ROLE OF ADVANCED ICT FOR FUTURE TEACHER EDUCATION

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Abstract

This article discusses the Roles of ICT in education. Information communication technologies (ICT) at present are influencing every aspect of human life. They are playing salient roles in work places, business, education, and entertainment. Moreover, many people recognize ICTs as catalysts for change; change in working conditions, handling and exchanging information, teaching methods, learning approaches, scientific research, and in accessing information. Therefore, this review article discusses the roles of ICTs, the promises, limitations and key challenges of integration to education systems. The review attempts in answering the following questions: (1) What are the benefits of ICTs in education? (2) What are the existing promises of ICT use in education systems of some developing countries? (3) What are the limitations and key challenges of ICTs integration to education systems? The review concludes that regardless of all the limitations characterizing it, ICT benefits education systems to provide quality education in alignment with constructivism, which is a contemporary paradigm of learning.

Introduction:- Educational systems around the world are under increasing pressure to use the new information and communication technologies (ICTs) to teach students the knowledge and skills they need in the 21st century. The 1998 UNESCO World Education Report, Teachers and Teaching in a Changing World, describes the radical implications the new information and communication technologies have for conventional teaching and learning. It predicts the transformation of the teaching-learning process and the way teachers and learners gain access to knowledge and information. It states:

New possibilities are emerging which already show a powerful impact on meeting basic learning needs, and it is clear that the educational potential of these new possibilities has barely been tapped. These new possibilities exist largely as the result of two converging forces, both recent by-products of the general development process. First the quantity of information available in the world-much of it relevant to survival and basic well-being-is exponentially greater than that available only a few years ago, and the rate of its growth is accelerating. A synergistic effect occurs when important information is coupled with the second modern advance-the new capacity to communicate among the people of the world. The opportunity exists to harness this force and use it positively, consciously, and with design in order to contribute to meeting defined learning needs (1998 UNESCO World Education Report, p. 19).

To effectively harness the power of the new information and communication technologies (ICTs) to improve learning, the following essential conditions must be met:
• Students and teachers must have sufficient access to digital technologies and the Internet in their classrooms, schools, and teacher education institutions.
• High quality, meaningful, and culturally responsive digital content must be available for teachers and learners.
• Teachers must have the knowledge and skills to use the new digital tools and resources to help all students achieve high academic standards.

Teacher education institutions are faced with the challenge of preparing a new generation of teachers to effectively use the new learning tools in their teaching practices. For many teacher education programmes, this daunting task requires the acquisition of new resources, expertise and careful planning.

In approaching this task it is helpful to understand:
• The impact of technology on global society and the implications for education
• The extensive knowledge that has been generated about how people learn and what this means for creating more effective and engaging student-centered learning environments
• The stages of teacher development and the levels of adoption of ICTs by teachers
• The critical importance of context, culture, leadership and vision, lifelong learning, and the change process in planning for the integration of technology into teacher education
• The ICT competencies required of teachers related to content, pedagogy, technical issues, social issues, collaboration, and networking
• The importance of developing standards to guide implementation of ICTs in teacher education
• The essential conditions for successful integration of ICTs into teacher education
• Important strategies to consider in planning for the infusion of ICTs in teacher education and managing the change process.

THE TRADITIONAL VIEW OF THE LEARNING PROCESS

The existing view of the learning process emerged out of the factory model of education at the turn of the 20th century and was highly effective in preparing large numbers of individuals with skills needed for low-skilled positions in industry and agriculture. The innovation of classrooms with 20-30 students was created along with the concept of standardized instruction for everyone. The traditional, teacher-centred approach to learning is illustrated. As described, the teacher is the expert and the dispenser of knowledge to the students. It is largely a 'broadcast' model of learning where the teacher serves as the repository and transmitter of knowledge to the students.

The traditional educational paradigm is often characterized by the following views of learning:
• Learning is hard. Many view learning as a difficult and often tedious process. According to this view, if students are having fun or enjoying what they are doing in a learning activity, they probably are not learning.
• Learning is based on a deficit model of the student. The system strives to identify deficiencies and weaknesses of the student. Based on noted deficiencies, students are tracked, categorized, remediated or failed. The impact of the deficit model of student learning is most obvious in compensatory education programmes. As implied by the term, compensatory education is designed to make up or remediate learning that some children, particularly poor minority children, do not have, but which the curriculum and structure of schooling assume are common to all children.
• Learning is a process of information transfer and reception. Much of our present learning enterprise remains "information-oriented," emphasizing students reproducing knowledge rather than producing their own knowledge. It also remains teacher-centred. Many still see the role of the teacher as a dispenser of information and the role of the student as a passive receiver, storer and repeater of the transmitted information. The prevalence of this view is supported by observations that teachers continue to rely on old standbys such as lectures, textbook reading, and fill-in-the-worksheets practices that reduce students to passive recipients of information and fail to develop their thinking skills.
• **Learning is an individual/solitary process.** In a study of schools in the United States, the National Assessment of Educational Progress noted that most students spend long hours working alone at their desks completing worksheets or repetitive tasks. A London Times survey of English school children indicated that students almost unanimously rejected this daily ordeal of dull and ritualistically solitary classroom activity and called for a broader and more exciting curriculum. Above all, they wanted more work allowing them to **think for themselves.** They wanted to design and make things, to experiment and to engage in first-hand observation. The Times reported, however, that there was little evidence of changes in the curriculum that would respond to the students’ wishes. (Resta, 1996)

• **Learning is facilitated by breaking content/instruction into small isolated units.** The educational system is often geared more to categorizing and analyzing patches of knowledge than to sewing them together. Bruer (1993) notes that the technology of mass education is quite adept at "breaking knowledge and skills into thousands of little standardized, decontextualized pieces, which could be taught and tested one at a time." Neil Postman in his book, *Teaching as a Subversive Activity*, states that our educational systems break knowledge and experience into "subjects, relentlessly turning wholes into parts, history into events without restoring continuity." (Postman, 1969)

• **Learning is a linear process.** Frequently, the textbook or teacher provides only one linear path through a narrowly bounded content area or sequence of standardized instructional units. For example, in a mathematics text only one correct problem solution trail may be offered for a specific subclass of problems. However, the problems encountered in daily life (or in mathematics) seldom have only one solution path or sequence.

**CHANGES IN VIEWS OF THE LEARNING PROCESS**

In contrast to the traditional teaching-learning paradigm, a new paradigm of the teaching-learning process is emerging, based on three decades of research in human learning, that encompasses the following views of the human learning process:

• **Learning is a natural process.** The natural state of the brain is to learn, however, not everyone learns in the same way. There are different learning, perceptual and personality styles that must be considered in the design of learning experiences for the individual student. Given interesting and rich learning environments, and supportive and stimulating teachers, students will learn. Teachers have often noted that children who appear disruptive or to have short attention spans when confronted with typical classroom instruction, may spend long periods engaged in meaningful and interesting computer-related activities.

• **Learning is a social process.** The communal context of knowledge and learning is beginning to be rediscovered, as evidenced by the rapid growth of quality circles and computer-supported collaborative work in business, government, medicine, and higher education. As Vygotsky (1978) noted long ago, students learn best in collaboration with peers, teachers, parents, and others when they are actively engaged in meaningful, interesting tasks. ICTs provide opportunities for teachers and students to collaborate with others across the country and across the globe. They also provide new tools to support this collaborative learning in the classroom and online.

• **Learning is an active and not a passive process.** In most fields, people are faced with the challenge of **producing knowledge** rather than simply **reproducing knowledge.** To allow students to move toward competence, they must be actively engaged in the learning process, in activities such as solving real problems, producing original writing, completing scientific research projects (rather than simply studying about science), dialoguing with others on important issues, providing artistic and musical performances, and constructing physical objects. The traditional curriculum asks students only to recall and describe what others have accomplished or produced. While all production of knowledge must be based on an understanding of prior knowledge, the mere reproduction of...
knowledge, without its connection to the production of knowledge, is largely a passive activity that neither fully engages nor challenges the student.

- **Learning may either be linear or non-linear.** Much of what now happens in schools appears based on the notion that the mind works like a serial processor that is designed to process only one piece of information at a time in sequential order. But the mind is a wonderful parallel processor that may attend to and process many different types of information simultaneously. Cognitive theory and research sees learning as a reorganization of knowledge structures. The knowledge structures are stored in semantic memory as schema or cognitive maps. Students "learn" by augmenting, combining, and rearranging a collection of cognitive maps, many of which overlap or are interconnected through a complex network of associations. There are many ways that students may acquire and process information and assimilate it into their existing knowledge structures. Although some knowledge domains, such as mathematics, may perhaps lend themselves to a linear approach, not all learning can or should occur linearly.

- **Learning is integrative and contextualized.** Pribram’s holistic brain theory suggests that information presented globally is more easily assimilated than information presented only in a sequence of information elements (Pribram, 1991). It is also easier for students to see relations and to make connections. Jacob Bronowski (1990), in *Science and Human Values*, made the point that to discover the connection between what had seemed two isolated facts of existence is a creative act, whether the field is art or science. He calls it an act of unifying. This is not something that can be done for learners; these connections cannot be made in learners’ minds. Information can be given, the connection can even be stated. But even if the information is repeated, it cannot be assumed it is really known. The learners must discover it for themselves. That is not to say that learners must discover everything unaided. The teacher’s role is to help them in several ways to make connections and to integrate knowledge.

- **Learning is based on a strength model of student abilities, interest, and culture.** Based on the work of Howard Gardner and others, schools are beginning to consider the specific strengths and interests that students bring to the learning environment, and are designing learning activities that build on student strengths rather than focusing only upon remediating weaknesses. In addition, schools increasingly recognize diversity as a resource rather than a problem in the classroom. In contrast to the remedial and standardized concept of instruction, diversity and individual differences are valued and the learning process is designed to build on the strengths and assets brought by the learner to the classroom.

- **Learning is assessed through task completion, products, and real problem solving of both individual and group efforts.** Rather than simply evaluating students through paper and pencil tests, assessments are made using portfolios of actual performances and work in both collaborative and individual learning tasks.

**The Benefits of ICT in Education**

The uses of ICT is making major differences in the learning of students and teaching approaches. Schools in the Western World invested a lot for ICT infrastructures over the last 20 years, and students use computers more often and for a much larger range of applications (Volman, 2005). Several studies reveal that students using ICT facilities mostly show higher learning gains than those who do not use. For instance, Kulik’s (1994) finding across 75 studies in the United States showed the following. Students who used computer tutorials in mathematics, natural science, and social science score significantly higher on tests in these subjects. Students who used simulation software in science also scored higher. The findings also indicated that primary school students who used tutorial software in reading scored significantly higher on reading scores. Very young students who used
computers to write their own stories scored significantly higher on measures of reading skill. Moreover, students who used word processors or otherwise used the computer for writing scored higher on measures of writing skill. Furthermore, the use of ICTs in education also shifts the learning approaches. As put by (Bransford, Brown, and Cocking, 1999) cited in Volman (2005), there is a common belief that the use of ICTs in education contributes to a more constructivist learning and an increase in activity and greater responsibility of students. This limits the role of the teacher to supporting, advising, and coaching students rather than merely transmitting knowledge. The gradual progress in using computers changes from learning about computers, to learning computers, and finally to learning with computers (Volman, 2005). With respect to introducing ICT technologies in schools, Olson (2000) advises to explore the following questions as bases for inservice teacher education. These are (1) how can the theoretical ideas tested in practice? (2) What does practice say back to these theoretical ideas? (3) How is useful negative feedbacks obtained? (4) What might be substantive talking points about the new processes? What is practical from a classroom perspective? (5) What does talking about the new say about the nature of existing technology? Is it adequate? (6) What scaffold needs for the next stage? On the other hand, teachers’ reluctance to adopt innovations need to be seen in the context of existing technology and commitments. Fullen (1989) cited in Watson (2001) states that change or improvement can happen at schools if teachers understand themselves and understood by others. For instance, many teachers are currently not in a position to make informed judgments on ICTs to support their teaching goals. Clearly a variety of factors still do make using ICT in the curriculum problematic (Watson, 2001). Because of this, the influence of ICT did not bring revolutionary changes at schools. For instance, the National ICT survey in the Netherlands shows that most primary-school students use computers less than once a week and there are still many secondary school teachers who do not use ICT at all (Volman, 2005). Most often, they use computers for drill-and-practice and word processing. In recent years however, there has been a growing interest to know how computers and internet can best utilized to improve effectiveness and efficiency of education at all levels and in both formal and non formal settings. As there is a shift of theories explaining learning processes, ICTs become handmaiden for learning activities. Voogt’s (2003) description on the major roles, distinguished ICTs as an object for study, an aspect of a discipline or a profession, and a medium of instruction. As a medium of instruction, ICTs fit to realize and implement the emerging pedagogy of constructivism (Davis, 1997; Office of Technology Assessment, 1995; Panel on Educational Technology, 1997; Watson, 1996) in Voogt (2003). Moreover, Voogt (2003) differentiated between traditional learning setting and constructivist approaches. The former considers learning as transmission of knowledge to students, which is the sole responsibility of the teacher. On the other hand, the constructivist approach considers learning as authentic and learner centred. ICT, the computer for example is a great help in the constructivist approach, where one can design simulated and individualized learning environments to students. ICTs are exerting impacts on pedagogical approaches in the classrooms. Their contribution to changes in teaching practices, school innovation, and community services is considerable. A research review by Kozma (2005) suggests three significant concerns of consideration regarding ICTs impact on education. Firstly, student out comes such as higher scores in school subjects or the learning of entirely new skills needed for a developing economy. Secondly, we should consider teacher and classroom outcomes such as development of teachers’ technology skills and knowledge of new pedagogic approaches as well as improved attitudes toward teaching. Finally, one has to consider other outcomes such as increased innovativeness in schools and access of community members to adult education and literacy. The table below presents comparison of the traditional pedagogy and the emerging pedagogy of constructivism that fits to the use of ICT (particularly the computer and internet) to increase student involvement in learning.
Emerging pedagogy is the name given to the new view of constructivist learning when compared to the relatively long existing behaviorist view of learning.

The Role of Information communication for future Teacher Education Overview of Pedagogy in the Traditional versus Information Society

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<th>Aspect</th>
<th>Traditional pedagogy</th>
<th>Emerging pedagogy for the information society</th>
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<tr>
<td><strong>Active learning</strong></td>
<td>Activities prescribed by teacher</td>
<td>Activities determined by learners</td>
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<td>Activities determined by learners</td>
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<td></td>
<td>Whole class instruction</td>
<td>Small group</td>
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<td></td>
<td>Little variation activities</td>
<td>Many different activities</td>
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<td></td>
<td>Pace determined by the programme</td>
<td>Pace determined by learners</td>
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<tr>
<td><strong>Collaborative</strong></td>
<td>Individual</td>
<td>Working in teams</td>
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<td>Homogenous groups</td>
<td>Heterogeneous groups</td>
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<td></td>
<td>Every one for him/herself</td>
<td>Supporting each other</td>
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<tr>
<td><strong>Integrative</strong></td>
<td>No link between theory and practice</td>
<td>Integrating theory and practice</td>
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<td>Separate subjects</td>
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<td>Teams of teachers</td>
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<td><strong>Evaluative</strong></td>
<td>Traditional pedagogy</td>
<td>Emerging pedagogy for the information society</td>
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**Active learning:** - ICT-enhanced learning mobilizes tools for examination, calculation and analysis of information in order to provide a platform for student inquiry, analysis and construction of new information. The learners therefore, learn as they do and, whenever appropriate work on real-life problems in-depth. Moreover, ICT makes the learning less abstract and more relevant to their life situations. In contrast to memorization-based or rote learning, that is the feature of traditional pedagogy; ICT-enhanced learning promotes increased learner engagement. ICT-enhanced learning can also be ‘just-in-time’ learning that the learners choose what to learn when they need.

**Collaborative learning:** - ICT-supported learning encourages interaction and cooperation among students, teachers, and experts regardless of where they are. Apart from modeling real world interactions, ICT-supported learning provides opportunity to work with students from different cultures, thereby helping to enhance learners teaming and communication skills as well as their global awareness. It models learning done throughout the learner’s lifetime by expanding the learning pace to include not just peers but also mentors and experts from different fields.

**Creative learning:** - ICT-supported learning promotes the manipulation of existing information and the creation of real-world products rather than the duplication of received information.

**Integrative learning:** - ICT-enhanced learning promotes a thematic integrative approach to teaching and learning. This approach eliminates the artificial separation between the different disciplines and between theory and practice, which characterizes the traditional approach.

**Evaluative learning:** - ICT-enhanced learning is student-directed and diagnostic.

Unlike static, text or print-based education,

ICT-enhanced learning recognizes the presence of different learning pathways to explore and discover rather than merely listen and remember. The discussion above clearly elaborates the role of ICTs in facilitating the pedagogy of schools in the information society. As put by (Davis, 1997; Office of Technology Assessment, 1995; panel of Education Technology, 1997; Watson, 1996) in Voogt (2003), ICT is becoming more fitting to realize and implement the emerging pedagogy of constructivism. Nevertheless, an International study by Pelgrum and Anderson (1999) in Voogt (2003) shows a major obstacle for ICT integration in education and that is the difficulty of integrating computers and internet into classroom practices. Teachers’ lack of competence and enthusiasm to use computers in the instructional processes also contribute for the difficulty. However, in order to improve, and make optimal use of ICTs, changes in the pedagogic approaches and classroom strategies as well as integrating ICT in teacher training and staff development practices accompanied
by teacher motivation schemes are imperative. Generally, Voogt (2003) describes the following functions of ICT in education. ICT as object. It refers to learning about ICT. Mostly organized in a specific course. What is being learned depends on the type of education and the level of the students? Education prepares students for the use of ICT in education, future occupation, and social life.

· ICT as an ‘assisting tool’. ICT is used as a tool, for example while making assignments, collecting data and documentation, communicating, and conducting research. Typically, ICT is used independently from the subject matter.

· ICT as a medium for teaching and learning. This refers to ICT as a tool for teaching and learning itself, the medium through which teachers can teach and learners can learn. It appears in many different forms, such as drill and practice exercises, in simulations and educational networks.

· ICT as a tool for organization and management in schools.

The Key Challenges of ICTs Integration in Education

The integration of ICTs in education systems may face various challenges with respect to policy, planning, infrastructure, learning content and language, capacity building and financing. ICT-enhanced education requires clearly stated objectives, mobilization of resources and political commitment of the concerned bodies. Tinio (2002) discusses issues such as analysis of current practices and arrangements, identification of potential drives and barriers, curriculum and pedagogy, infrastructure and capacity building to be considered in the formulation of policy and planning. In addition, it is wise to specify educational goals at different education and training levels as well as the different modalities of ICT use that can facilitate in the pursuit of the goals. Policy makers then, need to know the potentials of ICTs in applying different contexts for different purposes. Other challenging points at the level of policy and planning are identification of stakeholders and harmonization of efforts across different interest groups, the piloting of the chosen ICT-based model, and specification of existing sources of financing and the development of strategies for generating financial resources to support ICT use over the long term. The infrastructure challenges that may exist are absence of appropriate buildings and rooms to house the technology, shortage of electric supply and telephone lines, and lack of the different types of ICTs. Because of this, one need to deal with infrastructure related challenges before the planning of ICTs integration to education systems. With respect to challenges of capacity building, we have to develop competencies of teachers and school administrators for the successful integration of ICT in the education system. In fact, one impeding factor of ICTs integration in education systems is the skill gap of people implementing it (Tinio, 2002). For instance, teachers need professional development to gain skills with particular applications of ICT, integration into existing curricula, curricular changes related to its use, changes in teacher role, and on underpinning educational theories such as constructivism/or student-centred learning. Because of this, any attempt of ICT integration in education should parallel with teachers professional development. The school leadership also plays a key role in the integration of ICT in education. Lack of support from the school administration is also a big challenge. Thus, for the effectiveness of ICT integration, administrators must be competent and have a broad understanding of the technical, curricular, administrative, financial, and social dimensions of ICT use in education. Furthermore, learning content and language also challenge the integration of ICT in education. Content development is a critical area that educators overlook. In integrating ICT in education, we have to care for the relevance of the learning content to the target groups. With respect to language, English is the dominant language in many of educational software, while English language proficiency is not high in many of the developing countries, and this is one barrier in the integration of ICT to education. Another great challenge is the financing. ICTs in education programs require large capital investment and developing countries need to predict the benefit of ICT use to balance the cost relative to the existing alternatives. Potential sources of money and resources for ICT use programs suggested are grants, public subsidies, fund-raising events, in kind support from volunteers, community support,
Overcoming the mentioned challenges may help education systems benefit the most from this technology.

**Summary and the Way Forward**

This Research paper attempts to answer questions on the roles of ICTs in education, existing promises, limitations and the challenges of its integration in education systems. Information communication technologies are influencing all aspects of life including education. They are promoting changes in working conditions, handling and exchanging of information, teaching-learning approaches and so on. One area in which the impacts of ICT is significant, is education. ICTs are making major differences in the teaching approaches and the ways students are learning. ICT-enhanced learning environment facilitates active, collaborative, creative, integrative, and evaluative learning as an advantage over the traditional method. In other words, ICT is becoming more appropriate in the realization and implementation of the emerging pedagogy of constructivism that gives greater responsibility of learning for students. Several surveys are showing that ICT use in education systems of developed nations has comparatively advanced than ICT use in education systems of developing nations. In addition, the major promises of ICTs use in education systems of developing countries focus on training teachers in new skills and introducing innovative pedagogies into the classrooms, investing on ICT infrastructure for schools and creating networks among educational institutes, improving overall standard of education by reducing the gap in quality of education between schools in urban and rural areas, initiation of smart school with objectives to foster self-paced, self assessed, and self-directed learning through the applications of ICTs, and developing ICT policy for education and training. On the other hand, this article discusses the major limitations of ICT use in education as teacher related, student related, and technology related. In addition, the key challenges of ICTs integration into education systems discussed relate to policy, planning, infrastructure, learning content and language, capacity building and financing. What will be the way forward then? There is a consensus that the development of any country depends upon the quality of education programs offered to citizens. ICTs, despite their known limitations, are believed to be beneficial in this regard. The computer and the internet are especially useful to enhance student engagement in learning and positively impact student performance and achievement. Moreover, their usefulness is more apparent in the 21st century, where the time is an era of information rich that the conventional modes of teaching learning could hardly handle it. The reviewer of this article strongly recommends the mainstreaming of ICT utilization (particularly the computer and internet) in education systems at levels, for they benefit curriculum implementation and enhanced student learning. Therefore, education policy makers, educators and all concerned should evaluate and recognize the roles of ICT in education in order to work for the effective functioning of this technology in their education system.

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