
ICT in Education: A Critical Literature Review and Its Implications

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Abstract:

Purpose: *The paper discusses new possibilities and challenges that ICT has brought to teacher training and professional development. Development of ICT in school depends only on the quality and ability of the teachers handling the education system.*

Design/Methodology/Approach: *ICT's "may reshape, reorganize, and restructure working methods" through its "generic advantages of efficiency, information sharing, storage, faster knowledge accumulation, dissemination which can permit new and collaborative work methods" Social, political economic and cultural changes is inevitable based on the development and diffusion of technology. The advancement of Science and Technology has affected the society in various spheres including education specifically teacher education.*

Findings: *New teaching approaches and technical support should be offered by schools to allow them to retain control while facilitating learning with computers. Overall, implementing effective teaching with technology integration requires changes in teachers' knowledge, beliefs, and school culture.*

Practical Implications: *There is no doubt that ICT has brought revolutionary change in the field of teacher education. ICT can provide more flexible and effective ways for professional development for teachers.*

Originality/value: *This critical review discusses the current situations, barriers to, and solutions for ICT integration in the classroom. The possible gaps in the existing literature are shown in order to provide lucid directions for future research into ICT use.*

Keywords: *ICT, technology integration, barriers and solutions of ICT use, teachers' attitudes and beliefs on ICT use.*

JEL classification: *I20, I25.*

Paper Type: *Research study.*

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1. Introduction

‘Information and Communication Technology’ refers to, the technology used to handle information and to aid communication. The phrase was adopted by the new National Curriculum documents for UK in 2000. Rather than simply IT, ICT shows the importance of communications integrated with computers. Information and communication Technology constitutes ‘Information Technology’ and Communication Technology both of which are development at a very high speed.

The teachers get sufficient help from ICT in their task of teaching. Their acquaintance with the relevant source of information in the form of books, Journals and other reading material, audio – visual material and equipment and electronics and telecommunication media makes them able to acquire necessary teaching material and teaching.

They may also enjoy some sign of relief if they see their students making use of the ICT resource for self-learning. ICT makes it easy the realization of the teaching-learning objectives to them if its services are well employed. “Technological devices act as a supplement for the teachers and the texts.

Teachers will be able to take advantage of different kinds of information available in the internet and exchange ideas using these with the students. It is an incredible device for teacher to improve the curriculum material through the exchange of ideas with other educators”.

2. Benefits of Using ICT in Education

The merits of ICT in education have been extolled in the literature. The use of ICT has been found to:

Assist students in accessing digital information efficiently and effectively:

As Brush, Glazewski and Hew (2008) have stated, ICT is used as a tool for students to discover learning topics, solve problems, and provide solutions to the problems in the learning process. ICT makes knowledge acquisition more accessible, and concepts in learning areas are understood while engaging students in the application of ICT.

Support student-centered and self-directed learning:

Students are now more frequently engaged in the meaningful use of computers (Castro Sánchez and Alemán, 2011). They build new knowledge through accessing, selecting, organizing, and interpreting information and data. Based on learning through ICT, students are more capable of using information and data from various sources, and critically assessing the quality of the learning materials.

Produce a creative learning environment:

ICT develops students' new understanding in their areas of learning (Chai, Koh, and Tsai, 2010). ICT provides more creative solutions to different types of learning inquiries. For example, in a reading class, e-books are commonly used in reading aloud activities. Learners can access all types of texts from beginning to advanced levels with ease through computers, laptops, personal digital assistants (PDAs), or iPads.

More specifically, these e-books may come with some reading applications, which offer a reading-aloud interface, relevant vocabulary-building activities, games related to reading skills and vocabulary acquisition, and more. Therefore, ICT involves purpose designed applications that provide innovative ways to meet a variety of learning needs (Pham *et al.*, 2022).

Promote collaborative learning in a distance-learning environment:

Koc (2005) mentioned that using ICT enables students to communicate, share, and work collaboratively anywhere, any time. For instance, a teleconferencing classroom could invite students around the world to gather together simultaneously for a topic discussion. They may have the opportunity to analyze problems and explore ideas as well as to develop concepts. They may further evaluate ICT learning solutions. Students not only acquire knowledge together, but also share diverse learning experiences from one another in order to express themselves and reflect on their learning.

Offer more opportunities to develop critical (higher-order) thinking skills:

Based on a constructive learning approach, ICT helps students focus on higher-level concepts rather than less meaningful tasks (Levin and Wadmany, 2006). McMahon's study (2009) showed that there were statistically significant correlations between studying with ICT and the acquisition of critical thinking skills. A longer exposure in the ICT environment can foster students' higher critical thinking skills.

Thus, schools are strongly advised to integrate technology across all of the learning areas and among all learning levels. Where this is done, students are able to apply technology to the attainment of higher levels of cognition within specific learning contexts.

Improve teaching and learning quality:

As Lowther *et al.* (2008) have stated that there are three important characteristics are needed to develop good quality teaching and learning with ICT: autonomy, capability, and creativity. Autonomy means that students take control of their learning through their use of ICT.

In this way, they become more capable of working by themselves and with others. Teachers can also authorize students to complete certain tasks with peers or in groups (Kuzmina *et al.*, 2023).

Through collaborative learning with ICT, the students have more opportunity to build the new knowledge onto their background knowledge, and become more confident to take risks and learn from their mistakes. Further, Serhan (2009) concluded that ICT fosters autonomy by allowing educators to create their own material, thus providing more control over course content than is possible in a traditional classroom setting.

With regard to capability, once students are more confident in learning processes, they can develop the capability to apply and transfer knowledge while using new technology with efficiency and effectiveness. For example, in an ESL listening and speaking class, students may be asked to practice their pronunciation using an online audio dictionary.

They are required not only to listen to the native pronunciation from the dictionary, but also to learn the definitions and examples of a new vocabulary item. They then have to make a recording of their own pronunciation and provide examples of how this new word is used in context. Before completing this task, they have to know which browser to use in order to search a suitable online audio dictionary.

They will have to browse several online dictionaries, and select the one that best meets their learning needs. In addition, finding good software to record their voice is another prerequisite for these learners. Therefore, the whole learning process enriches students' learning skills and broadens their knowledge beyond what they already know.

By using ICT, students' creativity can be optimized. They may discover new multimedia tools and create materials in the styles readily available to them through games (Gee, 2007; 2011), CDs, and television. With a combination of students' autonomy, capability, and creativity, the use of ICT can improve both teaching and learning quality.

Support teaching by facilitating access to course content:

Watts-Taffe *et al.* (2003) found that teachers can act as catalysts for the integration of technology through ICT. If the encouragement, equipment, and necessary technological support are available from institutes for the teachers, developing an ICT class will be easier for them. The main responsibilities of these teachers will be changing their course format, creating and explaining the new assignments, and arranging for the computer lab through their technology learning specialists or assistants.

In sum, as Reid (2002) has indicated, ICT offers students more time to explore beyond the mechanics of course content allowing them to better understand concepts. The use of ICT also changes the teaching and learning relationship. Based on the findings of Reid's study, teachers reported that the relationship between teacher and learner is sometimes reversed with regards to information technology.

This relationship boosts students' confidence when they are able to help teachers with technical issues in the classroom.

Therefore, ICT changes the traditional teacher centered approach, and requires teachers to be more creative in customizing and adapting their own material. While ICT is changing teaching and learning for the better in several ways, the existing literature has also identified some barriers. In the following sections, these barriers are classified into four categories based on the perspectives of students, teachers, administrators, and ICT infrastructure. A variety of strategies for addressing these barriers is also discussed.

Barriers and Solutions, Student Perspective:

Although the advantages of using ICT in the classroom have been demonstrated in previous research, barriers or challenges associated with its use still exist. Frederick, Schweitzer and Lowe (2006) showed that student mobility, special needs, and anxiety over standardized test results are the main challenges associated with ICT use. These challenges can be solved by providing more authentic group- and problem-based learning activities, and adequate learning support (Whelan, 2008).

Whelan (2008) also identified more barriers from the student perspective, including: subpar technical skills that reduce access to ICT in classroom; an insufficient number of academic advisors and lack of timely feedback from instructors; and reduced interaction with peers and instructors.

Therefore, the author recommends the following strategies to facilitate the learning process, more induction, orientation, and training for students; an increased emphasis on the importance of instructor access and effective administration; and the expansion of podcasting and online conferencing tools.

In general, capacity building, curriculum development, infrastructure, policy, and government support are required in order to lower student barriers and improve the effectiveness of ICT use in the classroom. In addition, Castro Sánchez and Alemán (2011) encourage students to acquire specific technical skills to facilitate learning in ICT environments.

Barriers and Solutions, Teacher Perspective:

Barriers to effective technology integration from a teacher perspective include:

- Low teacher expectations and a lack of clear goals for ICT use in schools (Al-Bataineh *et al.*, 2008);
- A lack of teacher collaboration and pedagogical support, as well as a lack of experience among cooperating teachers (Ertmer and Otterbreit-Leftwich, 2010);
- Insufficient time to master new software or integrate ICT during a class period (Almekhlafi and Almeqdadi, 2010);

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- Insufficient skills for managing teaching materials (Frederick, Schweizer, and Lowe, 2006);
 - Low software competence and habitual ways of conceptualizing what and how students should learn (Goktas, Yildirim, and Yildirim, 2009);
 - Limited knowledge and experience of ICT in teaching contexts (Honan, 2008);
 - A lack of specific knowledge about technology and how to combine it with the existing pedagogical content knowledge to support student learning (Hutchison and Reinking, 2011);
 - Excessive focus on teaching technical or operational skills rather than course content (Lim, 2007);
 - Pressure to improve scores on national examinations (Liu and Szabo, 2009);
 - A lack of recognition and encouragement of the timely and effective use of ICT (Tezci, 2011a);
 - A lack of in-service training on the use of ICT (Yildirim, 2007);
 - Technical problems in the classroom (Yildirim, 2007);
 - Classroom management with large class sizes (Tezci, 2011a);
 - A lack of motivation, and technical and financial support (Liu and Szabo, 2009);
 - Uncertainty about the possible benefits of using ICT in the classroom (Yildirim, 2007);
 - Lack of specific and definite ideas about how integrating technology into instruction will improve student learning (Al-Bataineh *et al.*, 2008).

Several strategies for dealing with these challenges have been suggested. Schools are encouraged to:

- Provide professional development activities related to technology to update teachers' skills and knowledge, and offer technical support when needed (Al-Bataineh *et al.*, 2008);
- Support partnerships that help teachers share effective technology practices and experiences (Ertmer and Ottenbreit-Leftwich, 2010);
- Provide workshops that allow teachers to reflect upon effective strategies for technology integration into instruction and unveil issues that are central to understanding the process of technology integration into instruction (Almekhlafi and Almeqdadi, 2010);
- Offer opportunities to virtually observe teachers who use technology (Frederick, Schweitzer and Lowe, 2006);
- Augment curricula with technology-enhanced materials (Goktas, Yildirim, and Yildirim, 2009);
- Provide enough freedom for teachers in selecting and covering curriculum materials (Honan, 2008);
- Provide effective, timely, and continuous training to improve ICT skills and manage a technology-rich classroom (Hutchison and Reinking, 2011);

- Encourage positive attitudes about the significance of integrating ICT into instruction (Lim, 2007).
- Provide adequate technical support (Liu and Szabo, 2009; Tezci, 2011a; Yildirim, 2007).

Technology should be used for more than just support of traditional teaching methods (Tezci, 2011a). According to Tezci (2011a), teachers should learn not only how to use technology to enhance traditional teaching or increase productivity, but also should learn from a student centered perspective how ICT can be integrated into classroom activities in order to promote student learning.

This means that teachers need to use ICT in more creative and productive ways in order to create more engaging and rewarding activities and more effective lessons (Birch and Irvine, 2009; Honan, 2008). Hence, Castro Sánchez and Alemán (2011) suggested that teachers keep an open mind about ICT integration in classroom. It is imperative that teachers learn new teaching strategies to adapt to the new instruments when teaching with technology.

However, Yildirim (2007) found that teachers use ICT more frequently for the preparation of handouts and tests than to promote critical thinking. Similarly, Palak and Walls (2009) found that teachers mainly use technology to support their existing teaching approaches and rarely to foster student-centered learning.

According to the authors, one possible explanation is a lack of models for how to use technology to facilitate learning, and limitations related to contextual factors such as class size and student ability. Further, Brush, Glazewski and Hew (2008) found that preservice teacher preparation does not provide sufficient ICT knowledge to support technology based instruction, nor does it successfully demonstrate appropriate methods for integrating technology within a curriculum.

More training should be provided in pre-service teachers' curricula, and ICT skills must be applied in the classroom in order to integrate effective technology strategies (Supon and Ruffini, 2009). To help teachers cope with these difficulties, Chen (2008) suggested that rather than only providing education theories, ICT researchers should also document examples of how teachers accomplish meaningful and effective technology integration to meet their pedagogical goals and needs.

Barriers and Solutions: Administrative and ICT Infrastructure Perspective:

In addition to the challenges faced by both students and teachers in the use of ICT, other obstacles also exist in terms of an administrative and ICT infrastructures. Such barriers include:

- School inspectors focus more on the quantity of course content and student test scores than on ICT usage (Yildirim, 2007);

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- A lack of appropriate administrative support for the effective use of ICT (Lim, 2007);
 - Administrative mandates to improve examination results, which shifts the focus away from using ICT to engage students in higher-order thinking activities (Goktas, Yildirim, and Yildirim, 2009);
 - A lack of appropriate course content and instructional programs (Yildirim, 2007);
 - A lack of appropriate hardware, software, and materials (Yildirim, 2007).

To address these barriers, Yildirim (2007) suggested that schools need to provide appropriate access to technology. Furthermore, schools and related institutional systems need to employ new policies to involve teachers in the decision-making and planning processes regarding ICT in their classrooms. Lim (2007) conducted a qualitative study examining effective and ineffective ICT integration in schools in order to provide tangible solutions.

The results showed that the availability of ICT tools, the establishment of disciplinary and educational principles and procedures, as well as the division of labor among teachers, teaching assistants and students are crucial elements to establishing a well-managed ICT-integrated class. By emphasizing these elements, a learning process that is more likely to engage students in higher-order thinking can be facilitated.

Ertmer and Ottenbreit-Leftwich (2010) reviewed the existing literature on the necessary elements to enable pre-service and in-service teachers to apply ICT as a meaningful pedagogical tool. They recommended that schools provide teachers with solid evidence supporting the positive impact of technology-based and student-centered instruction on student learning and achievement on standardized tests.

For instance, schools can provide opportunities for preservice teachers to observe a variety of examples and models, which they can then apply with real learners. Schools need to help pre-service teachers understand difficulties they may face when they begin to use ICT in their classrooms, and present effective strategies for addressing them. In sum, school leaders should ensure that teachers understand that the ultimate objective of technology integration is to advance the teaching and learning process, not replace it.

Developing a pedagogical model requires a strong link between theory and application in order to help teachers overcome the obstacles faced in technology integration (Keengwe and Onchwari, 2009). Thus, Staples, Pugach and Himes (2005) stated that good planning for technology integration requires a special understanding of specific hardware and software related to the curriculum. Staff development and teacher training are also indispensable to supporting the curriculum with technology integration.

3. Factors Influencing the Use of ICT

Factors influencing the use of ICT can be divided into external factors and internal factors. The two types of factors are related to each other and to ICT usage level (Tezci, 2011a). A variety of external factors have been identified that influence the progression or effectiveness of technology integration in schools.

These include technology availability, accessibility of ICT equipment, time to plan for instruction, technical and administrative support, school curriculum, school climate and culture, faculty teaching load and management routine, and pressure to prepare students for national entrance exams (Al-Ruz and Khasawneh 2011; Lin, Wang and Lin, 2012; Tezci, 2011a). Among these external factors, the most common are lack of access to computers and software, insufficient time for course planning, and inadequate technical and administrative support (Chen, 2008).

Al-Ruz and Khasawneh (2011) found that some external factors were positively associated with technology integration, including availability of technology ($r = 0.39$, $p < 0.01$) and support from technicians, teachers, and principals ($r = 0.44$, $p < 0.01$).

Thus, technology availability and overall support are important to technology integration. The higher the support structure and technology availability, the higher the technology integration efforts are made by teachers. Several internal factors also influence technology integration outcomes (Sang *et al.*, 2011).

Internal factors related to teachers include: understanding of ICT use; beliefs, which may conflict with the application of ICT; attitudes toward technology integration; perceptions, including intention or motivation to use ICT; self-confidence and knowledge; technology skills; readiness to use ICT; and technology self-efficacy (Al-Ruz and Khasawneh, 2011; Chen, 2008; Lin, Wang and Lin, 2012; Sang *et al.*, 2011; Tezci, 2011a).

Chen (2008) discovered two common issues associated with internal factors. First, teachers may implement policies based on limited or improper theoretical interpretations and comprehension of ICT use. Second, teachers may be under pressure to cover all content and be unwilling or hesitant to let students spend more time exploring content on their own with technology due to their other conflicting beliefs.

These issues imply that teacher beliefs may not resonate in their practices. A school culture emphasizing competition and a high stakes assessment system can discourage teachers from integrating technology into their classrooms.

Thus, teacher beliefs influence ICT use in the classroom (Chen, 2008). More specifically, Teo *et al.* (2008) investigated a quantitative study examining the

possible relationship between Singaporean pre-service teachers' beliefs about teaching and technology use. Constructivist teaching beliefs were significantly and positively correlated with both constructivist ($r = 0.59, p < 0.01$) and traditional ($r = 0.50, p < 0.01$) technology use.

On the contrary, traditional teaching beliefs were significantly and negatively correlated with constructivist technology use. The outcome of the study implies that Singaporean pre-service teachers are not adequately prepared to facilitate student construction of knowledge. Even though technology can foster interactive, self-directed learning and higher order thinking, technology integration is not the most effective way to improve learning.

Through a combination of constructivist learning and technology, learners will be assisted in an active learning process and encouraged to organize information by making internal cognitive connections. ICT, therefore, will not in itself prove effective in the classroom without teachers who possess knowledge of both the technology and how to use it to meet educational goals (Koc, 2005).

4. Teacher Attitudes, Perceptions, and Confidence in ICT Use

As established in the literature, internal variables greatly influence how teachers integrate technology in the classroom. But which variable has the strongest impact on ICT use and how internal variables are influenced by ICT preparation programs are discussed below.

Palak and Walls (2009) conducted a mixed study to investigate whether teachers who frequently integrate technology and work at technology-rich schools shift their beliefs and practices toward a student-centered paradigm. The results showed that their practices did not change; neither student-centered nor teacher-centered beliefs are powerful predictors of practices.

However, teachers' attitudes toward technology significantly predict teacher and student technology use, as well as the use of a variety of instructional strategies ($p < 0.05$). Sang *et al.* (2010) focused on the impact of Chinese student teachers' gender, constructivist teaching beliefs, teaching self-efficacy, computer self-efficacy, and computer attitudes on their prospective ICT use. The findings confirmed the results of the study by Palak and Walls (2009) that the strongest predictor of future ICT use were teachers' attitudes toward it.

In addition to the influence of teacher attitudes, Sang *et al.* (2010) further indicated that preservice teachers with highly constructivist teaching beliefs have stronger intentions to integrate technology into their future teaching practices. Furthermore, more confident pre-service teachers were more capable of and interested in using computers in real classrooms.

Thus, although teachers' attitudes towards ICT use were found to be the strongest predictor of technology integration, the impact of their beliefs and confidence in using ICT should not be disregarded either. Internal variables can partially explain the success of technology integration in the classroom. However, the influence of these variables may change after participation in technology preparation courses or programs. Abbott and Faris (2000) examined pre-service teachers' attitudes toward the use of computers before and after a semester-long technology literacy course.

The results showed that positive attitudes toward computers increased after the course because of the instructional approaches, meaningful assignments requiring technology, and supportive faculty. Thus, the authors claimed that teacher education programs should teach preservice teachers not only how to use hardware and software, but also how to incorporate computers into their teaching strategies and activities.

The authors also noted that small groups and collaborative learning are the most appropriate when introducing new hardware and software because more advanced and experienced teachers can assist those who need more technology learning support.

Another similar study was conducted by Doering, Hughes and Huffman (2003), who analyzed pre-service teachers' perspectives regarding ICT in their future classrooms before and after participation in a teacher preparation program. Prior to taking the preparation courses, teachers were doubtful about the utility of ICT in the classroom, implying that they would closely examine and consider technology integration, rather than blindly incorporate it into their teaching practices. After completing the courses, their doubt had transformed into more positive sentiments. The teachers had a better understanding about ICT use in the classroom.

Although the teachers confronted other issues such as technology availability, accessibility, professional support, and classroom management, their perceptions about technology's role had changed. They were more likely to believe that technology can assist in learning and to recognize its importance.

Serhan (2009), and Chai, Koh and Tsai (2010) also investigated pre-service teachers' beliefs about the use of computer technology and the effectiveness of ICT courses. The results of both studies indicate that after participating in courses, pre-service teachers recognized the importance of technology integration into their curricula and believed that ICT use would enhance student learning. They felt that such courses prepared them to apply ICT in the future, and their abilities to select, evaluate, and use a variety of technological resources improved.

More specifically, Chai, Koh and Tsai (2010) found that ICT courses with direct instruction on the use of technological tools through the technology enhanced lesson (TEL) approach helped teachers learn how to use technologies as supporting tools in

order to enhance their teaching and student learning. Consequently, the pre-service teachers viewed the preparation course favorably. It is worth exploring how the ICT preparation courses or programs change teachers' intentions and actions.

Choy, Wong and Gao (2009) conducted a mixed study to examine the intentions of pre-service teachers before and after a technology preparation course. Their intentions were then compared with their actions related to technology integration during their teaching.

Confirming previous results from Doering, Hughes and Huffman (2003), the findings showed that their intentions became significantly more positive ($p < .05$) as a result of increased pedagogical knowledge. Nevertheless, these teachers were not able to translate the positive intentions into actual teaching, largely due to unfamiliar school environments.

Based on these results, Choy, Wong and Gao (2009) concluded that teacher education programs need to increase awareness of the benefits of integrating technology into student-centered learning approaches, and provide pedagogical knowledge related to student-centered learning as well as technology integration strategies.

Beyond the impact of preparation courses on teacher perceptions and attitudes, Vannatta and Beyerbach (2000) reported increased proficiency in technology applications and instructional methods. They found a significant increase ($p < 0.01$) in technology integration for both preservice and in-service teachers after participation in a preparation course. After the course, teachers were able to incorporate a constructivist view of technology integration into their instruction in order to engage students in meaningful learning.

Qualitatively, the pre-service teachers reported great benefits from the use of technology in the classroom after the course. The study concluded that simply teaching basic ICT skills is inadequate if teachers are to constructively integrate technology constructively into their instruction. More emphasis should be placed on advanced skills in teacher education programs in order to provide teachers with authentic opportunities to experience and develop lessons that integrate technology in a meaningful context. The findings also encourage collaborative learning in technology-related assignments.

5. The Importance of School Culture on ICT Use

School culture encompasses the vision, plans, norms and values that are shared by school members (Maslowski, 2001). Focusing on the importance of school culture for ICT integration, Pelgrum and Law (2009) indicated that effective ICT integration depends on the perceptions and vision of school leaders rather than teachers' ICT

skills. School culture has a mediating role that influences teachers' actions, beliefs, and attitudes (Chai, Hong and Teo, 2009).

Therefore, in addition to the external and internal variables mentioned previously, school culture also plays an important role in successful technology integration (Tezci, 2011b). In order to explore teacher perceptions of school culture related to the level of ICT usage, Tezci (2011b) examined Turkish teacher perceptions from both the technical and motivational perspectives. The results showed that their perceptions from both perspectives were not positive, because the majority did not believe that they would receive adequate technical and motivational support from their school.

However, as the school culture became more positive, the teachers' ICT usage level increased. Ward and Parr (2010) stated that teachers need to feel confident in their ability to facilitate student learning with technology in order to integrate technology into their classrooms. To achieve this goal, more professional development is required with a focus on increasing teachers' skills so that they are able to overcome apprehensions associated with using technology.

Further, new teaching approaches and technical support should be offered by schools to allow them to retain control while facilitating learning with computers. Overall, implementing effective teaching with technology integration requires changes in teachers' knowledge, beliefs, and school culture (Ertmer and Ottenbreit-Leftwich, 2010).

6. Synopsis of Previous Research on ICT Use in Education and Possible Directions for Future Research

ICT integration in education has its merits. Its use not only changes the traditional ways of teaching, but also requires teachers to be more creative in adapting and customizing their own teaching materials and strategies (Reid, 2002). Among all the teaching methods and strategies, collaborative learning, problem-based learning, and the constructivist approach are the most widely used teaching strategies to deal with the challenges of ICT use (Abbott and Faris, 2000; Whelan, 2008). This corresponds with the suggestion of Palak and Walls (2009), as well as Tezci (2011a), that technology integration will not have the desired effect without student-centered classroom practices.

Therefore, ICT integration in education cannot be implemented in isolation. When it is applied in combination with diverse teaching methods and approaches, especially constructivist practices, learning outcomes may be more successful. On this basis, future researchers are recommended to undertake studies related to the benefits and challenges of a combination of ICT and other student-centered approaches such as collaborative learning across all learning areas.

The findings may provide more tangible suggestions for the use of ICT by teachers and scholars. In addition, schools should also provide some well-structured learning support while integrating technology in their curriculum and instruction (Whelan, 2008). Schools are also highly recommended to offer their teachers workshops or training courses to improve their ICT skills and prepare them to encounter possible challenges while integrating technology in order to improve teachers' professional development on ICT use (Staples, Pugach, and Himes, 2005).

Previous research has indicated that both external and internal factors influence ICT use in education (Al-Ruz and Khasawneh, 2011; Lin, Wang, and Lin, 2012; Sang *et al.*, 2011; Tezci, 2011a). Among the external factors, the most common are access to computers and software, insufficient time for course planning, and inadequate technical and administrative support (Al-Ruz and Khasawneh, 2011).

Among the internal factors, teachers' attitude, confidence, and belief in ICT use are commonly cited in the existing literature (Al-Ruz and Khasawneh, 2011; Chen, 2008; Lin, Wang, and Lin, 2012; Sang *et al.*, 2011; Tezci, 2011a). The research appears to have identified all possible external and internal factors influencing ICT use (Al-Ruz and Khasawneh, 2011; Lin, Wang, and Lin, 2012; Sang *et al.*, 2011; Tezci, 2011a). However, there has been meager research into the possible relationships between external and internal variables, and how these relationships differ according to the variables involved in ICT integration.

Examining these relationships could not only help teachers, students, and administrators understand the challenges of ICT use better, it could also assist them in uncovering other solutions to overcome the existing barriers based on the relationships among different variables.

More specifically, Chen (2008) has shown that there is no resonance between teachers' beliefs and their actual practice while integrating technology in the classroom. While most of the previous studies focused more on the influence of teachers' attitudes and beliefs on actual practice (Chai, Koh, and Tsai, 2010; Palak and Walls, 2009; Sang *et al.*, 2010; Serhan, 2009), it has been rare for any study to investigate the reciprocal relationship between teachers' attitudes and beliefs and their practice.

Another area to explore could be whether the relationship differs between preservice teachers and in-service teachers. What are their views about their beliefs and their actual practice of ICT integration? Comparative studies would be particularly applicable in examining this perspective.

Additionally, few previous studies have examined the challenges or barriers to ICT integration from students, teachers, and administrative perspectives with involvement of specific teaching strategies and activities. This is also an area worth further investigation in future research. A review of the existing literature makes it

apparent that ICT integration is mediational and entails an evolving process, not a final product. To achieve successful integration of technology requires an effort from three sides: teachers, students, and school administrators.

This critical review discusses the current situations, barriers to, and solutions for ICT integration in the classroom. Further, the possible gaps in the existing literature are shown above in order to provide lucid directions for future research into ICT use.

7. Conclusion

ICT is basically an umbrella term that encompasses all communication technologies such as internet, wireless network, cell phones, satellite communication, digital television etc. that provide access to information. During the past few decades, ICT has provided society with a vast array of new communication capabilities and has fundamentally changed the way we live now

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