Towards Successful Implementatıon of ICT in Educatıon: A review of the Literature

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Abstract

With the advent of ICT, many countries have incorporated more technological tools in their educational system. Some research has suggested that using ICT in instruction enables students to take a more active role in their learning rather than their more traditional role of passive observer and listener. However, other research shows that changes in classroom practices will not occur simply because ICT is more available in the classroom unless it is used effectively. Facilitating the proper access to ICT resources in classrooms is only one step in the process. Thus, calls have been made to pay more attention to the way ICT has been implemented and how to achieve effective ICT implementation. This paper focuses on the issues educators may need to consider when pursuing effective implementation of ICT in education. It reviews relevant literature about the successful use of ICT, articulating the barriers and the requirements to the effective use of ICT. The findings indicate that ICT implementation should begin with the identification of an educational problem and deciding what students, teachers or schools want to achieve, not with the provision of technology. Effective ICT implementation requires using ICTs as knowledge construction tools rather than instructional tools. Furthermore, ICT becomes significant when its use is linked to teachers" visions and levels of knowledge.

Key words: ICT, education, knowledge, high school teachers, TPACK, ICT implementation, mixed methods, Saudi Arabia.

INTRODUCTION

One of the most vital parts of any society, education, has integrated ICT into teaching many subjects. There are many benefits of using ICT in education. For example, research has suggested that using ICT in education enables students to take a more active role in their learning rather than be a passive observer or listener (Balanskat, Blamire, & Kefala, 2006; Cradler & Bridgforth, 2002; Gao & Hargis, 2010; Saleh, 2008). ICT is also perceived to have many advantages in education including: pursuing problem-solving skills, fostering collaborative learning, providing flexible learning opportunities and increasing productivity (Bitter & Legacy, 2008; Chambers, 2011; Hatt, 2007). Furthermore, ICT is considered important for improving the effectiveness of teaching and learning in schools (Lin, Wang, & Lin, 2012).

Consequently, with the potential that it offers, ICT has become an important part of educational reform efforts. Many countries have allocated substantial budgets for ICT implementation in education. Since the late 1990s, many governments have developed strategic plans to increase their investments in ICT in their education systems (Pelgrum, 2001). In 2011, The Organisation for Economic Cooperation and Development (OECD) found that many governments are making sizeable investments in ICT. For example, the Australian government estimated that about AUD$8 billion was invested in ICT in education in 2008 (Lane, 2012). In 2006, the United States Department of Education reported spending more than USD$9.5 billion for educational technology in public schools (Brunk, 2008). Like Australia and the United States, Saudi Arabia has also made substantial investments in educational technology. King Abdullah's Public Education Development Project (Tatweer) which was seeking to equip classrooms with ICT equipment including laptop computers, projectors, and interactive whiteboards, was launched with a budget of SAR 9 billion over a six-year period (Ministry of Education, 2007). The importance and benefits of ICT has also been recognised by many European countries. Within the last decade, many school subjects have seen the implementation of ICT into the educational process (Balcon, 2003).

With these considerable investments in ICT for education, it is worthwhile to question the status of the educational implementation of ICT in schools. To what extent have teachers integrated ICT effectively into their classroom practices? Does the reality on the ground match the expectations? A review of the literature found that not all studies indicate the positive impact of using ICT. Several found either "no effect" or a negative impact of ICT on education

(Cuban, Kirkpatrick, & Peck, 2001; Ungerleider & Burns, 2003; Waxman, Lin, & Michko, 2003; Wozney, Venkatesh, & Abrami, 2006).

A study by Cuban, Kirkpatrick and Peck (2001) investigated the relationship between access to and use of computers in teaching and learning. Findings were that increased access to computers did not lead to a higher frequency of use in teaching. When computers and related resources were used, they were used to maintain, instead of transform, existing educational practices. Similarly, Wozney, Venkatesh and Abrami (2006) investigated computer technology practices among 764 teachers from both private and public school sectors in Quebec. The authors reported that the frequency of computer use among teachers in their study was limited. Only a small percentage of teachers reporting extensive use of computers, despite increased availability.

Investigating whether access to ICT in schools improves educational outcomes has also been questioned in a number of meta-analyses. For example, Ungerleider and Burns (2003) conducted a meta-analysis of Canadian studies. The results indicated that there was little evidence of the effectiveness of e-learning in promoting academic achievement and motivation, or on facilitating instruction. The authors asserted that having access to computers in the classroom does not necessarily improve academic achievement (Ungerleider & Burns, 2003). In the case of the USA, Waxman, Lin and Michko (2003) evaluated American studies from 1997 to 2003 with a sample size of about 7000 students. The aim was to study the effect of teaching and learning with ICT on the students' academic achievement. This meta-analysis reported that teaching and learning with ICT had little positive impact on students' academic achievements when compared to traditional education (Waxman, et al., 2003).

Clearly, although ICT has the potential to significantly enhance education, that potential is not being realised in practice. It seems that in order to justify continuity of investment in ICT in education, ways needs to be found to increase ICT use effectiveness. This paper discusses a number of issues related to the successful implementation of ICT in education including: why teachers integrate technology; how ICT implementation could be effective; what the requirements are to achieve effective ICT implementation; and the importance of teachers in the implementation process. Each of these issues will be discussed in the following subsections.

Rationale for ICT implementation

Trend, Davis and Loveless (1999) described this issue of the lack of an effect of ICT or a negative impact of ICT use as a *reality-rhetoric gap*. This refers to the difference between the claims made for ICT and its actual impact on education (Condie & Munro, 2007; Twining, 2008). Vallance, Vallance and Matsui (2009) commented on this issue by stating that educational reforms that promote ICT use often lack a solid rationale for the adoption of ICT. In other words, despite the efforts of teachers to use ICT in their teaching, teachers lack direction about how ICT might best be integrated into school and classroom practices. This view is supported by Avriam (2000) who indicated that "the introduction of ICT into education has often been carried out with vague and confused conceptions of the desired model of learning which the new technologies were supposed to enhance and without clear conceptions of any guiding educational values" (p. 332).

Some research (Department for Education and Skills, 2004; Moyle, 2006; Twining, 2007) mentioned what known as "shared vision" about the role ICT should play in education. For instance, *Discussing ICT, aspirations and targets for education project* (dICTatEd, 2007) is an international project that examined ways of enhancing the impact of investments in educational ICT. The dICTatEd project (2007) argues that one of the underpinning reasons for this "reality-rhetoric gap" seems to be a lack of shared understandings (visions) within the education community (including among policy makers, researchers and practitioners) about why we are using ICT in education. Through conducting a literature review and analyses of over 9,000 responses to the dICTatEd online questionnaire from respondents in 94 countries, the dICTatEd project identified 19 rationales given for the use of ICT in education grouped in three main categories. These categories are (1) supporting students' learning, (2) improving technological literacy, and (3) improving productivity (Twining, 2007). These three main rationales are supported by other research literature (DEST, 2002; Moyle, 2006; Newhouse, 2002).

Moyle (2006) asserted that:

> ..before any school or school system can have effective policies and practices to incorporate [ICT] to support learning and teaching, the school must have a clear vision of the learning it is aiming to foster and the organisation it is aiming to be (p. 5).

It can be seen that it is important to develop an explicit rationale for using ICT in education (Van Melle, Cimellaro, & Shulha, 2003). Clearly, there is little or no point in equipping schools with more ICT unless such a rationale has been confirmed (Newhouse, 2002).

Aspects of effective ICT implementation

There are a number of significant aspects required for effective implementation of ICT in the classroom. These aspects include: (1) avoiding techno-centric thinking, (2) starting with the identification of educational problems, and (3) promoting constructivist learning environments. The following paragraphs discuss each of these aspects in detail.

The first aspect of effective ICT implementation is that educators should avoid techno-centric thinking. Students' involvement within ICT-rich classroom "does not necessarily correlate with productive learning" (Geisert & Futrell, 2000, p. 10). Without appropriate directions, making ICT available in classrooms does not "in itself" lead to better education (Ministerial Council on Education Employment Training and Youth Affairs, 2005). Changes in classroom practices will not occur simply because ICT is more available in the classrooms. On its own, ICT does not improve education. In other words, the availability of ICT in classrooms might not matter; rather, the significant issue here is how ICT improves the educational process (Bingimlas, 2010).

As shown above, some research suggests that there is no direct link between the use of ICT and a positive impact on student outcomes (Cuban, et al., 2001; Newhouse, 2002; Ungerleider & Burns, 2003; Waxman, et al., 2003; Wozney, et al., 2006), "unless" ICT are used effectively (Becta, 2002). ICT has to be used in an effective way; otherwise, it may be a waste of time (Romeo, 2006). For example, according to Leach and Moon (2000) using computers only for word processing or presentations, does not indicate the "effective" implementation of computers. It is agreed that ICT should not solely be used for replicating existing practices (Leu, Jr., Kinzer, Coiro, & Cammack, 2004; NCTE, 2008; Stolle, 2008). For instance, using digital presentations rather than a chalkboard for presenting notes. Dockstader (1999) argued what is considered to be "not" ICT implementation:

> Implementation is not substituting 30 minutes of reading for 30 minutes of computer skill development. It is, however, using computers to teach 30 minutes of reading. Implementation is not providing application software like electronic encyclopedias, spreadsheets, databases, etc. without a purpose. It is not prepackaged programs that are often unrelated activities clustered around a particular topic that address few higher concepts or goals. Nor is it teacher created programs that cover special interests and/or technical expertise but do not fit content-area curriculum. Defining what technology implementation is and is not is the first step in deciding how to integrate it into the classroom (p. 73).

The second important aspect for effective ICT implementation is that educators should start with the identification of educational problems. The use of ICT to support the educational process should start from "dissatisfaction with the educational opportunities offered to [students] and a striving to do better" (Newhouse, 2002, p. 5). Educators should move from focusing merely on technology itself (or starting from the existence of ICT), and instead be able to do a systematic analysis of educational problems that need to be solved (Van Melle, et al., 2003). For instance, educators should start with asking questions such as, "What are the educational problems facing our students?" and "Do our students need to improve better educational skills?" Then, educators carefully choose ICT paying attention to advantages and limitations in supporting clear, well-defined educational objectives (Collins & Berge, 2000). Collins (2001) suggested that teachers cannot make good use of ICT until they know which ICT is relevant. Furthermore, ICT is less effective when the educational objectives are unclear (Honey, Culp, & Spielvogel, 2005). Honey, Culp, and Spielvogel (2005) agreed that instead of concentrating on ICT use itself, those who successfully implement ICT "show a clear and meaningful connection between technology and larger educational goals" (p. 13).

This argument leads us to the third aspect of effective use of ICT that is promoting constructivist learning environments. There is a growing tendency in the literature to encourage teachers to change from traditional teacher-centred classroom to more student-centred learning or what known as constructivism (Pedersen & Liu, 2003). Constructivists believe that "humans construct all knowledge in their mind by participating in certain experiences, and learning occurs when one constructs both mechanisms for learning and one's own unique version of the knowledge, colored by background, experiences, and aptitudes" (Roblyer & Doering, 2010, p. 35). Constructivism in education involves the process of how students construct knowledge. This depends upon what students already know, which depends on the kinds of experiences that they have had, how they have organised those experiences into knowledge structures, and what they believe about what they know (Jonassen, Carr, & Yueh, 1998). Thus, in Constructivist learning environments, students learn through purposeful activities in which they are active

participants rather than passive receptors of information. In other word, students involve in intentional and student-centred activities that enable the students to engage actively in setting their own goals for learning and determining the resources and process for reaching those goals (Brown, 2004; Pedersen & Liu, 2003).

Effective ICT implementation reflects using ICT as knowledge construction tools rather than instructional tools (Jonassen, et al., 1998). Jonassen, et al. (1998) advocated the use of ICT as *mindtools* to assist students in organising and interpreting what they learn, instead of as instructional tools to present facts and information to them, which allowing students "function as designers", and ICT as cognitive amplification tools "for interpreting and organizing their personal knowledge" (Jonassen, et al., 1998, p. 24). *Mindtools* are computer applications that engage students in critical, higher order thinking about content (Jonassen, 2000; Kirschner, 2006). These tools include databases, semantic networks, spreadsheets, systems modelling tools, intentional information search engines, visualisation tools, multimedia publishing tools, live conversation environments, and computer conferences (Jonassen, 2000; Jonassen, et al., 1998; Kirschner & Erkens, 2006). These applications are only considered as *mindtools* when students use them as cognitive tools to learn. That is, where students are actively involved in constructing their knowledge using the application that facilitates engaging them in and many thinking tasks. Jonassen, et al. (1998) explained:

> For instance, using databases to organize students' understanding of content organization necessarily engages them in analytical reasoning, where creating an expert system rule base requires them to think about the causal relationships between ideas. Students cannot use Mindtools as learning strategies without thinking deeply about what they are studying (p. 24).

Embracing a similar philosophy, the Australian Curriculum proposed that using ICT as a tool for learning enables students to:

> a. efficiently and effectively access digital information to assist with investigating issues, solving problems and decision making.
>
> b. produce creative solutions to support learning and develop new understandings in areas of learning.
>
> c. communicate, share and work collaboratively in local and global environments.
>
> d. understand the legal, ethical and health and safety implications of using ICT and their responsibilities as users and developers.
>
> e. develop new thinking and learning skills to support learning.
>
> (Curriculum Corporation, 2006, p. 2)

Thus effective ICT implementation promotes constructivist learning environments where students engage with ICT to facilitate creative and critical thinking involving real world learning.

In summary, avoiding techno-centric thinking, starting with identification of educational problems, and considering constructivist learning, are the most important aspects of the effective use of ICT in education. However, there are numerous and diverse factors affecting the successful implementation of ICT in schools and classrooms. These factors are discussed in the following section.

Requirements for effective ICT implementation

ICT implementation is not a *product*; it is, rather, a *process* (Yalin, Karadeniz, & Sahin, 2007). The success of ICT implementation in education means implementing ICT "effectively and efficiently in all dimensions of the processes" (Yalin, et al., 2007, p. 4036). This includes ensuring that the process requirements are met. In other words, successful ICT implementation requires overcoming the factors that limit the success of these processes. It is emphasised that ICT implementation processes "work best when optimal conditions are in place to support them" (Roblyer & Doering, 2010, p. 33).

The research literature witnesses a growing body of research studies that aim to investigate what prevents the successful implementation of ICT in education (Afshari, Bakar, Luan, Samah, & Fooi, 2009; Baek, Jung, & Kim, 2008; Balanskat, et al., 2006; Becta, 2004; Cox, Cox, & Preston, 2000; Ertmer, Ottenbreit-Leftwich, & York, 2007; Mumtaz, 2000; Tezci, 2011a; Van Braak, 2001). The most common finding is that ICT implementation is a complex process and involves a large number of influencing factors. Usually, in the literature, these factors are known, as

"barriers." A barrier can be defined as "any condition that makes it difficult to make progress or to achieve an objective", which is, in this case, the successful implementation of ICT in education (Schoepp, 2005).

There are a variety of ways in which the barriers to successful implementation of ICT have been classified. Some authors classify the barriers to successful implementation of ICT into two categories: first-order (extrinsic) barriers and second-order (intrinsic) barriers. Extrinsic factors relate to organisational support, policy and planning, or access to equipment, while intrinsic barriers refer to more emotional, personal issues related to teachers' beliefs and attitudes towards ICT (Ertmer, Addison, Lane, Ross, & Woods, 1999; Ertmer, et al., 2007). Another way of classifying barriers to successful implementation of ICT is by grouping them according to whether they relate to the individual (teacher-level barriers), or to the institution (school-level barriers). The teacher-level barriers include lack of time, lack of confidence and negative attitudes, whereas, the school-level barriers include lack of access to ICT resources and lack of effective training and technical problems (Becta, 2004). Other studies classify the barriers into three main groups: system-level barriers, school-level barriers and teacher-level barriers (Balanskat, et al., 2006). Finally, Hew and Brush (2007) use six categories classifying barriers according to whether they relate to: resources, institution, attitudes and beliefs, knowledge and skills, assessment, and subject culture (Hew & Brush, 2007).

This review, presented in this paper, will classify the barriers to successful ICT implementation into two main categories: teacher-related factors and non-teacher-related factors. In a review of non-teacher-related factors that impact the effectiveness of ICT implementation in education, the results show that the necessity of adequate infrastructure, policy and planning, support and management are the most frequently cited factors in the literature. The following paragraphs discuss the non-teacher-related factors in details, while the teacher-related factors will be discussed in a following subsection.

Infrastructure

Numerous research studies have indicated that many countries lack adequate hardware, software and network infrastructure. In a study by Korte and Hüsing (2006), the majority of teachers stated that the lack of ICT infrastructure in schools prohibited them from using ICT in their practices. Hew and Brush (2007) conducted a meta-analysis to identify the general barriers affecting the use of computing devices in schools for educational purposes, both in the United States as well as other countries. The examination of 48 studies revealed that a lack of resources was the most frequent barrier mentioned with a percentage of 40% compared to the other categories that ranged from 23% to two percent. According to Hew and Brush (2007), a lack of resources may include the lack of availability of technology in a school as well as the lack of access to this technology. Hew and Brush (2007) commented that "without adequate hardware and software, there is little opportunity for teachers to integrate technology into the curriculum, even in cases where technology is abundant, there is no guarantee that teachers have easy access to those resources" (p. 226).

There are a number of barriers associated with inadequate ICT infrastructure. According to a report by Becta (2004), levels of access to ICT are important in determining levels of use of ICT by educators, but it is not guaranteed that a school with low access means that school does not have enough resources; it may be these resources are inappropriately organised in the school. Similarly, in the report by Balanskat, et al. (2006), the authors emphasised that the accessibility of ICT equipments does not necessarily lead to effective implementation. The lack of high quality hardware and suitable educational software are also considered by the majority of educators to be significant barriers to effective ICT implementation.

In the case of Saudi Arabia, one of the most common barriers to the use of ICT in Saudi Arabian schools is the availability of resources in classrooms (AI-Sharhan, 1994; Al-Alwani, 2005; Alshumaim & Alhassan, 2010; Amaraee, 2003). As early as 1994, Al-Sharhan found that 87% of teachers chose not to use audio-visual aids because they did not have the equipment support. Fifty-seven percent of the study respondents also indicated that they had difficulty in getting the equipment, materials and personnel to the right place at the right time. This determined whether or not they utilised the ICT. Obsolete software and hardware make ICT difficult to integrate (Almusalam, 2001). Insufficient equipment, limited internet access and poor classroom environments (Al-Alwani, 2005) continue to pose challenges to integrating technology.

In addition, teachers and students, have limited or no access to highly technical equipment such as digital microscopes, digital cameras, computer labs, laptop computers, and scanners making it difficult for ICT to be integrated into education (Almaghlouth, 2008). There is a need to provide teachers with the technology, equipment, and support. Furthermore, resources should be organised in such a way to ensure maximum accessibility for all users

(Becta, 2004). Providing access for, and increased availability of technology will promote its implementation into classrooms (Al-Alwani, 2005).

Policy and Planning

Another key factor affecting the successful implementation of ICT in schools is the presence of an educational policy and planning strategy relating to ICT implementation. According to Wozney, et al. (2006), the absence of systematic policy and planning strategies can hinder teachers' efforts to integrate ICT into their educational practices. Cuban, et al. (2001) stated that "the prevailing assumptions guiding policy on new technologies in schools are deeply flawed and in need of re-assessment" (p. 830). There is a need to develop curricular plans and policies to place some structure on the introduction of ICT in education (Albirini, 2004). Hew and Brush (2007) reported that ICT implementation plans assist in the creation of a school culture towards ICT implementation. Balanskat, et al.(2006) indicated that educational policymakers should pay more attention to policies that stimulate teachers to integrate ICT more and more effectively. Balanskat, et al. suggested that such policies should include schemes for incentivising, recognising and rewarding the teachers' use of ICT, for example, making good ICT implementation part of career paths (Balanskat, et al., 2006).

In the case of Saudi Arabia, calls have been made by schools for clear policies and planning for integrating ICT into education articulating the mission statements, goals and objectives. For instance, Al-Oteawi (2002) found that most teachers and administrators who responded to his study reported that there is no planning for current technology in schools. They added that ICT cannot be effectively integrated without the development of a clear ICT policy and plan to facilitate its implementation into education. One administrator commented that "if there is no plan, it is difficult to utilise information technology in schools" (Al-Oteawi, 2002, p. 246).

Some researchers point to the importance of perceptions and visions held by educational leaders and policymakers. For example, Pelgrum and Law (2003) stated that effective implementation of ICT depends on educational leaders' perception and vision towards ICT and school culture. Similarly, Tondeur, Van Keer, Van Braak, and Valcke (2008) emphasised that successful implementation of ICT occurs when a school has a shared vision, develops ICT implementation strategies, and its teachers "share the values expressed within the school policy and understand their implications" (p. 220). Lim and Khine (2006) indicated in their study of four schools that a shared vision and ICT implementation plan provide school educators with an opportunity for communication about how ICT can be used, as well as "a place to start, a goal to attain, and a guide along the way" (p. 119).

Support and Management

Organisational support and management play an important role in ICT implementation. Research conducted in different countries indicated that ICT implementation did not receive sufficient organisational support (Becta, 2004; Pelgrum, 2001; Tezci, 2011b). Teachers need sufficient technical support to help them in using different ICT resources. Providing an inadequate number of technical support services in a school severely limits teachers' technology use (Hew & Brush, 2007). According to Becta's report (2004), "if there is a lack of technical support available in a school, then it is likely that preventative technical maintenance will not be carried out regularly, resulting in a higher risk of technical breakdowns" (p. 16). For example, Sicilia (2005) found that technical barriers (such as waiting for websites to open, failing to connect to the Internet, or printers not printing) prevented "the smooth delivery of the lesson or the natural flow of the classroom activity" (Sicilia, cited in Bingimlas, 2009, p. 43). Therefore, even when schools are equipped with sufficient ICT resources, if technical support is not immediately available, any technical problems will decrease that access until the problems are resolved (Becta, 2004). It seems that there is a relationship between the lack of technical support and teachers' access to ICT equipment at school.

To achieve wider impact with ICT in education, educational managers should establish sufficient ICT support services and maintenance contracts in order to guarantee that quality ICT resources for schools are indispensable conditions (Balanskat, et al., 2006). Lim and Khine (2006) suggested that schools should arrange regular appointments with technical assistance to troubleshoot hardware and software problems, test out equipment and install software, and maintain hardware and catalogue software.

Another important part of the organisational support towards successful ICT implementation is to provide ongoing professional development and technical training for teachers. Professional development can have an impact on teachers' attitudes and beliefs towards ICT, and provide them with the knowledge and skills needed to employ ICT in teaching and learning practices (Hew & Brush, 2007). Furthermore, teachers need to develop a high level of self-

confidence with using ICT. Therefore, they need to be very well trained on how ICT can be implemented into classroom practices, which in turn will raise teachers' confidence in their ability to use ICTs (Tezci, 2011a).

Lack of technical education and training is another barrier to the successful implementation of ICTs in classrooms (Al-Alwani, 2005; Al-Oteawi, 2002; Almaghlouth, 2008). For instance, Saudi Arabia's limited access to ICT and training has been a major obstacle in integrating ICT into education (Almohaissin, 2006). A study by Al-Oteawi (2002) found the majority of the participants (62%) had not taken computer or Internet courses. Additionally, 98% of participants stated a need for staff development in the area of information technology in order to improve their skills and knowledge. Al-Oteawi indicated overall that the participants did not have useful knowledge and skills in information technology. To combat the lack of technological knowledge and skills, the study suggests that the Ministry of Education creates comprehensive staff development programs and plans to aid the implementation of technologies into Saudi classrooms.

Similar research has also been conducted by others yielding the same results. Al-Alwani (2005) found that a contributing factor in the low use of technology by science teachers was the lack of information technology training. The research suggests that providing more staff development will help teachers successfully integrate ICT into their classrooms. Competency with ICT applications is developed through training (Sahin & Thompson, 2006). In addition, Almaghlouth (2008) found that lack of technical support and organised professional development programs are significant barriers. Professional development programs for teachers that provide encouragement to use ICT and that stress practical classroom use for the technologies are needed.

Al-Oteawi (2002) found a correlation between neutral and negative attitudes toward technology and lack of computer skills and knowledge. Training programs that focus on increasing technical proficiency help increase awareness of how technology can be applied to classroom teaching, thus, changing the attitudes toward the technologies themselves (Saleh, 2008). Similarly, Alshumaimeri (2008) conducted a study to further understand the relationship between computer training and attitudes toward technology in language instruction. Participants who used the technology available in the language labs developed more positive attitudes towards the technology in the classroom. According to Alshumaimeri, training programs are invaluable to the overall process of integrating computers in the classroom. Programs must be designed that create positive attitudes toward technology by raising skill levels with the technology itself. Improvement in attitudes, however, cannot guarantee teachers would use the language labs for instruction. Alshumaimeri concludes that when participants receive more computer training, the confidence they gain increases the likelihood of using technology in classrooms. Well planned staff development programs are crucial to the successful implementation of computers in classrooms (Alshumaimeri, 2008).

Lack of time is another important factor affecting the successful implementation of ICT in education. Pelgrum (2001) found that insufficient time for teachers is among the top ten barriers associated with the implementation of ICT into school practices. Technology takes time to integrate and implement into classrooms (AI-Sharhan, 1994; Al-Alwani, 2005). An overloaded curriculum that does not leave time for the use of audio-visual equipment is another barrier to the implementation of ICT in Saudi Arabian schools (Al-Sharhan, 1994). Teachers need time to develop their skills with technology and create course materials (Rogers, 2000). Al-Alwani (2005), found that a teacher's work schedule coupled with the average 18 45-minutes classes per week did not leave teachers enough time to work on integrating ICTs into their instruction.

Al-Otaibi (2006) also found that teachers, especially females, showed less confidence in their computer use. Additionally, they pointed to their responsibilities as mothers and raising children as factors limiting their time to attend e-learning training. Al-Otaibi also noted that there are many other reasons for teachers not attending training courses. Lack of motivation due to insufficient encouragement from their principals and administration also affected the attendance at training courses. To assist teachers to integrate ICT more effectively, school leaders and policymakers should pay more attention and find solutions to recognise teaching loads and provide teachers with sufficient time (Lim & Khine, 2006).

The previous paragraphs have discussed that important external requirements need to be established in order to achieve effective ICT implementation in education. These requirements, the need for infrastructure, policy and planning, and support and management, are non-teacher-related factors. The factors that are related to teachers are no less important. The literature review shows that teachers have the most influence on the quality of ICT implementation, and consequently, teacher-related factors are most frequently cited as impacting ICT implementation in education (Levin & Wadmany, 2008; Lim & Khine, 2006; Tezci, 2009). The next section articulates the role of teachers and their related factors in ICT implementation.

Teacher as a critical factor towards successful ICT implementation

The general assumption common in the past is that once ICT requirements, for example, ready access to technology, increased technical training for teachers, and favourable policy and support environment, is in place, ICT implementation will automatically follow (Lim & Khine, 2006). However, more research studies have indicated that one of the key determinants of whether ICT implementation is successful is the teacher (Albirini, 2006; Ertmer, 2005; Hew & Brush, 2007; Li, 2007; Lim & Khine, 2006; Newhouse, 2002; Tezci, 2009). For instance, while some researchers (Kozma, 2003) reported that the presence of ICT in the classroom leads to effective use, other research results indicated that effective use is also linked to teachers' attitudes and levels of knowledge (Garland & Noyes, 2004; Lim & Khine, 2006; Zhang, 2007). Similarly, P. Ertmer (2005) stated that the decision of whether and how to use ICT for educational purposes significantly depends on the teachers and their related factors, for example, beliefs, confidence and skills, with regards to ICT implementation. Baker (as cited in Ertmer, et al., 1999) described teachers as "viewing the computer as either an inspiration or an intrusion depending on the meanings and the values they assign to technology" (p. 55). Research has suggested that teachers' attitudes and beliefs may either decrease or increase the influence of the other barriers, for example, the lack of resources or the lack of technical and administrative support (Hativa & Lesgold, 1996).

ICT becomes significant when teachers use it in classroom practices, otherwise it does not have an educational value in itself (Tezci, 2009). Therefore, we could recognise that "teachers, not technology, hold the key to achieving integrated technology use" (Ertmer, et al., 1999, p. 55). To understand how to achieve successful technology implementation, we need to understand the factors that influence teachers' decisions and actions relating to ICT in their teaching. One of the most important of these factors is teachers' knowledge and skills. The next paragraphs discuss this issue.

Knowledge and skills

Technological knowledge and skills, or "competence" as some researchers (Al-Oteawi, 2002; Albirini, 2006) refer to it, have been considered as an important requirement for teachers to achieve successful ICT implementation in education. Previous research studies have shown that a large proportion of teachers lack knowledge and skills about ICT as a main barrier towards effective use of ICT (Balanskat, et al., 2006; Becta, 2004; Hew & Brush, 2007; Newhouse, 2002). For example, Hew and Brush (2007) reviewed the literature from both the United States as well as other countries to identify the general barriers preventing teachers from using technology for education. Hew and Brush reported that one of the most prevalent factors preventing teachers from integrating technology is their lack of specific technological knowledge and skills (Hew & Brush, 2007). Similarly, Albirini (2006) explored in his study the relationship between teachers' computer attitudes and five independent variables including teachers' computer competence. The findings suggest that the majority of respondents had little or no competence regarding the use of computers for instructional purposes. Furthermore, Newhouse (2002) points to the relationship between the lack of use of computers across the curriculum and the lack of teachers' knowledge and skills in operating ICT. Albirini (2006) asserted that irrespective of the availability of technological equipment, it will not be used unless teachers have sufficient knowledge and skills to integrate technology into educational practices.

The literature also shows that relationships exist between teachers' knowledge and skills and other teacher-related factors. For instance, Newhouse (2002) indicated that many teachers who lack the knowledge and skills to use computers are also not enthusiastic about the changes associated with bringing computers into their classroom practices. According to Becta, (2004) when teachers lack technical skills, they are likely to be anxious "about possible technical problems, as they would have less of an understanding of how to avoid or solve such problems independently" (Becta, 2004, p. 21). Teachers' confidence to integrate ICT into teaching practices is another factor associated with teachers' level of knowledge and skills. For example, Albirini (2006) indicated that teachers' lack of knowledge leads to their lack of confidence to integrate computers in education. Similarly, when responding to Becta's survey, most teachers who stated that their lack of confidence was a barrier, also indicated that they had limited knowledge in the area of ICT (Becta, 2004). Furthermore, teachers' attitudes towards computers have been found to be significantly influenced by teachers' computer competence (Albirini, 2006). Al-Oteawi (2002) found that teachers who demonstrated negative or neutral attitudes toward the use of ICT in teaching practices lacked knowledge and skill about ICT.

Apart from the need of technological knowledge and skills, some research studies emphasise the importance of other types of knowledge and skills; one is technology-related classroom management. Technology-related classroom management skills are those skills of managing ICT resources in classrooms. For example, teachers need to have

specific management skills allowing them to know how to organise their classrooms effectively so that their students have equal chances to use ICT equipment, or what to do if their students experience technical problems when working on this equipment (Hew & Brush, 2007). Several research studies found that the lack of technology-related classroom management skills prevented ICT implementation (Hew & Brush, 2007).

Another type of knowledge and skills that has been also been emphasised in the literature for effective ICT implementation is technology-supported pedagogy knowledge. This type of knowledge refers to teachers' understanding of the connection between the technology being used and teaching and learning strategies (Hughes, 2005; Ottenbreit-Leftwich, 2010). Some researchers went further adding "content knowledge" resulting in technological pedagogical and content knowledge, which means teachers' understanding of using technology to support pedagogical techniques in teaching specific content subject (Koehler & Mishra, 2009). Hughes (2005) asserted that teachers need to be equipped with a technology-supported pedagogy knowledge and skills base, so they can refer to it when they plan to use ICT in their classroom practices. According to Hew and Brush (2007), teachers' unfamiliarity with the pedagogy of using ICT may be considered as a barrier to effective ICT implementation. Hew and Brush note that professional development programs have focused mainly on how to operate ICT equipment. According to Becta (2004) "before teachers need to know how to use [ICT], they need to ask why they need to know, and what they need to know" (p. 10). Equipping teachers with technological knowledge and skills will not necessarily guarantee that those teachers will integrate ICT in teaching practices in an effective way (Becta, 2004).

Clearly, teachers' knowledge and skills are significant determinants of ICT implementation in education. However, teachers need to not only be technologically literate (Newhouse, 2002), they also need to develop other types of knowledge such as technological pedagogical and content knowledge (Koehler & Mishra, 2009). according to the TPACK (technological, pedagogical, and content knowledge) theory, teachers need more than just technical competence (Mishra & Koehler, 2006). TPACK was introduced in 2005 by Koehler and Mishra as a conceptual framework to describe the body of knowledge teachers need to effectively use technology in their teaching (Koehler, Mishra, & Yahya, 2007). This model suggests that relationships and complexities exist among the three main constructs of knowledge (technology, pedagogy, and content) (Koehler & Mishra, 2008; Mishra & Koehler, 2006). As these three components of knowledge intersect, this will lead to an understanding of teaching content with appropriate pedagogical methods and technologies. The intersection of all the components is the basis of the model which is the TPACK component (see Section 3.3 for further detail). The TPACK component could be defined as "a teacher's knowledge of how to coordinate and combine the use of subject-specific ... and topic-specific activities using emerging technologies to facilitate student learning" (Cox & Graham, 2009, p. 64). The theory assumes that teacher use of ICT has a relationship with their TPACK, that is, teachers having "strong" TPACK will be more successful with the implementation of ICT in their classrooms. Balanskat, et al. (2006) suggested that teachers' level of knowledge is directly linked to the quality and quantity of teachers' professional development programs. It is important for these programs to consider activities around pedagogical and content training rather than simply training teachers in the skills of using ICT resources (Becta, 2004). Although, it is important for teachers to acquire the basic technological skills, this should be just the first stage of training (Snoeyink & Ertmer, 2002). To facilitate change in teachers' knowledge and skills, professional development content should be appropriate to the needs of the teachers and classroom practice (Hew & Brush, 2007). For instance, to improve teachers' technology-supported pedagogy skills, opportunities should be provided for teachers to engage in active learning; grounding learning experiences in content-connected technology examples (Hew & Brush, 2007; Hughes, 2005).

CONCLUSION

To gain the optimum impact of ICT in education, more attention needs to be paid to the effectiveness of its use in schools. The review of the literature showed that effective ICT implementation will not occur simply because ICT is more available in the classrooms; rather, the significant issue here is how ICT improves the educational process. Issues including: why teachers integrate technology; how ICT implementation could be effective; what the requirements are to achieve effective ICT implementation should be considered. Additionally, more research studies have indicated that one of the key determinants of whether ICT implementation is successful is the teachers, particularly, teachers' knowledge. According to TPACK theory, teachers must have a coherent understanding of how ICT can be used combined with knowledge of subject matter and teaching strategies to raise the chances of effective learning.

Biography of author

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