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Impact of ICT on the Teaching and Learning Process

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Abstract: *The impact of ICT for teaching and learning process has become pertinent as it facilitates teaching and learning process, create conducive learning environment, and help learners develop creative thinking and self confidence. This paper focuses on the use of ICT in schools by students and teachers to support the processes of learning and teaching. It describes the ways in which teachers could and/or should facilitate student use of computer systems and how they can progress. The use of information and communication technology in schools is taken very seriously by governments and educational systems around the world as it provides access to a variety of information sources, forms and types; help in the preparation of reports and the organization of events; helps to put down the barriers between information held on several systems, thus creating a borderless communication and information environment by allowing users to access different database, thus having access to millions of information at their finger tips. This paper thus suggests that effective introduction of ICT in the teaching and learning process is an indispensable means of improving it.*

Keywords*: Computer Aided Instruction, Expert system, Intelligent tutoring system, E- learning, database management system.*

I. Introduction

Technology is developed to solve problems associated with human need in more productive ways. If there is no problem to solve, the technology may not be developed and/or not adopted. Applying this principle to educational technology would mean that educational institution should create and adopt technologies that address educational problems, of which there are many. Furthermore, a technology will not be adopted by educators where there is no perceived need or productivity gain. This is what Lankshear, Snyder and Green (2000) refer to as the 'workability' principle. Therefore, when discussing applications of computer technology to education the question must always be asked, "what educational problem needs to be addressed? This question needs to be asked at all levels of decision making from the teacher planning a programme, to a school administrator purchasing hardware and software, to an educational system officer developing policy and strategic plans. At the teacher level the question becomes: am I satisfied with the educational opportunities I am able to offer children in school classrooms? While teachers should never be completely satisfied, and the will always strive to do better, the question really is whether what they provide adequately develops the potential of the students and adequately prepares them for a productive life in the society. Many educators (for example National Centre for Vocational Education Research, 2002) and educational commentator (Muroch, 2001) believe that what is during the late 1970s and early 1980s, computers became more affordable to schools.

The use of information and communication technology in schools is taken very seriously by governments and educational systems around the world. As educational systems move towards the mainstream use of ICT in teaching and learning there appear to be more critical steps and vital ingredients needed for the successful infusion of ICT into educational environments. Although stand alone computers have been in most schools for more than two decades now, networked ICT is relatively new for many schools as they continue to grapple with how to use ICT to enhance teaching and learning environments. Since the development of the first computers many have argued that computers should be used to support learning. These argument have amplified as computers have evolved into powerful relatively low cost technology available today. However, there is considerable debate over how computers should be used in schools (Riel, 1998).

This paper focuses on the use of ICT in schools by students to support the processes of learning and teaching. It will aim to describe the ways in which teachers could and/or should facilitate student use of computer systems and how they can progress. This paper begins with a background to the use of computers in schools, touching on the rationale for computers in schools. This leads into a discussion of the professional development needs of teachers for the progression of using ICT in learning and teaching.

II. Schools, Learning And Computers

Schools and educational systems must provide the infrastructure and support for students and teachers, and the maintenance of constructive learning environment in which ICT is used. At the same time ICT tools will

assist schools and educational systems in carrying this out. Research has consistently shown that few schools and teachers implement ICT support to a degree where the potential benefits are likely to be realized. There are a number of significant problems which impede and prevent teachers from achieving the full advantage offered by ICT applications. Cradler (2002) gave seven requirements for effective use of ICT in education:

1. Suiting technology to education goals and standards.
2. Having a vision for the use of technology to support curriculum.
3. Providing for both in-service and pre-service training.
4. Ensure access to appropriate technology
5. Provide for administrative support for technology use
6. Providing time for teachers to plan and learn how to integrate technology
7. Providing for on-going technique support for technology use

In general, these requirements fall into three areas of impact:

- Providing the infrastructure of hardware and software,
- Providing curriculum and technical support for teachers,
- School organization, design, policies and practices, schooling, and management support.

Any discussion about the use of computer systems in schools is built upon understandings of the link between schools, learning and computer technology. When the potential use of computers in schools was first mooted, the predominant conception was that students would be 'taught' by computers (Mevarech, and Light, 1992). In a sense it was considered that the computer would 'take over' the teacher's job in much the same way as a robot computer may take over a welder's job.

Broadly speaking, computer literacy is a component of technology education, which is distinct from using technologies such as computer systems to support learning and teaching processes. The latter is generally referred to as educational technology; and is applied to a wide range of technologies such as black boards and chalk, pencils, books, and slide-rules to television, facsimiles and computers. This paper will focus on the use of computer systems as educational technologies. Since the beginning of the 1990s, educators have been particularly concerned that very little of the potential of computers to support learning in schools seems to have been realized, despite a sufficient installed base of computers. One reason often given for this anomaly is that the technology is not sufficiently accessible, particularly if students have to go to a special room to gain access. The 1990s was the decade of computer communications and information access, particularly with the popularity and accessibility of internet-based services such as electronic mail and the World Wide Web. At the same time the CD-ROM became the standard for distributing packages such as encyclopaedia to be cheaply and easily distributed. As a result educators became more focused on the use of the technology to improve student learning as a rationale for investment.

Today computer in schools are both a focus of studies in themselves (technology education) and a support of learning and teaching (educational technology). Rationales can be presented for both computer literacy and using computers as part of educational technology. It has been argued earlier that ICT is a mediator of learning as a component of the learning environment. It is generally agreed that in education the unique instructional characteristics of computers needs to be exploited (committee on Development in the Science of Learning, 2000). There are four distinct characteristics of computer technology which have clear implications for using computers in classroom logical programming, interactive control, graphics and audio output, and information processing. There are many ways in which these characteristics could be used and have been shown to support students and teachers in improving learning outcomes and increasing productivity. The degree to which each of these should be applied will depend on any array of variables such as the developmental age and characteristics of the student, the characteristics of the learning environment, and the nature of the curriculum content.

III. Providing The Infrastructure

The infrastructure requirements may be viewed in terms of the electronic resources, hardware, users and implementation. The relative lack of good quality software and associated courseware is well documented and is being attended to by software producers and educators throughout the world. The problems associated with hardware were mainly a lack of it however there is still a major problem with the appropriateness of the hardware used. The use of inappropriate hardware, the lack of useful software and the difficulty in gaining adequate access to computer system were noted as major obstacles to the use of ICT by teachers and students. The choice and distribution of hardware and software are crucial to the success of computer use in schools. In the establishment of the computer's place in the school curriculum, the school needs to carefully consider the establishment of a library of software able to support the use of the ICT in ways established in the school's computing philosophy. Schools with a small computing resource would probably need to buy software likely to have wide use in the school. Many packages are of limited use and can only be used for a small number of functions within a limited age group. Some packages require individual access to be of use to the teacher. These

may best be used in schools with more resources. Some packages are more easily integrated into the curriculum than others which may require a degree of teacher involvement and preparation. Many teachers prefer to use software which requires little teacher preparation and planning. In such instances the software can often determine the content of subsequent lessons rather than the teacher or the planned curriculum. When a teacher is made to plan the ways in which the computer will be used, it is likely that the use will be more applicable to the curriculum and more useful to the teacher and students.

IV. Electronic Resources

If the aim is to provide more student-directed learning experiences then students need to be provided with access to extensive sets of resources which is only feasible using predominantly electronic resources. These resources will consist of data files and software applications (programs) that may be distributed online or on disc. Therefore schools and systems need to provide teachers and students with ready and easy access to these resources. Increasingly, this access will be online, particularly for data files, and while there is a huge quantity of such resources there are two major problems:

1. Accessing high quality resources.
2. Choosing appropriate resources.

V. Hardware

It is important that students have adequate access to appropriate hardware. Teachers and students need access to computers for substantial periods of time where they are. Since the majority of programs require students to have individual access to computers, the achievement of significant results is dependent upon the amount of computer equipment available for use by the students. Computers are expensive items and it is difficult to afford to purchase an adequate number of computers. At times schools buy hardware not suited to the needs of their students. Computer technology is constantly improving making it difficult to make purchasing decisions. There are many considerations in the selection of appropriate hardware, most of which relate to the ability of the computer system to facilitate the completion of educational tasks. However, many studies have highlighted the effect of inappropriate hardware (and software) on the attitudes and associated skills of users. The serious unreliability of hardware diminishes the value of computer/ICT use in facilitating the completion of task.

Therefore, it is important that we select appropriate hardware for the educational environment in which it is to be used. This will require consideration of the characteristics of the:

1. Users (teachers and students).
2. Physical setting (layout of the classroom)
3. Educational application (that is, what the computer is to be used for)

The characteristics of the user which should be considered include:

1. Level of computer literacy (teacher or students)
2. Developmental age of students
3. Physical capabilities or disabilities of students

VI. Networking

The networking of educational technology resources benefits students, teachers and schools by facilitating information technology learning activities giving ready access to software, allowing a variety of communications, reducing costs of equipment, increasing processing power and facilitating the management of student learning (Cradler and Bridgforth, 2002). It helps to put down the barriers between information held on several (not only computer) systems, thus creating a borderless communication and information environment by allowing users to access remote programmes and remote database either of the same institution or from another institution with ease (Groessler, 1995). Three categories of network scenario should be considered in the use of computer networks in schools.

- Intra-school networks
- Inter-school networks
- External networks (internet)

Hardware Organization for adequate access

There are a number of methods which can be used to distribute access to a school's computer/ICT systems. This depends on the number of facilities available.

Laboratory: Groups of computers/ICT equipment are made available in a central location which may be booked by a teacher. This may be dedicated classroom, part of the library or part of a learning resource centre.

Mobile trolleys': Desk top computer/ICT equipment can be put on a trolley which a teacher may book and wheel into the normal classroom.

Mobile laboratory: A number of reasonably portable computer/ICT equipment (ideally notebook or palmtop size computers) may be available for a teacher to book for a lesson. The computers/ICT equipment are brought in and set up for the lesson and returned at the end.

Classroom computer(s): One or more computer(s)/ICT equipment may be allocated permanently to a teacher's classroom.

Impact on the learning environment

ICT has the following impacts on the learning environment:

Investigating reality and building knowledge

ICT allows students to investigate more thoroughly the real world. They can more readily access information sources outside the classroom and can use tools to analyse and interpret such information. Information may be accessed through online systems or through data logging systems. It also makes it easier for individuals to interact and gain expert knowledge with a very short time, thus making the acquisition of knowledge to take place easily within a very short period of time (Amalnik, Moayyedi, & Mirzaei, 2015)

Active learning and authentic assessment

ICTs potentially offer increased possibilities for codification of knowledge about teaching and for innovation in teaching activities through being able to deliver learning and cognitive activities anywhere at any time (Larsen & Vincent-Lancrin, 2005). In many classroom situations it is difficult to allow students to be sufficiently active as participants. Typically students are often passive, spending a lot of time listening or reading. It is well known that students are more likely to be interested and attentive and will achieve a wider range of learning outcomes if they can be active. Their engagement with the curriculum will increase as they are afforded opportunities to create their own information and represent their own ideas. Expert system can be used to provide students with learning experiences where they are interacting directly with the computer system, and are not just passive but active participants in the learning process, thus increasing the quality of education (Salekhova, Nurgaliev, Zaripova & Khakimullina, 2013). According to Motamedi (undated), technology makes the students take an active role in learning instead of taking on a passive role of receiving information from the teacher.

Engage students by motivation and challenge

The interactive and multimedia nature of modern computer system has provided the opportunity for software developers to create increasingly more stimulating features. Computer system does provide the opportunity to create a wide range of interesting learning experiences as it makes learning, participatory and a social process supporting personal life goals and needs (McLoughlin and Lee, 2007). This is likely to help to maintain student interest and interest a wide range of students (Cradler & Bridgforth, 2002). The interactive and multimedia features within software can be used to help students grapple with concepts and ideas.

Provide tools to increase student productivity

In the past students have spent a lot of time doing repetitive, low-level tasks particularly involving writing, drawing and computation. While it may be necessary for students to developing these skills at some times on most occasions they are pre-requisite to some higher level task. Unnecessary repetition of low-level tasks is inefficient, non-motivational and may obscure the real purpose of the learning activity. Many computer applications provide the tools to support students in quickly completing these lower-level tasks so that they can focus on the main purpose of the activity. Word processors, graphics packages, database packages, spreadsheets and other software support the performance of students. ICT has transformed teaching and learning processes from being highly teacher-dominated to student- centred, and that this transformation will result in increased learning gains for students, creating and allowing for opportunities for learners to develop their creativity, problem-solving abilities, informational reasoning skills, communication skills, and other higher-order thinking skills (Bhaurao, 2015).

Provide scaffolding to support higher level thinking

There is an increasing range of software tools which can be used to support the development of higher thinking skills such as application, analysis and synthesis (The National Foundation for the Improvement of Education, 2001). Tools can be used to analyze data, present data, link data or information, present information

in different formats, simulate environments and conditions and support interactive communications. This allows teachers to consider providing a range of activities to assist students to become critical thinkers, designers and problem solvers.

Increasing learner independence

Computer systems are increasingly being used to provide learning experiences when and where they are needed. This provides students with greater independence not only in terms of when and where they learn but also what they learn (Cradler and Bridgforth, 2002).

Collaborative and co-operative learning

The use of ICT leads to more co-operation among learners within and beyond school and a more interactive relationship between students and teachers.

Note: Collaboration is a philosophy of interaction and personal lifestyle where individuals are responsible for their actions, including learning and respect the abilities and contributions of their peers while co-operation is a structure of interaction designed to facilitate the accomplishment of a specific end product or goal through people working together in groups.

Tailoring learning to the learner

In most traditional learning situations it is not possible to provide each student with an instructor and for that instructor to specially design learning experiences for that student. The closest to this is the apprenticeship system. The programmability and interactivity possible with computer systems provides the opportunity to develop software which stimulates the role of an instructor. Intelligent tutoring software may use information about the student to recommend appropriate sequences or sections of a tutorial for the student (Cradler and Bridgforth, 2002).

Overcome physical disabilities

The variety of input and output devices available provides the opportunity for students who are physically handicapped to be involved in the same learning activities as other students. For some students computers provide the only environment which they can manipulate and the only tools that reduce their level of disability. Modified keyboards and mouse-drivers may be used to allow extremely handicapped students to use regular software packages. For students who are not able to take notes during the course of the class, the system stores in a database lessons already taken for further studies and provides a more user friendly environment for blind students through audio interpretation of the course (Bingimlas, 2009), thus enhancing their learning.

Educational productivity

Productivity is a concept most happily found in economics textbooks where the productivity of a worker or economic unit is defined by dividing the output (revenue) by the input (cost). This is more difficult to define for the education industry since the output is not easily measured, particularly not in monetary terms to compare with the costs. The output is largely the quantity and quality of learning demonstrated by students, or learning outcomes. Educational technology should influence educational outcomes and costs. If the most appropriate educational technology is selected by a teacher then student learning should be optimized, which means an increase in the value of the outcomes.

Student learning

There are many potential uses for computers in the learning process. In some situations changes in relevant industries makes computer use in schools imperative. For example, to provide courses in music, technical drawing, statistics, and business which do not incorporate computer use reduces the relevancy of the courses to the real world. Here the rationale cries out from the work place but needs to be responded to with careful impact of ICT on learning and teaching.

Management of learning experiences

The management of high quality educational programmes requires and generates large quantities and types of data. Teachers face many management problems which when analysed could be suitable for a computer solution. There are many such tasks which may be both time consuming and tedious for which teachers should consider a computer solution. Such tasks may include: the organization of assessments, the maintenance of library functions, the preparation of reports and the organization of events. There are many school management packages which will complete tasks such as these and thereby free up a substantial amount of time for other more important tasks. Schools should make use of the opportunity to continually provide more appropriate solutions to the dynamic problems associated with the provision of schooling.

VII. Impact On The Curriculum

Information and Communication Technology (ICT), impacts on educational standards only when there is fertile background for making efficient use of it (Machin, 2006). Earlier it was argued that there is a two-way relationship between ICT and the curriculum where ICT may be used to assist in conveying the curriculum but at the same time may change the content of the curriculum. Further research has shown that the effectiveness in the use of ICT to support learning is a function of the curriculum content and the instructional strategy such that when appropriate content is addressed using appropriate strategies students and teachers will benefit (Cradler and Bridgforth, 2002; Sharma, 2015). The impact of ICT on curriculum content may be viewed in terms of:

- Declarative knowledge – describes objects and events by specifying the properties which characterize them.
- Procedural knowledge – focuses on the processes needed to obtain a result.

Most educators would perceive the impact of ICT on the curriculum to be positive. With the use of ICT students can use more primary source material and be encouraged to address real problems and develop analytical and interpretive skills. The classroom can be a part of the learning process in an open and continuing dialogue. While the impact will be evident on almost all disciplines of learning, the degree will vary substantially (Becta, 2006). According to Balanskat, Blamire and Kefala (2006), ICT is said to enable teachers to save time and to increase productivity in such activities as:

- Access to a variety of information sources, forms and types
- preparing and updating daily lessons;
- plans, making hard copy visualisations and handouts for classes, as well as individualised educational plans for slower students and students with disabilities or with special problems;
- presenting visual/oral content materials, tasks, and questions to the audience;
- maintaining grade books;
- compiling a data bank of exam questions;
- online inspection and correction of students' work on their computers; and
- keeping records, chronicles, and archives of all the above-mentioned events and proceedings with fast retrieval and easy access to any entry.

ICT can enhance teaching by enhancing what is already practiced or introducing news and better ways of learning and teaching (European Schoolnet, 2004). It has a positive effect on behaviour, motivation, communication and process skills of students and teachers.

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