Review Article

Applications of Computer and Information Communication Technology in Research and Development: A Review

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Abstract

The computer has the potential of expanding the horizon of educational researchers to carry out quality research, analyses necessary data and then get the research information disseminated. It is relevant in educational research design, getting relevant related literature, and the design, development, validation and administration of research instruments. It has made possible and enhanced the possibility of global research with real time contact (synchronous) between researchers. The computer can be used for data collection, collation, analysis and interpretation of research data than can be done using the hand. Educational researchers should not be contented with using the computer as word processing equipment, but rather, should integrate it into all aspects of educational research and statistics to husband its potentials.

Keywords: Research, Computer; Data collection; Data analysis; Literature review; Research design

Introduction

Computer is an advanced electronic device that takes raw data as input from the user and processes these data under the control of set of instructions (called program) and gives the result (output) and saves output for the future use. It can process both numerical and non-numerical (arithmetic and logical) calculations. A computer has following characteristics, which make very important in various fields:

FAST: a computer is so fast that it can perform the given task in few second as compare to man who can spend many months for doing the same task. A computer can process million instructions per second.

Accurate: while doing calculator, a computer is more accurate than man. Man can make mistake in calculations but a computer does not, if it provide with accurate instructions.

High memory: a computer has much more memory of storage capacity then human. It can store million of data and instruction, which can be retrieving and recalled even after number of years.

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According to Daniels (2002), ICTs have become within a very short time, one of the basic building blocks of modern society. Many countries now regard understanding ICT and mastering the basic skills and concepts of ICT as part of the core of education, alongside reading, writing and numeracy. However, there appears to be a misconception that ICTs generally refers to 'computers and computing related activities'.

Pelgrum and Law (2003) state that near the end of the 1980s, the term 'computers' was replaced by 'IT' (information technology) signifying a shift of focus from computing technology to the capacity to store and retrieve information. This was followed by the introduction of the term 'ICT' (information and communication technology) around 1992, when e-mail started to become available to the general public (Pelgrum and Law, 2003).

According to a *United Nations report (1999)*, ICTs cover Internet service provision, telecommunications equipment and services, information technology equipment and services, media and broadcasting, libraries and documentation centres, commercial information providers, network-based information services, and other related information and communication activities.

According to *UNESCO (2002)*, information and communication technology (ICT) may be regarded as the combination of 'Informatics technology' with other related

technology, specifically communication technology.

The various kinds of ICT products available and having relevance to education, such as teleconferencing, email, audio conferencing, television lessons, radio broadcasts, interactive radio counselling, interactive voice response system, audiocassettes and CD ROMs etc have been used in education for different purposes (Sharma, 2003; Sanyal, 2001; Bhattacharya and Sharma, 2007).

The developments in information and communication technology (ICT) have further given further impetus to the exploitation of the potentials of computer in educational research. The advantages inherent in the computer have facilitated and provided educational researchers with limitless opportunities for designing, implementing, and analyzing, storing and disseminating educational research findings. These are possible through the advantages of several application packages (word processing, statistical and graphical) CD-ROM, Internet, e-mail, on-line databases, digital video, virtual library,' and so on. With the advances in computer technology, educational researchers are provided with useful and simpler tools for designing instruments for instrument administration, and statistical analysis.

In specific terms, the computer can provide useful avenue for the identification of appropriate research questions, access to useful and related literature and other forms of information relevant to educational research, It can be used for data generation, data collection, organization and data analysis (quantitative and qualitative).

Generally, the computer can be used in the following areas of educational research: research design, review of related literature, design and implementation of experimental or descriptive studies, statistical analysis of research data, production and storage of research information, and the dissemination of research information.

Thus, this paper presents a review of ways and methods through which the potentials of computer can be exploited in the various stages of educational research from the design, through implementation to the eventual dissemination of educational research report.

A computer has four functions:

(i). Input (Data): Input is the raw information entered into a computer from the input devices. It is the collection of letters, numbers, images etc.

(ii). Process: Process is the operation of data as per given instruction. It is totally internal process of the computer system.

(iii). Output: Output is the processed data given by computer after data processing. Output is also called as Result. We can save these results in the storage devices for the future use.

(iv). Computer System All of the components of a computer system can be summarized with the simple equations.

- *COMPUTER SYSTEM = HARDWARE + SOFTWARE+ USER*
- *Hardware = Internal Devices + Peripheral Devices*
- *Software = Programs Software gives "intelligence" to the computer.*
- *USER = Person, who operates computer.*
- *Processor = Central PROCESSING UNIT (CPU)*

The main unit inside the computer is the CPU. This unit is responsible for all events inside the computer. It controls all internal and external devices, performs arithmetic and logic operations. The CPU (Central Processing Unit) is the device that interprets and executes instructions.

Software, simply are the computer programs. The instructions given to the computer in the form of a program is called Software. Software is the set of programs, which are used for different purposes. All the programs used in computer to perform specific task is called Software.

Types of software

I. System software:

a) *Operating System Software*: DOS, Windows XP, Windows Vista, Unix/Linux, MAC/OS X etc.

b) *Utility Software*: Windows Explorer (File/Folder Management), Windows Media Player, Anti- Virus Utilities, Disk Defragmentation, Disk Clean, Back Up, WinZip, Win RAR etc…

II. Application software:

a) *Package Software*: Ms. Office 2003, Ms. Office 2007, Macro media (Dreamweaver, Flash, and Freehand), Adobe (PageMaker, Photo Shop)

b) *Tailored or Custom Software*: SAGE (Accounting), Galileo/World span (Travel) etc.

Application of computer

In Research and Development

Computers have always assisted to solve the problem faced by the mankind. Since the time of invention the size of computers has drastically reduced from that of room to that can be accommodated in a human palm. The word computer mean “something which computes or a machine for performing calculations automatically”. But today computer means not merely a “calculator”. It does vast

variety of jobs with tremendous speed and efficiency. Today people use computers in almost every walk of life. Computers have become a subject of study schools, collage and laboratories etc.

Research and development, often called R&D a phrase that means different things in different applications. Computers play a major role today in every field of scientific research from genetic engineering to astrophysics research. Our Nation's economic growth depends on our capacity to educate, innovate, and build. Long-term national investments in basic and applied research and development (R&D) play an important role in the flow of market-based innovations through a complex system that leverages the combined talents of scientists and engineers, entrepreneurs, business managers and industrialists. These funds have led to everything from small entrepreneurial initiatives to growth in high technology industries with the concomitant employment of millions of workers.

The large impact on employment results from innovation impacts not only in high tech enterprises, but also other industries that benefit from increased capabilities and productivity. Mutually reinforcing and complementary investments in R&D by both private and public sectors work in concert to support the development, production, and commercialization of new products and processes.

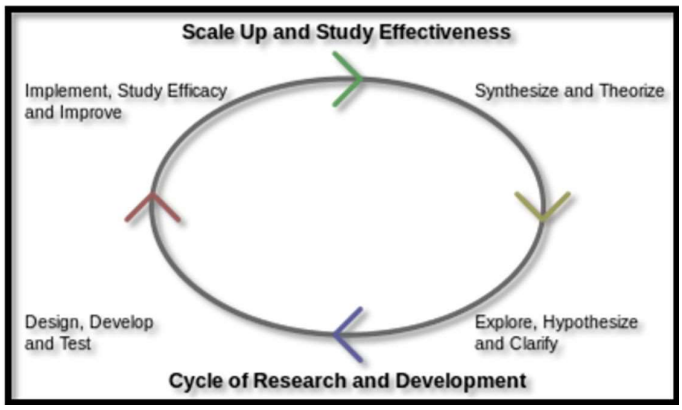

Figure 1. Schematic Representation of R and D Cycle

Research and Development aids us as human beings to understand ourselves better and hence get the solutions particularly to our health problems, easily and guided. Today the results of Research and Development conducted by universities and other organizations are applied to industry in a number of ways.

The Institute of Physical and Chemical Research of Japan is, as the name suggests a laboratory for the study of physics and chemistry. It was established in 1917, with a vision to promote Japanese scientific research.

Dr. KikunaeIkeda, a chemist who discovered monosodium glutamate, a flavoring element that was later commercialized belonged to this famous Institute. Such opportunities enable our budding scientists to experiment and deliberate on certain discoveries which could make our lives better and improve our health and wellbeing.

Currently, much study has been embarked by the world scientists to find the cure to HIV/AIDS. Another drug for malaria, coathemather, has been introduced to deal with the disease as it changes form due to natural circumstances. Research and Development and subsequent facilities which are well equipped and stocked enable us to get, sometimes quick, at times long solutions to problems that affect our day to day living.

Economic growth depends on the existence of reliable institutions within which human beings think, interact and carry on business. The key to economic growth is R & D.

In Education

Computer application in educational research and statistics has greatly improved the quality of research and reduced the rigours involved in research**.** In education, research design is the arrangement of conditions for the collection and analysis of research data in a manner that aims to combine relevance to research purpose(s). It deals with the logical structure which guides the data collection of a study to answer questions on "What" When" "Where" and "Who" in educational research. In this content "what" refers to what is being measured or studied, "when" refers to the time of measurement, "where" relates to the context of the measurement, while "who" refers to the individuals involved in the measurement or investigation. "How" is concerned with the procedure of actualizing the research, research materials/instruments, data gathering procedure, and the statistical techniques, which are dependent on the scales (ordinal, nominal, interval or ratio).

ICT increases the flexibility of delivery of education so that learners can access knowledge anytime and from anywhere. It can influence the way students are taught and how they learn as now the processes are learner driven and not by teachers. This in turn would better prepare the learners for lifelong learning as well as to improve the quality of learning. In concert with geographical flexibility, technology-facilitated educational programs also remove many of the temporal constraints that face learners with special needs (Moore & Kearsley, 1996). Students are starting to appreciate the capability to undertake education anywhere, anytime and anyplace.

One of the most vital contributions of ICT in the field of education is Easy Access to Learning. With the help of ICT, students can now browse through e-books, sample

examination papers; previous year papers etc. and can also have an easy access to resource persons, mentors, experts, researchers, professionals, and peers-all over the world. This flexibility has heightened the availability of just-in-time learning and provided learning opportunities for many more learners who previously were constrained by other commitments (Young, 2002).

Wider availability of best practices and best course material in education, which can be shared by means of ICT, can foster better teaching. ICT also allows the academic institutions to reach disadvantaged groups and new international educational markets. As well as learning at anytime, teachers are also finding the capabilities of teaching at any time to be opportunistic and able to be used to advantage. Mobile technologies and seamless communications technologies support 24x7 teaching and learning. Choosing how much time will be used within the 24x7 envelope and what periods of time are challenges that will face the educators of the future (Young, 2002).

Thus, ICT enabled education will ultimately lead to the democratization of education. Especially in developing countries like India, effective use of ICT for the purpose of education has the potential to bridge the digital divide.

India has a billion-plus population and a high proportion of the young and hence it has a large formal education system. The demand for education in developing countries like India has skyrocketed as education is still regarded as an important bridge of social, economic and political mobility (Amutabi and Oketch, 2003). There exists infrastructure, socio-economic, linguistic and physical barriers in India for people who wish to access education (Bhattacharya and Sharma, 2007). This includes infrastructure, teacher and the processes quality. There exist drawbacks in general education in India as well as all over the world like lack of learning materials, teachers, remoteness of education facilities, high dropout rate etc (UNESCO, 2002). Innovative use of Information and Communication Technology can potentially solve this problem. Internet usage in home and work place has grown exponentially. ICT has the potential to remove the barriers that are causing the problems of low rate of education in any country. It can be used as a tool to overcome the issues of cost, less number of teachers, and poor quality of education as well as to overcome time and distance barriers (McGorry, 2002).

People have to access knowledge via ICT to keep pace with the latest developments (Plomp et al., 2007). ICT can be used to remove communication barriers such as that of space and time (*Lim and Chai, 2004*). ICTs also allow for the creation of digital resources like digital libraries where the students, teachers and professionals can access research material and course material from any place at any time (Bhattacharya and Sharma, 2007; Cholin, 2005). Such facilities allow the networking of academics and researchers and hence sharing of scholarly material. This avoids duplication of work (Cholin, 2005). ICT eliminating time barriers in education for learners as well as teacher. It eliminates geographical barriers as learners can logon from any place (Sanyal, 2001; Mooij, 2007; Cross and Adam, 2007; UNESCO, 2002; Bhattacharya and Sharma, 2007). ICT provides new educational approaches (Sanyal, 2001). It can provide speedy dissemination of education to target disadvantaged groups (UNESCO, 2002; Chandra and Patkar, 2007). ICT enhances the international dimension of educational services (UNESCO, 2002). It can also be used for non-formal education like health campaigns and literacy campaigns (UNESCO, 2002). Use of ICT in education develops higher order skills such as collaborating across time and place and solving complex real world problems (Bottino, 2003; Bhattacharya and Sharma, 2007; Mason, 2000; Lim and Hang, 2003). It improves the perception and understanding of the world of the student. Thus, ICT can be used to prepare the workforce for the information society and the new global economy (Kozma, 2005). Plomp et al (2007) state that the experience of many teachers, who are early innovators, is that the use of ICT is motivating for the students as well as for the teachers themselves. Bottino and Sharma (2003) mention that the use of ICT can improve performance, teaching, administration, and develop relevant skills in the disadvantaged communities. It also improves the quality of education by facilitating learning by doing, real time conversation, delayed time conversation, directed instruction, self-learning, problem solving, information seeking and analysis, and critical thinking, as well as the ability to communicate, collaborate and learn (*Yuen et al, 2003*). A great deal of research has proven the benefits to the quality of education (Al-Ansari, 2006). Hepp et al., (2004) state that the literature contains many unsubstantiated claims about the revolutionary potential of ICTs to improve the quality of education. They also note that some claims are now deferred to a near future when hardware will be presumably more affordable and software will be come, at last, an effective learning tool.

ICT enhancing learning Environment

ICT presents an entirely new learning environment for students, thus requiring a different skill set to be successful. Critical thinking, research, and evaluation skills are growing in importance as students have increasing volumes of information from a variety of sources to sort through (New Media Consortium, 2007). ICT is changing processes of teaching and learning by adding elements of vitality to learning environments including virtual environments for the purpose.

ICT is a potentially powerful tool for offering educational opportunities. It is difficult and may be even impossible to imagine future learning environments that are not supported, in one way or another, by Information and Communication Technologies (ICT). When looking at the current widespread diffusion and use of ICT in modern societies, especially by the young the so-called digital generation then it should be clear that ICT will affect the complete learning process today and in the future.

Authenticity is an important issue which should be addressed in the design and development of learning environments (Collins, 1996). Learning environments need to reflect the potential uses of knowledge that pupils are expected to master, in order to prevent the acquired knowledge from becoming inert (Bransford et al. 1990; Duffy and Knuth, 1990). In addition, teachers should stimulate pupils to engage in active knowledge construction. This calls for open-ended learning environments instead of learning environments which focus on a mere transmission of facts (Collins, 1996; Hannafin et al.,1994; Jonassen et al., 1999).

ICT provides opportunities to access an abundance of information using multiple information resources and viewing information from multiple perspectives, thus fostering the authenticity of learning environments. ICT may also make complex processes easier to understand through simulations that, again, contribute to authentic learning environments. Thus, ICT may function as a facilitator of active learning and higher-order thinking (Alexander, 1999; Jonassen, 1999). The use of ICT may foster co-operative learning and reflection about the content (Susman, 1998). Furthermore, ICT may serve as a tool to curriculum differentiation, providing opportunities for adapting the learning content and tasks to the needs and capabilities of each individual pupil and by providing tailored feedback (Mooij, 1999; Smeets and Mooij, 2001).

As Stoddart and Niederhauser (1993*)* point out, ICT may fit into a spectrum of instructional approaches, varying from traditional to innovative. Another aspect which may of course influence the use of ICT is access to technology (Kennewell et al., 2000). This refers not only to the number of computers, but also to the placement of the equipment e.g. in the classroom or in a computer room.

Kennew et al. (2000) feel it is essential that computers be placed in the classroom, in order to maximize the opportunities for curriculum activity. ICT environment improves the experience of the students and teachers and to use intensively the learning time for better results. The ICT environment has been developed by using different software and also the extended experience in developing web based and multimedia materials. ICTs have an important role to play in changing and modernizing educational systems and ways of learning.

ICT enhancing learning motivation

ICTs can enhance the quality of education in several ways, by increasing learner motivation and engagement, by facilitating the acquisition of basic skills, and by enhancing teacher training.

ICTs are also transformational tools which, when used appropriately, can promote the shift to a learner centered environment. ICTs, especially computers and Internet technologies, enable new ways of teaching and learning rather than simply allow teachers and students to do what they have done before in a better way. ICT has an impact not only on what students should learn, but it also plays a major role on how the students should learn. Along with a shift of curricula from “content-centered” to “competence-based”, the mode of curricula delivery has now shifted from “teacher centered” forms of delivery to “student-centered” forms of delivery.

ICT provides motivation to Learn. ICTs such as videos, television and multimedia computer software that combine text, sound, and colourful moving images can be used to provide challenging and authentic content that will engage the student in the learning process. Interactive radio likewise makes use of sound effects, songs, dramatizations, comic skits, and other performance conventions to compel the students to listen and become more involved in the lessons being delivered. Some of the parents of the respondents opined that their children were feeling more motivated than before in such type of teaching in the classroom rather than the stereotype 45 minutes lecture. They were of the view that this type of learning process is much more effective than the monotonous monologue classroom situation where the teacher just lectures from a raised platform and the students just listen to the teacher.

ICT changes the characteristics of problems and learning tasks, and hence play an important task as mediator of cognitive development, enhancing the acquisition of generic cognitive competencies as essential for life in our knowledge society. Students using ICTs for learning purposes become immersed in the process of learning and as more and more students use computers as information sources and cognitive tools (Reeves and Jonassen, 1996), the influence of the technology on supporting how students learn will continue to increase. Learning approaches using contemporary ICTs provide many opportunities for constructivist learning through their provision and support for resource-based, student centered settings and by enabling learning to be related to context and to practice (Berge, 1998; Barron, 1998).The teachers could make their

lecture more attractive and lively by using multi-media and on the other hand the students were able to capture the lessons taught to them easily. As they found the class very interesting, the teachings also retained in their mind for a longer span which supported them during the time of examination. More so than any other type of ICT, networked computers with Internet connectivity can increase learner motivation as it combines the media richness and interactivity of other ICTs with the opportunity to connect with real people and to participate in real world events.

ICT enhanced learning is student-directed and diagnostic. Unlike static, text-or print-based educational technologies, ICT-enhanced learning recognizes that there are many different learning pathways and many different articulations of knowledge.

ICTs allow learners to explore and discover rather than merely listen and remember. The World Wide Web (www) also provides a virtual international gallery for students' work (Loveless, 2003). ICT can engage and inspire students, and this has been cited as a factor influencing ready adaptors of ICT (Long, 2001).

ICT enhancing the scholastic performance

Based on the extensive usage of ICTs in education the need appeared to unravel the myth that surrounds the use of information and communication technology (ICT) as an aid to teaching and learning, and the impact it has on students' academic performance.

ICTs are said to help expand access to education, strengthen the relevance of education to the increasingly digital workplace, and raise educational quality. However, the experience of introducing different ICTs in the classroom and other educational settings all over the world over the past several decades suggests that the full realization of the potential educational benefits of ICT.

The direct link between ICT use and students' academic performance has been the focus of extensive literature during the last two decades. ICT helps students to their learning by improving the communication between them and the instructors (Valasidou and Bousiou, 2005).

The analysis of the effects of the methodological and technological innovations on the students' attitude towards the learning process and on students' performance seems to be evolving towards a consensus, according to which an appropriate use of digital technologies in education can have significant positive effects both on students' attitude and their achievement. Research has shown that the appropriate use of ICTs can catalyze the paradigmatic shift in both content and pedagogy that is at the heart of education reform in the 21st century.

Kulik's (1994) meta-analysis study revealed that, on average, students who used ICT-based instruction scored higher than students without computers. The students also learned more in less time and liked their classes more when ICT-based instruction was included.

Fuchs and Woessman (2004) used international data from the Programme for International Student Assessment (PISA), they showed that while the bivariate correlation between the availability of ICT and students' performance is strongly and significantly positive, the correlation becomes small and insignificant when other student environment characteristics are taken into consideration.

Attwell and Battle (1999) examined the relationship between having a home computer and school performance, their findings suggest that students who have access to a computer at home for educational purposes, have improved scores in reading and math.

Becker (2000) found that ICT increases student engagement, which leads to an increased amount of time students spend working outside class.

Coates et al. (2004) showed that students in on-campus courses usually score better than their online counterparts, but this difference is not significant here. ICTs especially computers and Internet technologies enable new ways of teaching and learning rather than simply allow teachers and students to do what they have done before in a better way.

ICT helps in providing a catalyst for rethinking teaching practice (Flecknoe, 2002) developing the kind of graduates and citizens required in an information society improving educational outcomes (especially pass rates) and enhancing and improving the quality of teaching and learning (Wagner, 2001). ICT can help deepen students' content knowledge, engage them in constructing their own knowledge, and support the development of complex thinking skills (Kozma, 2005; Kulik, 2003; Webb and Cox, 2004). Studies have identified a variety of constructivist learning strategies (e.g., students work in collaborative groups or students create products that represent what they are learning) that can change the way students interact with the content (Windschitl, 2002).

Fister et al (2008) also depict the power of tablet PCs to improve mathematics instruction. ICTs have the potential for increasing access to and improving the relevance and quality of education.

Agriculture

Agriculture Research have benefited from incorporation of technological advances primarily developed for other industries. The industrial age brought mechanization and

synthesized fertilizers to agriculture. The technology age offered genetic engineering and automation. The information age brings the potential for integrating the technological and industrial advances into sustainable agriculture production system.

The application of the computer in agriculture research originally exploited for the conversion of statistical formula or complex model in digital farm for easy and accurate calculation which are found relatively tedious in manual calculation.

Data Storage & Analysis

Computers and related software can be used to analyses data, draw graph and other statistical tasks. It is the science of collecting, analyzing and interpreting quantitative data in a way that the reliability of the conclusions can be evaluated in an objective way. The computer facilitates the compilation and performance of statistical analysis, and prints out results in tables, charts and graphs.

Complex statistical analyses are not only performed instantaneously, but also more accurately than possible through manual manipulations. It can be used for resembling which is the process of estimating probabilities by conducting vast numbers of numerical experiments (Rudner & Shafer, 1992).

Survey studies can be executed using e-mail or web form, which are electronic text communication Research instruments earl be obtained and validated through the listserv of Newsgroup.

Experimentation is the corner-stone of scientific research. Every experiment in any of the natural sciences generates a lot of data that needs to be stored and analyzed to derive important conclusions, to validate or disprove hypotheses. Computers attached with experimental apparatuses, directly record data as its generated and subject it to analysis through specially designed software.

Analyzing tons of statistical data is made possible using specially designed algorithms that are implemented by computers. This makes the extremely time-consuming job of data analysis to be a matter of a few minutes. In genetic engineering, computers have made the sequencing of the entire human genome possible. Data from different sources can be stored and accessed via computer networks set up in research labs, which makes collaboration simpler.

Instrumentation control

Most advanced scientific instruments come with their own on board computer, which can be programmed to execute various functions. For example, the Hubble space craft has its own onboard computer system which is remotely programmed to probe the deep space. Instrumentation control is one of the most important applications of computers.

Scientific Stimulations

One of the prime uses of computers in pure science and engineering projects is the running of simulations. A simulation is a mathematical modeling of a problem and a virtual study of its possible solutions. Problems which do not yield themselves to experimentation can be studied through simulations carried out on computers.

For example, astrophysicists carry out structure formation simulations, which are aimed at studying how large-scale structures like galaxies are formed. Space missions to the Moon, satellite launches and interplanetary missions are first simulated on computers to determine the best path that can be taken by the launch vehicle and spacecraft to reach its destination safely.

In pharmaceutical research

Computers play vital role in pharmaceutical field. It helps in developing protocol of various products, collection and storing of data. It play important role of collection of data of validation, good manufacturing practice and standard operating procedure etc.

Computers, Technology and Distance Learning

Distance education has been part of the educational lane and commercializes its outcomes in markets as new products or new production processes. The purpose of R & D is to create knowledge for generations. From the earliest days of correspondence courses, to the days of electronic course delivery through radio, television, and satellite, to the more recent developments of electronic course delivery via the Internet, educators have asked if students who take courses away from the teacher and the traditional classroom setting learn as much or as well as do students who are face to face with the teacher or part of a larger learning group.

The Computer as Tutor and Surrogate Teacher

One of the earliest uses of computers in classrooms was to teach the traditional curriculum and basic skills, often operating as a means to deliver instruction, sometimes as a supplement to the teachers' classroom instruction, and sometimes in lieu of the teachers' instruction.

Much of the software focused on basic skills and knowledge in the various content areas, used programmed instruction and drill and practice, and was often based on behaviorism and reductionism for its instructional design.

As time progressed, the software and usage changed and the line between the computer as a tutorial and the computer as a tool became blurred. For example, as word processors became more sophisticated and available, the computer was often used to produce student writing.

Other types of programs, such as Logo, soon further blurred the line between tutor and tool. With the change of

usage came questions about how best to evaluate the effect of the technology on student learning, but in most instances, the researchers relied on standardized test scores or other traditional measures of achievement.

Conclusion

In order to conclude we will try to proceed to synthesize from a general viewpoint the results obtained, taking into consideration the relevant aspects of the literature. The results provided by both the quantitative and qualitative analysis of the literature obtained will be exposed especially regarding those aspects which are related to ICTs for Education and ICTs in Education. ICTs for education refers to the development of information and communications technology specifically for teaching/learning purposes, while the ICTs in education involves the adoption of general components of information and communication technologies in the teaching learning process.

This literature review has sought to explore the role of ICT in education as we progress into the 21st century. In particular ICTs have impacted on educational practice in education to date in quite small ways but that the impact will grow considerably in years to come and that ICT will become a strong agent for change among many educational practices.

Extrapolating current activities and practices, the continued use and development of ICTs within education will have a strong impact on: ICT and teaching learning process; quality and accessibility of education; learning motivation, learning environment and ICT usage and academic performance. The adoption and use of ICTs in education have a positive impact on teaching, learning, and research. ICT can affect the delivery of education and enable wider access to the same. In addition, it will increase flexibility so that learners can access the education regardless of time and geographical barriers. It can influence the way students are taught and how they learn. It would provide the rich environment and motivation for teaching learning process which seems to have a profound impact on the process of learning in education by offering new possibilities for learners and teachers. These possibilities can have an impact on student performance and achievement. Similarly wider availability of best practices and best course material in education, which can be shared by means of ICT, can foster better teaching and improved academic achievement of students. The overall literature suggests that successful ICT integration in education.

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