ICT AND ITS' ROLE IN PRIMARY MATHEMATICS EDUCATION

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Abstract

We live in a dynamic society with knowledge increasing at an unpredictable rate. With the accompanying advance in technology, developing countries are no longer insulated from the effects of these changes, as evidenced by the extent to which the whole world is fast becoming a global village with constant interaction on many levels. One goal of education is the preparation of the young not only for this changed world, but also with the willingness and ability to face new and changing situations. Social, economic, and technological changes of the past decades are making education and training for all more crucial than ever. Yet, educational systems, to different degrees worldwide, are struggling to afford educational opportunities for all, to provide their graduates with the necessary knowledge and skills for evolving marketplaces and sophisticated living environments, and to prepare citizens for lifelong learning. To meet these challenges, countries have to focus concurrently on expanding access, improving internal efficiency, promoting the quality of teaching and learning right from the elementary level, and improving system management.

Keywords: ICT, education, mathematics

Mathematics continues to be an important component in the formation of the educated person and as such, mathematics education should reflect the goals of education in a dynamic society. We must therefore address not only the acquisition of skills and mastery of ideas. We must address more than the accumulation of facts and principles. Mathematics education in the age of information must place emphasis on the higher skills of discussion, interpreting and evaluation. Also, the acquisition of communication skills must become one of its prime goals. Since many mathematical ideas are abstract in nature, every effort must be made to reduce the range of such concepts at the lower level. It is the understanding and grasp of concepts in practical experiences that give children the confidence to go on to more abstract ideas in later years.

A linear expansion of existing processes and methods may not be sufficient to meet these objectives within a reasonable time. Some countries and institutions have turned to information and communication technologies (ICTs) and are exploring ways by which ICTs may help them in pursuing their educational goals. Frequently, users and experts tend to concentrate on what a specific technology can and cannot do for education. But, as Table illustrates, one technology may have different potentials depending on the purpose for using it. Also, many of the technologies have similar characteristics. Therefore assessments of the potential and appropriateness of particular technologies must be based on educational needs and objectives, rather than on the technologies themselves.,

ICTs and their potential for education

Technology	Outreach	Flexibility	Sensorial Stimulation	Interactivity
Radio	High	Limited	Audio Only	Limited
Television	High	Limited	Audiovisual	Limited
Video	Low	High	Audiovisual	Limited
PC	Low	High	Audiovisual	High
Internet	Highest	High	Audiovisual	Highest

* Limited = students and teachers must be present during transmission.

High = students can access the material at different times.

The main hindrances in the teaching–learning of Math as identified are variations in difficulty level of topics, some concepts are abstract, lack of student interest in the subject, shortage of teaching time, variations in teacher competencies, and The initial grooming at home (parental attitude and competencies)

To tackle these challenges the teaching of Math needs to be handled differently. A partial solution to all the above can be through introduction of audio visual aids in classroom teaching.

Learning perceptions

1% of what is learned is from the sense of TASTE.

1.5% of what is learned is from the sense of TOUCH.

3.5 % of what is learned is from the sense of SMELL.

11 % of what is learned is from the sense of HEARING.

83 % of what is learned is from the sense of SIGHT.

### Technology And Innovation In Mathematics Education

This is a very exciting time in the development of the educational use of ICT (Information and Communication Technology) because of recent breakthroughs in technology which are making mobile computing devices ever smaller, powerful, robust, affordable and practicable .

In UK there has been considerable developments in the educational use of ICT to support classroom teaching of mathematics with nearly all teachers having access to laptops, data projectors and the Internet, and most also having the use of Interactive White Boards (IWB) and Virtual Learning Environment platforms (VLE). The

problem now being addressed is that of providing hands-on access for students to ICT in their normal mathematics lessons when and where needed.

Educational Technology

It is concerned with the application of scientific knowledge about learning and conditions of learning. It helps to improve the effectiveness of teaching, learning and evaluation. Audio visual aids are an integral part of Educational Technology.
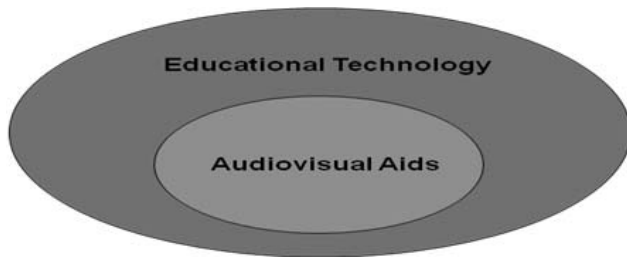
Audio visual aids (general) helps to introduce a new topic, reinforce stated facts, aid the understanding of ideas, clarify relationships or physical layouts, and distance learning (no space and time bar). Audio visual aids can be used in Math to clarify and establish concepts co-relate and co-ordinate concepts, to interpret abstract concepts, make learning more concrete, make learning more effective, and diagnosis and treatment of discalculia. With audio visual learning Math can become more interesting, meaningful and vivid.

ICT offer(s) opportunities in mathematics for practicing and consolidating number skills; developing mathematical models through exploring, interpreting and explaining data; exploring the links between shape and space and algebra; developing logical thinking; making connections within and across areas of mathematics; working with realistic data; exploring patterns and relationships; and working with graphic images.

PowerPoint Presentations can be created for a wide range of topics to help improve the average performance of students in Mathematics e.g. Numbers and number sense; Fractions; Basics concepts geometry; Area and perimeter; Time distance and speed; Circle; Angles; Elementary algebra; Mensuration; Proof without words; Audio visual proofs

Integration of PowerPoint lessons in classroom teaching can help in the effectiveness of teaching-learning of concepts in a large group is maximum, teachers find it easy to bridge the gap, when and wherever textbooks are not updated, using visuals to clarify concepts and to bring accuracy in learning Mathematics, reducing the time for learning a concept and increasing the learning outcome in the given time, and by enabling the teacher to follow the maxims of teaching like 'concrete to abstract', 'known to unknown' and 'learning by doing'.

Ground realities

Using Technology in Education is not an easy one step solution to making teaching easier. There are many obstacles that may still come in the way of introducing Technology Aided Education – these would be Resistance from school administrators; Resistance from teachers; Space; Time; Funds; Inertia (resistance to change in general) These can be overcome if the introduction is not sporadic, but planned thoroughly and process worked out right till the end.

The process that should be followed is Identification of problem as such Problem of lack of time for teaching of certain topics, students lose interest in certain topics, student result being affected, teacher frustration, and administrator dissatisfaction,

Solution; Means; Review; Modify; Educational technology cannot be implemented in isolation of the entire school system. It is a system with a number of interconnected and interdependent components.

Expanding Access

Education for All: Unattainable Reality?

Expanding access to education is a matter of both economic development and social justice. It is true that worldwide illiteracy rates have declined in the past 30 years, but it is also true that the demands on knowledge are much higher now than 30 years ago. In the past, an agrarian society could thrive economically even when more than half of its population was barely literate, but this is no longer possible in modern societies in the Information Age. To remain economically competitive and prosper in this global, knowledge-driven economy, countries cannot afford to have large sectors of their population excluded from education, or at the lower level of the educational process. Education is positively related to development—that is, a higher proportion of the population of the most developed countries has attained higher educational levels than the population of developing countries.

Reaching Large Audiences

For more than a century, education has used technology to expand beyond the physical limits of schools and university campuses and reach more and non-traditional groups of students. For instance, in the beginning of the last century, Australia and New Zealand used a system of itinerant teachers to educate children and youth living in sparsely inhabited territories. The teachers maintained contact with their students through postal correspondence. Radio, television, and computer-related technologies have expanded outreach potential further, and higher education institutions have been at the forefront of this expansion. In 1992, 41% of higher education students in Thailand and 38% in Turkey studied at a distance. The China TV University System

(Republic of China) and Anadolu University in Turkey each serves more than 500,000 students per year. The United Kingdom Open University has provided education to more than 2 million individuals since it was established about 30 years ago. Distance learning institutions generally use a mix of technologies that may include printed material, videos, videoconferencing, CD-ROMs, e-mail, and the Internet. Many of them start with less expensive technologies, such as printed materials, and move to faster and more powerful resources as the need for expansion increases.

Including the Excluded

Expanding access also means integrating populations that have been traditionally excluded from education for cultural and social reasons. In cultures with strict rules regarding interaction between genders, girls may be forced to leave school before puberty to avoid contact with male colleagues and teachers. For girls who remain in school, the rules regarding with whom they may or may not talk make it difficult to succeed. If a girl is having academic difficulties, she may rather fail than address the male teacher. Technology can promote alternatives for educating women that are more cost-effective than all-female schools without disrupting cultural traditions. Television and radio broadcasts or Internet-based technologies enable girls to continue their studies from home or small learning centers. Technology functions as a neutral mediator, without gender or cultural allegiances, thereby facilitating communication.

For persons with disabilities—who represent another significant and forgotten sector of the world population—technologies provide essential supports enabling them to participate in the educational system and the job market. VisualTek is a camera and monitor that enlarge print materials for people with visual disabilities. Voice synthesizers enable individuals with muscular dystrophies to communicate. Special computer software can be used to ameliorate learning disabilities or to enhance the memory of individuals with traumatic brain injury. Keyboard adaptations enable individuals with motor disabilities to write, and the Internet can connect homebound individuals to classrooms and workplaces. Lifelong learning and economic development for populations living outside mainstream cultures are two other venues for using ICTs.

Promoting Efficiency

The Traditional Paradigm

The internal efficiency of an educational system is measured by its ability to deliver quality education in cost-effective ways. The traditional model for providing primary through tertiary education, adopted across the world, relies on three basic principles.

Learners must congregate in a building where the teaching/learning process takes place.

There must be a predetermined path, divided into grades, that leads to a diploma, and students must follow this path, regardless of their interests, needs, or abilities.

There must be a hierarchic structure where the instructor is the provider of knowledge and the students are the recipients.

The traditional school is, therefore, a physical entity organized into classrooms where learners congregate according to a grade structure and constrained by the limits of space and time. If a school serves students from grades 1 through 12, it must have at least 12 classrooms to accommodate each grade separately. Each classroom must have one teacher. A certain number of teachers require a principal and, often, administrative and teaching support. If the number of students or grades increases, so must the number of needed classrooms, teachers, and support personnel. Generally, beginning in the seventh grade, another dimension is added to the classroom/grade framework: specialization. From then on, the number of teachers is related to both the number of classrooms and the number of specialties offered. Each school must have at least one mathematics teacher, a science teacher, a social studies teacher, and so on. As the educational level advances, classroom organizations will rely more on specialization than grades, but the framework is maintained. To be cost-effective within this structure, the learning place must have a critical number of students that justifies school construction and maintenance, particularly personnel costs. In areas of low population density, building and maintaining schools to serve the traditional paradigm is economically prohibitive. The requirement of one specialist per specialty makes secondary schools an even more expensive venture. Some countries sidestep the problem by leaving the solution to individual families, with catastrophic results. If the families choose to move to urban areas and ensure their children's education, they jeopardize their country's fragile economic balance and further deplete the economy of their native regions. If they decide to remain, they jeopardize their children's future. Areas of high population density but weak economy are not free of problems. In this case, the traditional model encourages administrators to accommodate as many students as possible in one classroom to control personnel costs, which leads to overcrowded and unsafe environments that are unfit for learning.

Learning Time vs. Classroom Time

The capacity of ICTs to reach students in any place and at any time has the potential to promote revolutionary changes in the traditional educational paradigm. First, it eliminates the premise that learning time equals

classroom time. To avoid overcrowded classrooms, a school may adopt a dual-shift system without reducing its students' actual study time. Students may attend school for half a day and spend the other half involved in educational activities at home, in a library, at work, or in another unconventional setting. They may be required to watch an educational radio/television program and complete related activities, or work on a computer-assisted lesson at the school technology lab or in a community learning center. For areas with low population density, multigrade schools become viable alternatives. While more advanced students listen to an educational program on the radio or watch a television broadcast, the teacher can attend to the students who are in less advanced level or vice versa.

Student-Centered Curricula

Traditional educational systems also tend to rely on curricula that were developed at the beginning of the Industrial Revolution and are now disconnected from the realities of the job market. For bright students, these systems offer little in the way of motivation. Eventually, a few extraordinary students will be able to skip a grade, but rushing through the system is not encouraged, and early graduates may find obstacles when they attempt to gain access to the next level. For low-income students, who have less academic support, the schools offer even less: the wealthier schools lure the best teachers, leaving the least prepared for schools in poor and remote areas. When the need to work conflicts with schools' requirements, the student sees no reason to stay in school. As a result, these systems perpetuate social inequalities, lose many excellent students to boredom, increase the costs of education through high dropout rates and grade retention, and pass on to employers or other systems the costs of retraining their graduates. ICTs have the potential to bring the products of the best teachers to classrooms anywhere in the world. For self-motivated, disciplined students, ICTs can speed the path toward a degree and expand their learning options through selfstudy. Students can "shop" courses on the Internet and choose their own program of study and schedules. Students in virtual schools can take extra online courses to graduate earlier or fulfil specific interests and curiosity. For those who need to balance studies with work and family obligations—full- or part-time workers, parents of small children, homebound individuals—this flexibility may be most cost-effective for them.

Improving the quality of learning

Learning about Learning

ICTs diversify the systems of representation through the use of various types of stimuli (images, sound, and movement) and address the needs of diverse types of learning (visual, psychomotor, and affective). In addition,

ICTs have the potential to enhance educational quality by increasing motivation, facilitating acquisition of basic skills, promoting inquiry and exploration, and preparing individuals for the technology-driven world.

Motivating to Learn

An effective teaching/learning process must stimulate intellectual curiosity and offer a sense of enjoyment that will move the students from the passive role of recipients of information to the active role of builders of knowledge. Yet, engaging the learner in this process can be the most challenging task for teachers. ICTs are effective instructional aides to engage students in the learning process. Videos, television, and computer multimedia software provide information that can be authentic and challenging in addition to stimulating students' sensorial apparatus through images, color, sound, and movement.

Facilitating the Acquisition of Basic Skills

Transmission of accumulated knowledge to new generations is an essential component of the educational process. This includes basic skills and information that are at the foundation of more complex knowledge. It would be inefficient to use a time-consuming process, such as inquiry and exploration, to transmit basic information. In addition, non-structural learning environments based solely on inquiry and exploration may be confusing and overwhelming for some children and youth. These students will do better in well structured classrooms, where the information is broken into less complex units, thus making it easier to understand. Exposition and practice strategies help to structure the classroom, enhance retention and recall, and cut learning time.

Computers also can be used as auxiliary tools in mathematics and science classes to free teachers' and students' time. While computers work on repetitive tasks (such as long calculations and statistical computations), teachers and students can concentrate on analytical activities that require higher-order thinking skills. Research indicates that elementary and secondary school students who use calculators have higher test scores and better attitudes toward mathematics than their peers who do not use calculators. Elementary school children who use computers and calculators in the classroom were found to understand mathematical concepts much earlier than expected. (debatable).

Fostering Inquiry and Exploration

Although basic skills and information are essential components of the teaching/learning process, learning is more than information transfer. Learning requires the ability to analyze and synthesize information, use it in diverse circumstances, and propose new lines of inquiry that foster knowledge. Inquiry and exploration are essential strategies to attain those abilities. Astronomer Carl Sagan used to say that all children start out as

scientists, full of curiosity and questions about the world, but schools eventually destroy their curiosity. ICTs have the potential to restore curiosity to education. ICTs can take students on exciting journeys through time and space. Movies, videos, audio technology, and computer animations bring sound and movement to static textbook lessons and enliven children's reading classes. They also provide social studies and foreign language students with vicarious experiences of distant societies and bygone times. Spreadsheets can store and analyze large amounts of data necessary for complex math and science studies. Computer simulations transform risky and expensive experiments into safe and cost-effective procedures. The Internet offers virtual reality settings where students can manipulate parameters, contexts, and scenarios. Computer simulations are a good example of the power of technology to improve the learning process. The flight simulator has been used for decades as the initial step in training airplane pilots. A flight simulator offers trainees the opportunity to practice the proper skills to control the plane and deal with emergency situations without risking lives or property loss. Although flight simulators can be complex and expensive machines, no pilot training program would question their utility. Simulators also are becoming essential tools in medical training. Through their use, medical students and residents are introduced to risky and invasive procedures without endangering patients' lives or exposing them to unnecessary pain and discomfort. Simulations are particularly helpful in situations that are too risky, expensive, or time-consuming to allow real-life experiments. For instance, welding simulators have proved to be a cost-effective method to train future welders. Without simulators, this training requires long hours of practice and burning expensive electrodes. Simulations also enable students to test explosive materials virtually without running the risk of real explosions, and to "experiment" on animals without the ethical implications of real-life procedures. For elementary and secondary school students—and sometimes even for adults even for adults—exploring the Internet can be a fun and enriching experience, or a frustrating adventure in trivia. Teachers and instructors play an important role as guides and facilitators by providing background material and guidelines for the search. They also need to monitor the process, particularly for younger students, who tend to browse the Web, rather than follow structured search plans. Teachers and instructors also are instrumental in helping students to separate unreliable sources from reliable ones and make sense of the large amount of information that may overwhelm them.

Enhancing the quality of teaching

Teacher Training

Learning is only one component of the educational process, and quality learning cannot be attained without good teaching. For developing countries, in rural areas and in some specialties such as math and science, the teacher shortage has become critical. Simply hiring a teacher does not ensure quality education. To be effective, teachers must keep abreast of new perspectives on learning theories and their area of specialization, a task that becomes impossible when teachers work in distant, isolated areas. The mentoring process that has been used traditionally to prepare new cadres is an extra burden on experienced teachers, particularly in places where they are already in short supply. Some schools of education are using videotaped sessions to prepare new teachers to enter the classroom without relying solely on mentors. The process frequently involves videotaping experienced teachers during regular classroom time. Student teachers observe their experienced peers in action, analyzing in detail the strategies used to present the material and interact with the students.

The trainees then practice mock lessons with a group of peers or volunteer students while being videotaped. Peers and instructors review the tapes, highlighting weaknesses and strengths and making suggestions for improvement. Only after completing this process is the student teacher sent into actual classrooms. Videos can also be used to analyze teaching styles and idiosyncrasies and help educational systems to change their approaches. A research project related to the Third International Mathematics and Science Study (TIMSS) videotaped mathematics and science teachers in Japan, Germany, and the United States. The study analyzed variations in teaching style and lesson content among the three countries, looking for correlations between those dimensions and students' performance. ICTs can be used as tools for training and support of teachers, regardless of their geographical dispersion. Scripted lessons in conjunction with educational programs via radio and television, ensure that all students receive quality, updated information, while imparting to inexperienced and generalist teachers the appropriate content knowledge and new pedagogical strategies. The use of technology for teacher training has at least three major advantages: it reduces travel costs, avoids disrupting classroom routines, and familiarizes the teachers with the technology.

Teacher Support

The Internet has myriad Websites to help teachers develop or improve lesson plans, exchange ideas, obtain information, and find free animations and simulations to enliven their lessons. Most Internet-based collaborative learning projects include teacher support and training, and conference proceedings are published regularly on the Web. Chat rooms or forums may become a laboratory for new ideas.

Teacher Empowerment

More important still, research indicates that the introduction of ICTs for educational purposes has the potential to bring positive changes to teaching practices. In a survey of more than 2,000 teachers and school principals across the United States, the teachers stated that the technology helped them to become more effective (92% of respondents) and creative (88%). Both teachers and administrators agreed that technology had reinforced instruction, and functioned as a motivator for the students, who were more prone to ask questions and participate in the lessons. Despite this potential for training and support, ICTs have not been accepted easily among teachers. Some complain that scripted lessons take away their ability to address students' individual differences and improve their own teastrategies. Others fear that technologies will reduce the role of teachers in defining curriculum and educational strategies, or totally replace them. This theme is discussed further in chapter4.

Improving Management Systems

Education policy development is an intricate process that requires reliable, timely, user-friendly data. ICTs can be valuable for storing and analyzing data on education indicators; student assessments; educational, physical, and human infrastructure; and cost and finance. The use of computer-related technology is particularly helpful in this field. For instance, administrators and policy makers can construct virtual scenarios around different policy options to determine needs and analyze potential consequences. Each scenario can be analyzed and evaluated systematically, not only in terms of its educational desirability, but also in terms of financial affordability, feasibility, and sustainability over a sufficient period of time to show results. The same elements of computing and telecommunications equipment and service that have made businesses more efficient and cost-effective can be applied to schools and educational systems. ICTs can help administrators and school principals to streamline operations, monitor performance, and improve use of physical and human resources.

Conclusion

Social, economic, and technological changes of the past decades are making education and training for all more crucial than ever. Transmission of accumulated knowledge to new generations is an essential component of the educational process. One goal of education is the preparation of the young not only for this changed world, but also with the willingness and ability to face new and changing situations. Educational systems required to prepare citizens for lifelong learning. Expanding access to education is a matter of both economic development and social justice. Education is positively related to development. To meet these challenges, countries have to focus on promoting the quality of teaching. Mathematics continues to be an important component in the formation of the educated person. Some countries and institutions have turned to information and communication technologies (ICTs). Teachers having access to laptops, data projectors and the Internet, and most also having the use of Interactive White Boards (IWB) and Virtual Learning Environment platforms (VLE) are more enabled. *Distance learning institutions generally use a mix of technologies that may include printed material, videos, videoconferencing, CD-ROMs, e-mail, and the Internet.* Technology can promote alternatives for educating women. Technology functions as a neutral mediator, without gender or cultural allegiances, thereby facilitating communication. ICTs have the potential to bring the products of the best teachers to classrooms anywhere in the world. For self-motivated, disciplined students, ICTs can speed the path toward a degree and expand their learning options through self-study. ICTs can be used as tools for training and support of teachers, regardless of their geographical dispersion. Despite this potential for training and support, ICTs have not been accepted easily among teachers. Some complain that scripted lessons take away their ability to address students'.

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