Factors influencing teachers' adoption and integration of information and communication technology into teaching: A review of the literature

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ABSTRACT

Global investment in ICT to improve teaching and learning in schools have been initiated by many governments. Despite all these investments on ICT infrastructure, equipments and professional development to improve education in many countries, ICT adoption and integration in teaching and learning have been limited. This article reviews personal, institutional and technological factors that encourage teachers' use of computer technology in teaching and learning processes. Also teacher-level, school-level and system-level factors that prevent teachers from ICT use are reviewed. These barriers include lack of teacher ICT skills; lack of teacher confidence; lack of pedagogical teacher training; I lack of suitable educational software; limited access to ICT; rigid structure of traditional education systems; restrictive curricula, etc. The article concluded that knowing the extent to which these barriers affect individuals and institutions may help in taking a decision on how to tackle them.

Keywords:, ICT adoption;, ICT integration; information and communication technologies; personal; institutional and technological factors

INTRODUCTION

The rapid growth in Information Communication and Technologies (ICT) have brought remarkable changes in the twenty-first century, as well as affected the demands of modern societies. ICT is becoming increasingly important in our daily lives and in our educational system. Therefore, there is a growing demand on educational institutions to use ICT to teach the skills and knowledge students need for the 21st century. Realizing the effect of ICT on the workplace and everyday life, today's educational institutions try to restructure their educational curricula and classroom facilities, in order to bridge the existing technology gap in teaching and learning. This restructuring process requires effective adoption of technologies into existing environment in order to provide learners with knowledge of specific subject areas, to promote meaningful learning and to enhance professional productivity (Tomei, 2005).

Global investment in ICT to improve teaching and learning in schools have been initiated by many governments. For example in United Kingdom, the government spending on educational ICT in 2008–09 in the UK was £2.5bn (Nut, 2010), in United States, the expenditure on K-12 schools and higher education institutions was $6 billion and $4.7 billion respectively in 2009 (Nut, 2010) and in New Zealand, the government spends over $ 410 million every year on schools ICT infrastructure (Johnson, Calvert & Raggert 2009). Despite all these investments on ICT infrastructure, equipments and professional development to improve education in many countries, Gulbahar (2007) claimed that huge educational investment have produced little evidence of ICT adoption and use in teaching and learning especially in Turkey. Evidence suggests that education sector is investing heavily on ICT but ICT adoption in education sector lagged behind the business sector (Leidner & Jarvenpaa, 1995). Several surveys are carried out to investigate the factors that are related to the use of computer technology in teaching and learning processes by teachers (Baek, Jung & Kim, 2008; Norton, McRobbie, & Cooper, 2000).

FACTORS INFLUENCING TEACHERS' ADOPTION AND INTEGRATION OF ICT

Before the review of factors influencing the adoption and integration of the use of ICT by teachers, the concepts of adoption and integration are described. Rangaswamy & Gupta, (2000) describes adoption as the decisions that individuals make each time that they consider taking up an innovation. Similarly, Rogers (2003) defines adoption as the decision of an individual to make use of an innovation as the best course of action available. Rogers (2003) argues that the process of adoption starts with initial hearing about an innovation to final adoption. For the purpose of this study, Rogers' definition of adoption is used.

Earle (2002) linked ICT integration with the concept of wholeness, when all elements of the system are connected together to become a whole. For instance, the two important elements of teaching and learning which are content and pedagogy must be joined when technology is used in lesson. In other way, if students are offered series of websites or ICT tools (e.g. CD ROMs, multimedia, etc) then the teacher is not integrating ICT into teaching since he/she is not tackling the pedagogical issues. Similarly, Williams (2003) described ICT integration as the means of using any ICT tool (Internet, e-learning technologies, CD ROMs, etc) to assist teaching and learning. For the purpose of this study, Williams' definition of ICT integration is adopted.

Several factors influencing the adoption and integration of ICT into teaching have been identified by researchers. Rogers (2003) identified five technological characteristics or attributes that influence the decision to adopt an innovation. Stockdill and Moreshouse (1992) also identified user characteristics, content characteristics, technological considerations, and organizational capacity as factors influencing ICT adoption and integration into teaching. Balanskat, Blamire & Kefalla (2007)) identified the factors as teacher-level, school-level and system-level. Teachers' integration of ICT into teaching is also influenced by organizational factors, attitudes towards technology and other factors (Chen, 2008, Tondeur; van Braak & Valcke, 2008; Lim & Chai, 2008; Clausen, 2007). Sherry & Gibson (2002) claim that technological, individual, organizational, and institutional factors should be considered when examining ICT adoption and integration. Neyland (2011), factors such as institutional support as well as micro factors such as teacher capability influencing the use of online learning in high schools in Sydney. This article reviews studies on the use of ICT by teachers and identify factors that included and categorized in the framework of Sherry & Gibson (2002).

Personal Characteristics

Personal characteristics such as educational level, age, gender, educational experience, experience with the computer for educational purpose and attitude towards computers can influence the adoption of a technology, Schiller (2003). Teachers are implored to adopt and integrate ICT into teaching and learning activities, but teachers' preparedness to integrate ICT into teaching determines the effectiveness of the technology and not by its sheer existence in the classroom (Jones, 2001). The attitudes of teachers towards technology greatly influence their adoption and integration of computers into their teaching. According to (Russell & Bradley, 1997), anxiety, lack of confidence and competence and fear often implies ICT takes a back seat to conventional learning mechanisms. Therefore, an understanding of personal characteristics that influence teachers' adoption and integration of ICT into teaching is relevant.

Teachers' attitudes

To successfully initiate and implement educational technology in school's program depends strongly on the teachers' support and attitudes. It is believed that if teachers perceived technology programs as neither fulfilling their needs nor their students' needs, it is likely that they will not integrate the technology into their teaching and learning. Among the factors that influence successful integration of ICT into teaching are teachers' attitudes and beliefs towards technology Hew and Brush, 2007; Keengwe and Onchwari, 2008). If teachers' attitudes are positive toward the use of educational technology then they can easily provide useful insight about the adoption and integration of ICT into teaching and learning processes. Demici (2009) conducted a study on teachers' attitudes towards the use of Geographic Information systems (GIS) in Turkey. The study used questionnaire to collect data from 79 geography teachers teaching in 55 different high schools. The study revealed that though barriers such as lack of hardware and software existed, teachers positive attitudes towards GIS was an important determinant to the successful integration of GIS into geography lessons.

In a similar study, Teo (2008) conducted a survey on pre-service teachers' attitudes towards computer use in Singapore. A sample of 139 pre-service teachers was assessed for their computer attitudes using questionnaire with four factors: affect (liking), perceived usefulness, perceived control, and behavioural intention to use the computer. He found that teachers were more positive about their attitude towards computers and intention to use computer than their perceptions of the usefulness of the computer and their control of the computer. Also, Drent & Meelissen (2008) conducted a study about factors which influence the innovative use of ICT by teacher educators in the Netherlands. A sample of 210 teachers was used for the study. Their study revealed that student–oriented pedagogical approach, positive attitude towards computers, computer experience, and personal entrepreneurship of the teacher educator have a direct positive influence on the innovative use of ICT by the teacher.

Research has shown that teachers' attitudes towards technology influence their acceptance of the usefulness of technology and its integration into teaching, Huang & Liaw (2005). In European Schoolnet (2010) survey on teachers' use of Acer netbooks involving six European Union countries, a large number of participants believed that the use of netbook had had positive impact on their learning, promoted individualized learning and helped to lengthen study beyond school day. However, evidence suggests that small number of teachers believe that the benefits of ICT are not clearly seen. The Empirical survey revealed that a fifth of European teachers believed that the use of ICT in teaching did not benefit their students' learning, Korte & Hüsing (2007). A survey of UK teachers also revealed that teachers' positivity about the possible contributions of ICT was moderated as they became 'rather more ambivalent and sometimes doubtful' about 'specific, current advantages', Becta (2008, p.45).

Teachers' computer experience relates positively to their computer attitudes. The more experience teachers have with computers, the more likely that they will show positive attitudes towards computers (Rozell & Gardner, 1999). Positive computer attitudes are expected to foster computer integration in the classroom (van Braak, Tondeur & Valcke, 2004). According to (Woodrow, 1992) for successful transformation in educational practice, user need to develop positive attitudes toward the innovation.

ICT Competence

Computer competence is defined as being able to handle a wide range of varying computer applications for various purposes (van Braak et al., 2004). According to Berner (2003), Na (1993) and Summers (1990) as cited in Bordbar (2010), teachers' computer competence is a major predictor of integrating ICT in teaching. Evidence suggests that majority of teachers who reported negative or neutral attitude towards the integration of ICT into teaching and learning processes lacked knowledge and skills that would allow them to make "informed decision" (Al-Oteawi, 2002, p.253, as cited in Bordbar, 2010).

In a qualitative multiple case-study research on primary school competence and confidence level regarding the use of ICT in teaching practice conducted in five European countries, Peralta & Costa (2007) found that technical competence influenced Italian teacher's use of ICT in teaching. However, the teachers cited pedagogical and didactic competences as significant factors if effective and efficient educational interventions are likely to be implemented. In Portugal, teachers reported different views regarding the most important competences for teaching with ICT. The experienced and new teachers stressed the need for technical skills and attitude, the innovative teachers emphasized curricula and didactic competences and the student-teachers cited technical competence and pedagogical efficiency as significant to integrate ICT in teaching and learning processes. According to Peralta & Costa (2007), teachers with more experience with computers have greater confidence in their ability to use them effectively. To conclude, Jones (2004) reported that teachers competence relate directly to confidence. Teachers' confidence also relate to their perceptions of their ability to use computers in the classroom, particularly in relation to their children's perceived competence.

Computer self-efficacy

Research has been conducted on teacher's self-efficacy and reported to have greater effect on their use of ICT. Self-efficacy is defined as a belief in one's own abilities to perform an action or activity necessary to achieve a goal or task (Bandura, 1997). In real meaning, self-efficacy is the confidence that individual has in his/her ability to do the things that he/she strives to do. Thus teachers' confidence refers both to the teachers' perceived likelihood of success on using ICT for educational purposes and on how far the teacher perceives success as being under his or her control (Peralta &Costa, 2007). Teachers' computer self-efficacy is described as a judgment of their capability to use a computer (Compeau & Higgins, 1995). According to Liaw, Huang and Chen (2007), teachers' computer self-efficacy influences their use of ICT in teaching and learning. Similarly, (Yuen & Ma, 2008) revealed that the Hong Kong teachers' implementation of ICT was depended on simplicity of computer use and perceived teacher self-efficacy.

Christensen and Knezek (2006) described computer self-efficacy as computer confidence in competence. Knezek and Christensen (2002) revealed that teachers' competence with computer technology is a key factor of effective use of ICT in teaching. Peralta and Costa (2007) conducted a study on 20 teachers' competences and confidence regarding the use of ICT in classrooms. They revealed that in Italy, teachers' technical competence with technology is a factor of improving higher confidence in the use of ICT. In addition, teachers in Greece reported pedagogical and personal factors as those which mostly contribute to their confidence in ICT use. Also, innovative teachers in Portugal linked the perception of confidence in using ICT with the loss of fear of damaging the computer and at the same possessing absolute control over the computer. However, they reported plenty of available time to work and practice ICT, support of experienced teachers and training as favourable conditions for gaining confidence in ICT usage.

The conventional teachers also reported organizational factors as a facilitating condition towards gaining confidence and finally new teachers stated that their confidence level in using ICT depended on personal factors.

According to Jones (2004), teachers feel reluctant to use computer if they lack confidence. "Fear of failure" and "lack of ICT knowledge" (Balanskat et al., 2007) have been cited as some of the reasons for teachers' lack of confidence for adopting and integrating ICT into their teaching. Similarly, in a survey conducted by (Becta, 2004), approximately 21% of the teachers who were surveyed, reported that lack of confidence influence their use of computers in their classrooms. Becta (2004, p.7) stated that "many teachers who do not consider themselves to be well skilled in using ICT feel anxious about using it in front of a class of children who perhaps know more than they do".

Gender

Gender differences and the use of ICT have been reported in several studies. However, studies concerning teachers' gender and ICT use have cited female teachers' low levels of computer use due to their limited technology access, skill, and interest (Volman & van Eck, 2001). Research studies revealed that male teachers used more ICT in their teaching and learning processes than their female counterparts (Kay, 2006; Wozney et al., 2006). Similarly, Markauskaite (2006), investigated gender differences in self reported ICT experience and ICT literacy among first year graduate trainee teachers. The study revealed significant differences between males and females in technical ICT capabilities, and situational and longitudinal sustainability. Males' scores were higher. Jamieson-Proctor, Burnett, Finger and Watson (2006) conducted a study on teachers' integration of ICT in schools in Queensland State. Results from 929 teachers indicated that female teachers were integrating technology into their teaching less than the male teachers. But the situation was different in mid-western US basic schools where Breisser (2006) found that females' self-perceptions about technology competence improved while males' self-perceptions about technological dominance remained unchanged in a lego-logo project. The study was in agreement with (Adams, 2002) that female teachers applied ICT more than the male teachers. This study confirms report by Yukselturk and Bulut (2009) that gender gap has reduced over the past years, presently, a greater number of females than males have used internet and web 2.0 technologies.

However, some studies revealed that gender variable was not a predictor of ICT integration into teaching (Norris, Sullivan, Poirot & Soloway, 2003). In a research conducted by Kay (2006), he found that male teachers had relatively higher levels of computer attitude and ability before computer implementation, but there was no difference between males and females regarding computer attitude and ability after the implementation of the technology. He claims that quality preparation on technology can help lessen gender inequalities.

Teaching Experience

Though some research reported that teachers' experience in teaching did not influence their use of computer technology in teaching (Niederhauser & Stoddart, 2001), most research showed that teaching experience influence the successful use of ICT in classrooms (Wong & Li, 2008; Giordano, 2007; Hernandez-Ramos, 2005). Gorder (2008) reported that teacher experience is

significantly correlated with the actual use of technology. In her study, she revealed that effective use of computer was related to technological comfort levels and the liberty to shape instruction to teacher-perceived student needs. Also, Baek, Jong & Kim (2008) claimed that experienced teachers are less ready to integrate ICT into their teaching.

Similarly, in United States, the (U.S National Centre for Education Statistics, 2000) reported that teachers with less experience in teaching were more likely to integrate computers in their teaching than teachers with more experience in teaching. According to the report, teachers with up to three years teaching experience reported spending 48% of their time utilizing computers, teachers with teaching experience between 4 and 9 years, spend 45% of their time utilizing computers, teachers with experience between 10 and 19 years spend 47% of the time, and finally teachers with more than 20 years teaching experience utilize computers 33% of their time. The reason to this disparity may be that fresh teachers are more experienced in using the technology.

Further, Lau & Sim (2008), conducted a study on the extent of ICT adoption among 250 secondary school teachers in Malaysia. Their findings revealed that older teachers frequently use computer technology in the classrooms more than the younger teachers. The major reason could be that the older teachers having rich experience in teaching, classroom management and also competent in the use of computers can easily integrate ICT into their teaching. The result is in agreement with Russell, Bebell, O'Dwyer, & O'Connor, (2003) who found that new teachers who were highly skilled with technology more than older teachers did not incorporate ICT in their teaching. The researchers cited two reasons: new teachers focus could be on how to use ICT instead of how to incorporate ICT in their teaching. Secondly, new teachers could experience some challenges in their first few years of teaching and spend most of their time in familiarizing themselves with school's curriculum and classroom management.

But in a survey of almost 3000 teachers, Russell, O'Dwyer, Bebell and Tao (2007) argued that the quality of ICT integration was related to the years of teacher service. However, Granger, Morbey, Lotherington, Owston and Wideman (2002) conducted a qualitative survey on factors contributing to teachers' successful implementation of ICT in Canada. They interviewed 60 respondents from 12 schools. The findings found no relationship between teachers' teaching experience and experience in the use of ICT implying that teachers' ICT skills and successful implementation is complex and not a clear predictor of ICT integration.

Teacher workload

Many studies have revealed that the workloads of teachers influence their acceptance of technology in classrooms. For example, Samarawickrema & Stacey (2007) investigated factors related to the use of learning management system in a large multi-campus urban university in Australia. They adopted case study method and purposive sampling to select 22 participants used web-based methods to teach both on- and off- campus students for the study. The findings of the research found that increased workload coupled with teaching with technology was critical to the participants of the study. Factors reported to contribute to increased workload were course maintenance and constant upgrades, student emails, the learning of new skills and the continuous search of sustainable strategies.

Similarly, Neyland (2011) conducted both quantitative and qualitative research on factors influencing the integration of online learning in high schools in Sydney. The study involved 26 computer coordinators. In an interview, one computer coordinator in a schools stated that increased workload of teachers was alarming: "Asking them to take on board yet another task in an already overcrowded curriculum and extremely busy work day is pushing many teachers to the

limit and in some cases beyond" (p.11). Also, Abuhmaid (2011) conducted study on the conduct and effectiveness of ICT training courses within the Jordanian education system. The sample population was 115 teachers and 12 school principals. Interviews, questionnaires, direct classroom observations, and field-notes of classroom practices were used for data collection. In the study, one principal reported that "teachers are already overloaded; they could not cope with the pressure and the pressure from ICT training" (p.12). In addition, a teacher stated that "teachers are overloaded to learn, prepare and practice what they learn" (p.12). According to Fullan (2003), for teachers to realize the aims of educational system as well as implementing new initiatives, it necessary to lessen the workload of teachers.

Institutional characteristics

Institutional factors help to improve teachers' existing attributes. According to Vannatta & Fordham (2004), teacher's time committed to teaching and amount of technology training are reliable factors of technology use in classroom. They asserted that teacher trainers and administrators should not only "provide extensive training on educational technology, but should also facilitate a contribution to teaching improvement" (p. 262). Norris, Poirot & Soloway (2003) also pointed out to the importance of access to technology. Therefore, an understanding of institutional characteristics that influence teachers' adoption and integration of ICT into teaching is relevant.

Professional development

Teachers' professional development is a key factor to successful integration of computers into classroom teaching. Several studies have revealed that whether beginner or experienced, ICT-related training programs develop teachers' competences in computer use (Bauer & Kenton, 2005; Franklin, 2007; Wozney et al., 2006), influence teachers' attitudes towards computers (Hew and Brush, 2007; Keengwe and Onchwari, 2008) as well as assisting teachers reorganize the task of technology and how new technology tools are significant in student learning (Plair, 2008). Muller and his colleagues (2008) related technology training to successful integration of technology in the classroom. In a study of 400 pre-tertiary teachers, they showed that professional development and the continuing support of good practice are among the greatest determinants of successful ICT integration
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Sandholtz & Reilly (2004) claim that teachers' technology skills are strong determinant of ICT integration, but they are not conditions for effective use of technology in the classroom. They argue that training programs that concentrate on ICT pedagogical training instead of technical issues and effective technical support, help teachers apply technologies in teaching and learning. Research studies revealed that quality professional training program helps teachers implement technology and transform teaching practices (Brinkerhoff, 2006; Diehl, 2005). Lawless and Pellegrino (2007) claim that if training program is of high quality, the period for training lasts longer, new technologies for teaching and learning are offered, educators are eagerly involved in important context activities, teamwork among colleagues is improved and has clear vision for students attainment. Teachers may adopt and integrate ICT into their teaching when training programs concentrate on subject matter, values and the technology.

Similarly, research has shown that teachers require expert in technology to show them the way to integrate ICT to facilitate students' learning (Plair, 2008). Teachers' understanding of content knowledge and how to apply technology to support students' learning and attainment are joined to their increase in knowledge level, confidence and attitudes towards technology. Educators who integrate technology with new teaching practices gained through professional training can transform the performance of the students (Lawless & Pellegrino, 2007). According to (Chen, 2008), professional training courses must be designed to identify beliefs about successful teaching, policies for enhanced teaching and learning and syllabus design for teaching purposes. Teachers who are committed to professional development activities gain knowledge of ICT integration and classroom technology organization (Wepner, Tao & Ziomek, 2006).

Clearly, it is imperative to allow teacher trainees to apply ICT in their programs when in school in order to be able to use the technology to supplement their teaching activities. Teachers when given time to practice with the technology, learn, share and collaborate with peer, it is likely that they will integrate the technology into their teaching. Training programs for teachers that embrace educational practices and strategies to address beliefs, skills and knowledge improve teachers' awareness and insights in advance, in relation to transformations in classroom activities (Levin & Wadmany, 2008).

Accessibility

Access to ICT infrastructure and resources in schools is a necessary condition to the integration of ICT in education (Plomp, Anderson, Law, & Quale, 2009). Effective adoption and integration of ICT into teaching in schools depends mainly on the availability and accessibility of ICT resources such as hardware, software, etc. Obviously, if teachers cannot access ICT resources, then they will not use them. Therefore, access to computers, updated software and hardware are key elements to successful adoption and integration of technology. A study by Yildrim (2007) found that access to technological resources is one of the effective ways to teachers' pedagogical use of ICT in teaching. Further a study of 814 faculty members in higher education in Turkey showed that majority of the respondents reported having access to computers and the internet. 82.5% and 81.2% of faculty members had access to computers and internet respectively (Usluel, Askar & Bas, 2008).

Also a quantitative study was conducted by Albirini (2006) to collect evidence from high school English teachers' views on computer attributes, cultural perceptions, computer competence, computer access, and personal characteristics. The respondents of the study were 63 male sand 251female teachers. The result revealed that 57% of the respondents had computers at home and 33.4% had access to computers at school. This is an indication of teachers' inadequate access to computers. Further the National Centre for Education Statistics (2000 as cited in Afshari, Bakar, Luan, Samah, & Fooi 2009) report revealed that over 50% of the respondents used computers for research and lesson preparation in their schools. About 78% of the respondents complained of inadequate access to computers in classroom. Of this percentage, 38% of the respondents stated that inadequate computers were not great barriers to ICT use in their teaching, but improved availability and fairness of access to technology resources by teachers, students and administrative staff is essential.

Access to hardware and software is not only important, but also the use of suitable kind of tools and program to support teaching and learning (Tondeur, Valcke, & van Braak, 2008). "Access to appropriate technology means that affordances and constraints (Friedhoff, 2008, cited in Chen, 2010, p.3) of a technological tool need to be carefully considered when the tool is incorporated in lesson". Also, it is necessary to make a distinction of access to ICT resources. For instance, in a study of preservice teachers by Dexter & Reidel (2003), they revealed that 37.4% of the teachers

had access to computers and 14.4% of the students had access to computers, implying that computers are more available to teachers than students. Obviously, to encourage student-centred technology learning, it is necessary that learners have access to quality technology resources.

Technical support

Jones (2004) reported that the breakdown of a computer causes interruptions and if there is lack of technical assistance, then it is likely that the regular repairs of the computer will not be carried out resulting in teachers not using computers in teaching. The effect is that teachers will be discouraged from using computers because of fear of equipment failure since no one would give them technical support in case there is technical problem. Becta (2004) agreed that "if there is a lack of technical support available in a school, then it is likely that technical maintenance will not be carried out regularly, resulting in a higher risk of technical breakdowns" (p.16). In Ireland, the National Council for Technology in Education, NCTE 2005 census on ICT infrastructure (as cited in ICT strategy group report, 2008-2013) found that about 85.3% of schools reported technical support and maintenance as a 'high' or 'very high' priority and claimed that it should be an important element of the school ICT environment with proper technical support being made available to maintain hardware and infrastructure. Similarly, Yilmaz, (2011) in assessing the technology integration processes in the Turkish education system reported that in providing schools with hardware and internet connections, it is also crucial to provide the schools with technical support with regard to repair and maintenance for the continue use of ICT in schools.

Therefore, if there is no technical support for teachers, they become frustrated resulting in their unwillingness to use ICT (Tong & Trinidad, 2005). Even though, lack of technical support discourages teachers from adopting and integrating technology in classrooms, a study by (Korte & Husing, 2007) revealed that schools in Britain and the Netherlands have appreciated the significance of technical support to help teachers to integrate technology into their teaching. They argued that ICT support in schools influence teachers to apply ICT in classrooms without wasting time troubleshooting hardware and software problems.

Leadership support

Though infrastructure support is imperative, school technology leadership is a stronger predictor of teachers' use of computer technology in teaching (Anderson & Dexter, 2005). Yee (2000) believe that a leader who implements technology plans and also shares a common vision with the teachers stimulate them to use technology in their lessons. Schiff and Solmon suggest that for effective utilization of ICT by teachers, there is the need for a strong leadership to drive a well-designed technology plans in schools (as cited in Lai & Pratt, 2004, p.462). Becta report on the effect of ICT on teaching in basic schools in United Kingdom also stressed on significance of good leadership (as cited in Lai & Pratt, 2004, p.462). In addition Becta, identified five factors that were essential to be present in schools if ICT was to be utilized properly (as cited in Lai & Pratt, 2004, p.462). These factors were ICT resources, ICT teaching, ICT leadership, general teaching and general school leadership. According to the report:
> *"Although ICT opportunities are typically provided by the classroom teachers, the quality of leadership and management of ICT in a school is crucial to the provision of good ICT learning opportunities. As the quality of ICT leadership improves, so does the percentage*

of schools providing good quality ICT learning opportunities" (as cited in Lai & Pratt, 2004, p.462).

Wong & Li (2008) conducted a study on factors that influenced transformational integration of ICT in eight schools in Hong Kong and Singapore. The study revealed that leadership promotion of collaboration and experimentation and teachers dedication to student-centred learning influenced effective ICT transformation. In a quantitative study conducted by Ng (2008) on aspects of transformational leadership with 80 Singaporean secondary teachers, he found that a transformational leadership with qualities of identifying and articulating a vision, promoting acceptance of group goals, providing individualized support, offering intellectual stimulation, providing an appropriate model, creating high performance expectations, and strengthening school culture could influence the integration of ICT. Similarly, Afshari et al. (2009) distributed questionnaires to 30 heads of second-cycle institutions in Tehran. Their results revealed a relationship between the head's level of computer competence and transformational leadership practices. They concluded that transformational leadership could help improve the integration of ICT into teaching and learning processes.

Further, Yuen, Law & Chan (2003) conducted case study of 18 schools in Hong Kong. They found that in catalytic integration model schools, the school principal is the key change agent, exhibiting visionary leadership, staff development and involvement while in cultural innovation model schools, multiple leadership is exhibited where the school principal is not necessarily involved in ICT leadership, teachers are free to implement new ideas in supportive and enhancing culture. Also studies have shown that various levels of leadership such as principal, administrative leadership and technology leadership influence successful use of ICT in schools (Anderson & Dexter, 2005). This aspect of leadership will help the principal to share tasks with subordinates while focusing on the adoption and integration of technology in the school. Institutions exemplified by executive involvement and decision-making, strengthened by ICT plan, effectively adopt ICT integration curriculum.

Technological Characteristics

Technology characteristics influence the diffusion processes of an innovation and are significant factors impacting an innovation adoption. Evidence suggests that innovation attributes: relative advantage, compatibility, complexity, trialability and observability as perceived by individuals influence the rate of adoption (Rogers, 2003). He stresses the need to understand the perceptions of an innovation, as this has strong influence on future prediction of adoption of specific innovation. Understanding educators' perceptions of innovation is key to successful adoption of technology in learning, which according to Watson (2006) is a particular kind of instructive innovation. Groff & Mouza (2008) assert that when teachers integrate ICT into teaching, they operate as innovators. A number of recent studies on these areas have been studied. Examples include studies on students' perceptions of educational technology in tertiary education (Parker, Bianchi &Cheach, 2008), perceptions of pre-service teachers, perceptions of asynchronous discussion boards (Ajayi, 2009), teachers' perceptions of learning technologies (Cope & Ward, 2002) and perceived attributes of the Internet to predict the adoption of the Internet as a learning tool (Martins, Steil & Todesco, 2004). These studies found observability and trialability as the two most significant elements.

Further, Jebelie & Reeve (2003) studied teacher adoption of web technology in a second-cycle school and reported that relative advantage, compatibility, visibility, ease of use, results demonstrability and trialability be taken into consideration by school principals wanting to

maximize the ICT use in their schools. More recent study by Smarkola (2007), confirmed that perceived usefulness and perceived ease of use were predictors of user acceptance of computer technology. Also, Tella,Tella, Toyobo, Adika & Adeyinka (2007) investigated 700 Nigerian secondary school teachers' uses of ICTs and implications for further development of ICT use in schools. The findings showed that most teachers perceived ICT as very useful and as making teaching and learning easier.

Further, Askar, Usluel & Mumcu, (2006) examined the extent to which perceived innovation characteristics are associated with the probability of task related ICT use among secondary school teachers. A questionnaire was completed by 416 secondary school teachers in Turkey to determine the task-related usage and the perceptions of the teachers in regard to ICT. The findings showed that complexity or ease of use was a common perceived innovation characteristic for teaching delivery, preparation and managerial tasks in schools. Also the study reveals that observability is a perceived attribute in teaching delivery in some specific tasks performed during the class period while relative advantage and compatibility are for teaching preparation tasks.

In a similar study, Usluel, Askar & Bas (2008) adopted structural equation modeling technique to analyze the effects of technology resources and computer attributes (i.e. relative advantage, compatibility, ease of use and observability) on innovative educational and administrative uses. The study involved 834 faculty members from 22 universities in Turkey. They reported that about 61% of variance of ICT use was explained by ICT resources and computer attributes. In addition, Yi et al. (2006) reported that relative advantage, complexity, observability, and image are the most significant factors in predicting student teachers' intentions to make use of technology. According to Dillon & Morris (1996, p.6), "innovations that offer advantages, compatibility with existing practices and beliefs, low complexity, potential trialability and observability will have a more widespread and rapid rate of integration". Therefore, if teachers perceive that an innovation has an advantage over the existing technology, compatible with their social needs, ease to adopt, it can be trialed before use and finally the results can been seen, it is likely that teachers will adopt and integrate it quickly.

In spite of the factors that encourage teachers' use of ICT in classrooms, several studies have conducted empirical research on factors (barriers) that discourage the use of ICT by teachers. Balanskat et al. (2007), categorized the factors that prevent teachers from ICT use into teacher-level, school-level and system-level barriers. Teacher-level barriers include lack of teacher ICT skills; lack of teacher confidence; lack of pedagogical teacher training; lack of follow-up of new and lack of differentiated training programmes. The school-level barriers comprise absence of ICT infrastructure; old or poorly maintained hardware; lack of suitable educational software; limited access to ICT; limited project-related experience; lack of ICT mainstreaming into school's strategy and the system-level barriers include rigid structure of traditional education systems; traditional assessment; restrictive curricula and restricted organizational structure.

Yildirim (2007) conducted a survey on factors that discourage teachers' use of computer technology in classrooms. He reported that the major use of technology by teachers was to prepare lesson notes and assessments instead of improving students' performances. The research also revealed that barriers to the use of technology include congested classes, insufficient training, inadequate technical and pedagogical support, rigid school syllabi, inadequate motivation, lack of strong leadership and inadequate cooperation among teachers. Slaouti & Barton (2007) also claimed that lack of access, time pressures, lack of mentors and

opportunities for training have effect on teachers' use of ICT in teaching and learning. Similarly, Chigona & Chigona (2010) employed qualitative approach to collect and analyze empirical data on factors preventing teachers from using ICT in teaching in Khanya schools in South Africa. Fourteen educators were sampled from four high schools and interviewed. The study revealed that inadequate training, lack of access to computer laboratories, lack of technical support and inadequate technology resources were factors discouraging teachers from implementing ICT into their teaching.

Also Peralta & Costa (2007) collected and analyzed data on teachers' confidence and competence in the use of ICT in teaching. The quantitative and qualitative research randomly sampled 20 teachers from Greece, Italy, Spain, Portugal and the Netherlands. The findings revealed that lack of teachers' time to learn new skills, old ICT equipment, large classes, number of computers available for pupils' use, lack of technical and pedagogical support and lack of collaboration among teachers were constraints to teachers' confidence and competence in the use of ICT. Understanding the extent to which these barriers affect individuals and institutions may help in deciding how they are to be tackled (Becta, 2004).

CONCLUSION

The rise of technologies has complicated its adoption and integration by teachers in classroom. The effective integration of technology into classroom practices poses a challenge to teachers than connecting computers to a network. For successful integration of ICT into teaching, the review has highlighted on factors that positively or negatively influence teachers' use of ICT. These are personal, institutional and technological factors. Research has revealed that these factors are related to each other.

On a personal level, there are numerous factors that influence teachers' use of ICT. Teachers' feelings, knowledge and attitudes influence their use of ICT in teaching. Research has shown that teachers' attitudes towards technology influence their acceptance of the usefulness of technology and its integration into teaching (Huang & Liaw, 2005). If teachers' attitudes are positive toward the use of educational technology then they can easily provide useful insight about the adoption and integration of ICT into teaching and learning processes.

On the school level, factors such as support, funding, training and facilities influence teachers' adoption and integration of technologies into their classrooms. Teachers' professional development is a key factor to successful integration of computers into classroom teaching. ICT-related training programs develop teachers' competences in computer use (Bauer & Kenton, 2005; Franklin, 2007; Wozney et al., 2006), influencing teachers' attitudes towards computers (Keengwe and Onchwari, 2008) and assisting teachers reorganize the task of technology and how new technology tools are significant in student learning (Plair, 2008).

On the technological level, for successful adoption and integration of ICT into teaching, teachers must perceive the technology as better than previous practice; consistent with their existing values, past experiences and needs; ease to use, can be experimented with on a limited basis before making a decision to adopt and finally the results of the innovation are visible to others. Many teachers are hesitant to change an existing program to something they only know through discussion and reading and not through observation. These three characteristics or attributes of teachers' adoption and integration of ICT into teaching provide information of factors supporting their use of technology as well as barriers to ICT integration. The key factor in the studies is teachers' attitudes toward technology or intentions to use technology in their classrooms. If teachers have negative attitudes toward technology, providing them with excellent ICT facilities

may not influence them to use it in their teaching. Therefore, teachers need to be assured that technology can make their teaching interesting, easier, more fun for them and students, more motivating and more enjoyable.

Finally, factors (barriers) that discourage the use of ICT by teachers were also reviewed. These factors categorized are into teacher-level, school-level and system-level barriers. Teacher-level barriers include lack of teacher ICT skills; lack of teacher confidence; lack of pedagogical teacher training; lack of follow-up of new and lack of differentiated training programmes. The school-level barriers comprise absence of ICT infrastructure; old or poorly maintained hardware; lack of suitable educational software; limited access to ICT; limited project-related experience; lack of ICT mainstreaming into school's strategy and the system-level barriers include rigid structure of traditional education systems; traditional assessment; restrictive curricula and restricted organizational structure. Knowing the extent to which these barriers affect individuals and institutions may help in taking a decision on how to tackle them (Becta, 2004).

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