for teachers' effective ICT use: supporting teachers' pedagogical needs differently, as the way they learn and their learning needs are different; allowing teachers to learn and interact with others as well as to access learning resources; supporting teachers whose needs are large through offering monitoring and feedback; supporting teachers in their subject needs and pedagogy; and monitoring what they do in the classroom, which can be helpful in creating more confident and skilful teachers.

Both reviews of Cox et al. (2003) and Daly et al. (2009) set a number of conditions that need consideration in teachers' professional development training in order to help them effectively integrate ICT in the educational process. However, the study by Cox et al. (2003) concerns the types of knowledge teachers have to acquire; while Daly et al. (2009) considers offering extra support to teachers with greater needs in terms of the types of knowledge they need for ICT to make an effective change in the process of teaching and learning. Therefore, policy makers need to take all of this into careful consideration in order to make sure that all teachers and their needs are equally treated, which in turn can reflect on teachers' effective integration of ICT in their classrooms, in turn improving the quality of education.

Since teachers may use ICT in schools through two main categories. ICT as a tool, referring to those teachers who use ICT for their teaching preparation, presentation or administrative tasks rather than an integral part of their teaching and learning; and ICT as a method, which refers to ICT integration. If, however, teachers decide to use ICT as a method, teachers will need an understanding of the way towards effective ICT integration in their teaching and learning process. Therefore, the following section will present the TPACK framework with the intention of helping teachers to integrate ICT in their teaching and learning more effectively.

TPACK framework and discussion:

It has been argued that the role of teachers is central to effective ICT integration in the classroom. However, merely being ICT skilled does not mean effective integration of ICT will take place, rather, if ICT is to enhance and improve learning, integration of ICT requires a close link to pedagogical and content related aspects that teachers must have knowledge about alongside their ICT knowledge. To illustrate this, the TPACK framework will be presented below as a useful ICT model for teachers, because if teachers have this knowledge, ICT can be integrated into the process of teaching and learning and potentially improve students' learning.

Thus, if ICT is to make effective change in the classroom for both teaching and learning, teachers are required to acquire appropriate knowledge as one of the central requirements for effective ICT integration (Mishra & Koehler, 2006; Koehler et al., 2011). The following model will present a framework for teachers, which shows the required knowledge to effectively integrate ICT in the educational process.

Background:

The roots of the TPACK framework go back to Shulman's framework of pedagogical content knowledge (PCK) in 1986 and 1987, which considers the necessity of combining two categories of knowledge for teachers in their teaching practice: what teachers know about their subject (content knowledge); and how they teach the content of their subjects, including methods and strategies of teaching (pedagogical knowledge). As they are blended together this forms an integrated knowledge (pedagogical content knowledge) which teachers can use to actively engage students and relate the subject matters to the way they teach (Koehler & Mishra, 2005; Shulman, 1987). In 2005, Koehler & Mishra built their framework on the PCK framework and extended this by including technology knowledge to form the TPCK framework, as it was previously called. This was a way of understanding the teachers' knowledge regarding effective teaching with the use of technology (Koehler & Mishra, 2005, 2009). The TPACK abbreviation was initially named TPCK but then renamed to TPACK because it is believed to be simpler to remember and, more significantly, it is thought that the three domains of knowledge (technology, pedagogy and content) should not be isolated and instead should form a more 'integrated whole'. This encourages teachers to benefit from the advantages of technology to develop learning (Thompson & Mishra, 2007).

Definition and assumption:

The TPACK framework refers to the intersection of multiple kinds of knowledge that teachers need to have for their teaching practices when using technology (Mishra & Koehler, 2006). This framework is based on the idea that simply providing technology in classrooms is not enough, as teaching is a complex activity and requires different kinds of knowledge for effective ICT integration in teaching and learning (Mishra & Koehler, 2006). The assumption of the TPACK framework is that effective ICT use for the educational process is associated with teachers' high level of TPACK. This is not to say there are no other factors influencing their teaching practices with the use of ICT, but this interrelated factor is fundamental when ICT is used in teaching. Nevertheless, the TPACK framework acknowledges the multiple contextual factors affecting teachers' ICT use.

TPACK's kind of knowledge:

According to Mishra and Koehler (2006; 2009), there are three main kinds of knowledge in the TPACK framework that more effective teachers use. 1. Content knowledge (CK): what teachers know; 2. Pedagogical knowledge (PK): how teachers teach; and Technological knowledge (TK): how technologies are used. These will be briefly presented as follows:

1. ***Content knowledge (CK):***

This refers to teachers' knowledge regarding the subject they teach.

If the teacher fails to have the CK, they must gain that knowledge by understanding their overall subject content related aspects in order for teaching and learning to be effective.

2. ***Pedagogical Knowledge (PK):***

This refers to teachers' extensive knowledge about their teaching experiences, i.e. their teaching processes and approaches or strategies.

Teachers with deep pedagogical knowledge can understand how learners think and learn and construct their knowledge, know the appropriate way of teaching so that learners learn optimally, and choose the appropriate strategies for learning evaluation.

3. ***Technological knowledge (TK):***

This is the knowledge that teachers need to have to know how to use technology in the classroom and to decide which technology is appropriate for learning.

According to Mishra & Koehler (2006), the above three kinds of knowledge are key requirements for effective teaching. However, what is essential here is the need for teachers' understanding of how these three kinds of knowledge are integrated for effective teaching with ICT. So, based on the TPACK framework, when these three types of knowledge mentioned above are combined or intersected, they will form three further integrated kinds of knowledge:

A. ***Pedagogical Content Knowledge (PCK***):

This kind of knowledge refers to the knowledge of how to teach the content of a particular subject.

B. Technological Pedagogical Knowledge (TPK):

It refers to how to employ technology in the teaching and learning process.

C. Technological Content Knowledge (TCK):

This refers to the knowledge of how to use technology to explore the content of the subject.

When all three components of knowledge intersect, this will form the basis of the Technological Pedagogical and Content Knowledge Framework (TPACK): This refers to knowledge teachers need to have to teach a specific content while employing appropriate approaches of pedagogies and technologies. Here, teachers should be able to choose the appropriate ICT and teaching strategies that suit the taught content.

The framework assumes that teachers acquiring TPACK related knowledge can integrate ICT more effectively than those who fail to develop these types of knowledge. The TPACK framework also guides the use of appropriate programmes for teachers' professional development to help them effectively integrate ICT (Schmidt et al. 2009). According to Koehler et al. (2011) and González-Sanmamed et al. (2017), the TPACK model is commonly recognised in professional development-ICT-related programmes, in teacher education programmes, and universities courses.

It should be mentioned that focusing on a particular kind of knowledge and excluding another leads to professional development programmes with one dominant knowledge. This encouraged Shulman to propose his PCK framework as different kinds of knowledge are integrated altogether (Mishra & Koehler, 2006). Therefore, as TPACK is built on the PCK framework, while the focus in professional development for teachers in terms of ICT must be on the development of these forms of knowledge, they must not be limited to technology knowledge (Mishra & Koehler, 2006). According to Mishra & Koehler, teachers are no longer required to simply learn how to use technologies but rather need to develop their technology knowledge and skills alongside relating that to appropriate knowledge in pedagogy and their subject.

Supporting and encouraging teachers towards effective ICT integration does not imply teachers are required to know what the TPACK framework is, but rather refers to teachers understanding how to shape their teaching in a way which integrates the three main kinds of knowledge (Voogt & McKenney, 2017).

It should be noted that the framework has been criticised in a number of aspects. For example, referring to several studies examining the model, Graham (2011) argues that the TPACK framework is theoretically unclear. However, Koehler et al. (2011) claim that there has been a misconception in research about the framework in describing modem technologies that focus only on TPACK, and that technologies in TPACK actually imply both digital and old technology, while the goal of TPACK is not only related to technology, but also includes content and pedagogy.

Another criticism by Graham (2011) is that the TPACK framework fails to separate categories and this makes it difficult to study them. For Mishra and Koehler (2006), dealing with the TPACK's categories of knowledge could result in centrality of one category over another.

Graham (2011) also argues that the framework lacks clarity in defining its concepts. However, based on different research, the definitions are almost similar, for example, Tozkoparan & Kılıç (2015) summarise the TPACK's concepts from a number of studies and found similarities between them.

To conclude, this framework is an important consideration because that fact that simply providing ICT resources or acquiring ICT skills does not mean ICT will be integrated into the process of teaching and learning. Since ICT integration requires teachers to employ ICT to enhance the process of teaching and learning, this requires knowledge of how to use it effectively. As mentioned before, this knowledge in TPACK consists of different types of knowledge, which are integrated as guidance for teachers and their professional development programmes. This intersection of knowledge types here is crucial for education authorities to consider in their educational and ICT strategic planning, which should reflect on the nature and implementation of teachers' professional development training programmes to help teachers to integrate ICT effectively. This is especially important when considering students today who are likely to engage with ICT more readily than the content of the subject of study or with the pedagogy that their teachers follow, but when ICT is integrated into that content and pedagogy, students' learning should be enhanced. It is also important to mention that teachers need to be ready for different pedagogies. This means employing the only pedagogy that is thought to improve students learning. It is the same case with the use of ICT - it should not be used if it will not make learning better. Therefore, in TPACK, teachers will have the opportunities to understand and decide if that pedagogy or particular ICT is worth employing in the classroom.

When teachers acquire and employ this integrated knowledge, the learning and quality of education can be improved which means achieving the broad purposes of education too. However, in order to make teachers' professional development programmes effective and successful, and to acquire TPACK, it is essential to determine and overcome any obstacles hindering actual ICT use in the classroom for educational processes (Ertmer et al., 2012).

Conclusion

If ICT is to make effective change in the classroom for both teaching and learning, teachers are required to acquire appropriate knowledge as one of the central requirements for effective ICT integration (Mishra & Koehler, 2006; Koehler et al., 2011). That is why the TPACK framework assumes that teachers acquiring TPACK related knowledge can integrate ICT more effectively than those who fail to develop these types of knowledge. The TPACK framework also guides the use of

appropriate programmes for teachers' professional development to help them effectively integrate ICT (Schmidt et al. 2009). However, it is should argued that supporting and encouraging teachers towards effective ICT integration does not imply teachers are required to know what the TPACK framework is, but rather refers to teachers understanding how to shape their teaching in a way which integrates the three main kinds of knowledge (Voogt & McKenney, 2017).

To conclude, when teachers acquire and employ integrated knowledge developed in TPACK framework, the quality of teaching and learning process be improved. However, in order to make teachers' professional development programmes effective and successful, and to acquire TPACK, it is essential to determine and overcome any obstacles hindering actual ICT use in the classroom for educational processes (Ertmer et al., 2012). Therefore, future research should investigate that.

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