Critical Success Factors For Effective Use Of Information And Communication Technology (ICT) In Teaching And Learning And Its Impact On Student Achievement

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ABSTRACT

This paper examines the influences that are driving change in the education landscape especially in the teaching and learning process. The main objective of this article is to analyse how to effectively integrate Information and Communication Technology (ICT) into the teaching and learning process. Review of literature have pinpointed a number of "levers" that contribute to successful integration of ICT in teaching and learning such as Vision for learning, leadership, empowerment through professional development, collegial support, infrastructure and technical support , constructivist environment and continuous monitoring and feedback. The second part of the article will examine the studies done on the impact of ICT on student learning.

1. Introduction

Recent educational and technological developments are challenging educators to redefine traditional approaches to teaching and learning. Education institutions across the globe are at different stages of integrating information and communications technologies (ICTs) in teaching and learning. While the debate over the true value added contribution of ICT in enhancing the teaching and learning process still rages, we all agree that there is a tremendous opportunity for technology to revolutionize learning, just as it did for business. A number of questions come to mind when we talk about computers in education, namely Are the teachers applying ICT as it should to facilitate teaching? Are the students learning better with the aid of ICT? In this article I will try to highlight the critical success factors for integration of ICT into the teaching and learning process and studies on its impact on student's learning. The Malaysian government is very keen in integrating ICT into school curriculum. The computer in education (CIE) project is part of the Ministry of Education's pilot project launched in 1992. Recently the government launched the teaching of Science and mathematics in English programme which also utilized the use of computers in teaching science and mathematics whereby the teachers are provided with laptops and LCDs. Apart from these, the Smart School project launched as a MSC Flagship project

Although numerous studies have done on computers in education, but most of them looked at the computer related behavior and user-related factors; computer anxiety (Igbaria and Nachman, 1990; Torkzadeh and Angulo, 1992); motivation (Rockart and Flannery, 1983; Doll and Torkzadeh, 1989); involvement (Doll and Torkzadeh, 1989; Barki and Hartwick, 1989); social norms (Thompson, Higgins and Howell, 1991), attitudes (Melone, 1990; Igbaria and Nachman, 1990; Harrison and Rainer, 1992) and self-efficacy (Torkzadeh and Koufterous, 1994; Compeau and Higgins, 1995). Student and teacher attitudes toward computer have been studied by several researchers (Koohang, 1989; king, 1995, Zoriani, W. Abas, 1995; Harris & Grandgenett, 1996). The issue of how to manage the integration of ICT into the teaching and learning process and its impact on student achievement is lacking analysis in the computer and education literature

2. Driving forces for ICT

A number of drivers for implementing ICT in teaching and learning process have been identified namely knowledge society, globalization and life-long learning. The Knowledge society or the information society which is now widely published in the world is facilitated by the use of ICT. The knowledge society reflects a shift from the leaner as a passive consumer of educational offerings to an active knowledge gathering and productive participant in educational process. This is shown in Table 1. For the country to develop the competitive advantage in today's competitive environment depends increasingly on how knowledge is used and how expertise is deployed. Generally our cultures become increasingly technological cultures meaning that technology is an integral part of society . The answer to the knowledge society is that education and schools in particular should not be isolated but instead be an integral part of all these changes. It seems that the current belief is that ICT is not only the backbone of the knowledge society, but also an important catalyst and tool for inducing educational reforms that change our students into productive knowledge workers. To prepare for the knowledge society some countries have adopted ambitious, national plans to open access to computers and the internet to all school students, namely the Technology Literacy Challenge in the USA, The National Grid for Learning in the UK, Schulen am Netz in Germany, Edunet in France and the Smart School MSC Flagship Program in Malaysia. The creation of the knowledge society aslo have profound concerns about the gaps opening up between the ICT haves and have-nots, thus enlarging the digital divide between countries.

Globalisation is another driver for ICT use in education. Gobalisation offers considerable opportunities through its borderless world concept. Students can dialogue with their counterparts across the globe. Teachers can create networks and be members of professional teams drawn from far and wide, rather than feel trapped within the boundaries of the single classroom or even the single school. New sources of learning materials drawn for right around the world are accessible via the internet and these different networks. In short globalization brings the teachers and students of the world into a single global classroom. Lifelong learning defines the third set of issues underpinning the keen interest in ICT and education. At the end of the 20th century, the

key role learning throughout the life span to meet the needs of the knowledge society. For this idea of lifelong learning to work, learning must be available in a much broader and more flexible manner than that which can be provided by traditional schools and colleges. The search is on for flexible, individualized forms of learning which is outside institutional walls-the promise of ICT here is quite obvious and lifelong learning for all will be brought nearer by ICT.

3. Benefits of ICT

The use of ICT in teaching and learning brings benefits to both teachers and students, and also to administrators, researchers and parents. Using educational technologies for drill and practice of basic skills can be highly effective according to a large body of data and a long history of use (Kulk, 1994). Students learn more, and learn more rapidly, in courses that use computers assisted instruction (CAI). The new technologies allow students to have more control over their own learning, to think analytically and critically, and to work collaboratively. Numerous studies over the years, summarized by Bialo and Sivin-Kachala (1996), report other benefits enjoyed by students who use technology. These benefits involve attitudes toward self and towards learning. The studies reveal that students feel more successful in school are more motivated to learn and have increased self confidence and self esteem when using CAI. This is particularly true when the technology allows the students to control their own learning. Teachers and administrators use computers and information technologies to improve their roles in the educational process.(Kosakowski, 1998) Some examples include:

- Using computers tools to streamline record keeping and administrative tasks, thereby helping to free up time for instruction or professional development
- Decreasing isolation by using e-mails and the internet to communicate with colleagues, parents, and the outside world
- Increasing professional development activities by taking distance education courses, accessing educational research , and accessing classroom material such as lesson plans

There is emerging research on how internet can be an important component of a program that significantly increases student learning. In brief summary, the internet plays four roles in student improving learning:

- Students learn to make use of the internet as an aid to retrieving information from multiple sources
- Students learn to use the internet as an aid to communicating with and collaborating wit people throughout the world
- Students learn to develop web materials, especially as a component of project based learning that is rooted in constructivism and in cooperative learning
- Students learn in an IT-Assisted Project-based learning environment, with the internet playing a major supportive role.

Studies shows that there are advantages to students having access to the internet (Nicol, 1998). Students have opportunity to collect research from a variety of sources, which can come from anywhere in the world giving very broad, detailed information about any subject. There is a chance to publish work on the web and to take part in collaborative learning and discussion groups with other students. Nicol comments on the web as being an: enhanced learning environment" providing a rich resource of global information. Collins (1991) believes that this increased dependence on the web will bring about many changes in the teaching styles used. Traditional methods of delivery are either in decline or being enhanced or supported by alternative multiple media delivery mechanism. Collins proposes that this will affect the students more, and with effective planning teachers can contribute more actively to the learning taking place by the student. This should enable lecturers to spend more time at an individual level than is currently possible (Longstaff, 1999). As well changes in learning methods, there are also variations being made in the way students will be taught (Clarke, 1993). The lecturer may adopt a management and supervisory role as opposed to the traditional view of the lecturer teaching students particular subject content. Teachers will no longer be content providers. Rather, they will be discussion leaders, advisors, tutors, field trip leaders-always helping their students build interpersonal skills while they pursue their academic subjects. Schools will become more like summer camps, teaching kids what they need to know about functioning in society, dealing with issues like teamwork, handling stress, getting people to like you, and other subjects critical to working life. School will be fun and interesting.

Amy Bruckman believes that the web makes its possible to put ideas of theorists like Piaget, Vygotsky, and especially Dewey into practice. The problem of making these ideas a reality is basically problems of human communication .which can be overcome through the power of computer networks. Computer networks can make these kinds of communication not just possible but easy. Communications via computer networks has the potential to make progressive approaches to education more practical and scalable in real, nonlaboratory settings.

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4. Critical Success Factors (CFS) for ICT Integration

ICT has demonstrated considerable potential for enhancing teaching and learning in schools and universities. Despite the widespread use of computers in education, evidence suggests that educational institutions are not achieving the full advantages which they might from their investments in ICT. The capacity of teachers to use technology in classrooms has not kept pace with the increased access to technology in schools. Teachers and Technology; Making the Connection, a comprehensive study from the Office of Technology Assessment (1995), portrays both opportunities and obstacles of technology use in US schools, Technology offers richer, more varied, and more engaging learning opportunity for students but these practices tend to be the exception rather than the norm. Three common barriers cited in the report relate to access, training and support. Although the numbers of computers and internet connections in schools has increased

(Anderson & Ronnkvist, 1999, NCES, 1999a), the ability of teachers to incorporate technology into their daily practice is lagging. Only 20 percent of teachers report feeling well-prepared to integrate technology into their teaching (NCES, 1999b). Gilbert (1995) suggests that many lecturers are reluctant to move beyond word processing, and that institutions may have underestimated the difficulty of persuading lecturers to use ICT. In a study of one university in the USA, Wilkins and Nantz (1995) discovered that teaching uses of the computer network were low and perceived future uses were also low. Pare and Elam (1995) claim that despite the technological infusion which take place in universities, the use of personal computers (PCs) is, for most lecturers, still wholly discretionary, as it is for most students who are not engaged directly in technology-related programmes. A study of main ICT-related obstacles as perceived by educational practitioners found that most frequently mentioned problem was insufficient numbers of computers and teachers lack of knowledge/skills. This is shown in Table 2. SITES (Second Information Technology in Education Study) provide a summary of the topics that need to be addressed in transforming to an ICT enabled environment. This is shown in Table 3. In short, the greatest challenge in bringing Information and Communication Technology (ICT) into the classroom is not in acquiring the latest know-how but managing the required transformation.

A review of literature on integrating ICT into the classrooms have highlighted a number of critical issues that must be addressed for successful transformation to ICT enabled teaching and learning process, namely the human factors, organisational factors, environment factors and technical factors.

4.1 Vision of learning

Technology lends itself well to learning and instruction because it is a powerful tool that, when properly implemented, improves student learning and achievement. However, teachers have little incentive to tackle the technical and scheduling problems associated with technology unless they have a clear idea of how it can improve teaching and learning (Means, Blando, Olson, Middleston, Morocco, Remz, & Zorfass, 1993). Technology cannot prescribe for a teacher which students should use technology, how often it should be used, or how to integrate technology into existing instructional practices. Unless teachers start out with specific technology goals that support their vision of learning, technology will most likely be used to reinforce the status quo (Cohen, 1988; Cuban, 1986).

There is evidence that when learning and technology goals are not decided before technology implementation, technology can become a drain on resources and add to the burdens of teachers who are already trying to do too much (Piele, 1989). This problem can be avoided by formulating a vision for learning that connects to educational goals, values, and objectives for technology use. Once the stakeholders involved understand the vision and how technology will make their lives better, they are likely to become more open to technology planning and implementation. the following questions should be addressed when planning how to use technology to support a vision of earning:

- How will ICT be used to provide and support a challenging curriculum through engaging instructional practices (e,g collaborative learning, problem-based learning, problem solving; critical thinking; constructivist classrooms, project-based learning, and so on)
- What educational technology skills will be part of your curriculum and how will teaching them to students and staff enhance and support your broader instructional goals?
- How will technology be used to support an articulated pre-school to adult learning program for all students?
- How will technology be used to support changes in the roles and responsibilities of students, teachers, administrators, parents, community members, and others in order to achieve your vision?
- How will ICT be used to support organizational and governance structures that are consistent with your vision of learning?
- How will ICT be used to support and provide meaningful professional development experience for staff?
- How will ICT be used to support your school's accountability and assessment systems?
- How will ICT be used to support positive home-school-community collaboration?
- How will technology be used to support the provision of comprehensive services (e,g school based, school-linked health and social services)?

4.2 Leadership is the key ingredient

Research literature confirms that leadership is the single most factor affecting the successful integration of technology. Vision, commitment and support are important components of the leadership equation. Its is especially important at the school level for principals to have a vision of what is possible through the use of ICT, and be able to work with others to achieve the vision. Without this vision, and translation of the vision into action, lasting technology use is almost impossible. Traits of leaders who are committed to helping their teachers and students use ICT effectively include:

- Leading by example

  Effective principals lead by example. They have a clear idea about how technology can support best practices in instruction and assessment, they used technology fluently, and they participate actively in professional development opportunities. The leader who expects to see technology used in the classroom but does not know how to use e-mail sends at best, a mixed message

- Supporting the Faculty

  In addition to modeling the use of ICT, supportive school principals highlight the efforts of teachers who attempt to use ICT to improve teaching and

learning. Effective leaders also attend professional development sessions with their teaching staff. Principals also committed to support teachers in three ways upon returning to schools:

- To provide time for teachers to plan together and reflect on their practice,
- To offer recognition of efforts, and
- To give teachers authority and flexibility in curriculum decisions and daily instructional schedules.

- Shared leadership

School technology committees can serve an important role in making decisions that reflect the needs of a total school community. School leaders facilitate this happening by showing both interest and trust in decisions that the group makes. Committees members should be those who are representative of the total faculty and staff and selected by a method other than principal-appointed. Shared input and decisions are critical fro committee members to feel that they serve a real role and to reduce the chances that decisions will be sabotaged.

4.3 **Empowerment through Professional Development**

Professional development of the individual is a process which occurs in phases. Brown (1994) describes an evaluation of a teacher training programme in schools which sought to enhance management of information technology and classroom applications of IT to enhance learning. He describes three phases:

Typically novices are concerned in developing their own competence. Concern the switches to the tasks to be undertaken; for example they may focus upon the support necessary to get learners to use IT for particular tasks. The final stage can involve a more critical reflection on the use of IT; how it is used to enhance learning rather than just encourage its use per se. (Brown, 1994)

- Competence with some software
- understanding the place of that software within the curriculum
- starting to distil this for student teachers
- enlarging range of practices;
- clarifying enhanced learning through IT
- improving practice in courses, classroom and assessment

Teacher involvement in the planning and design of professional development programs is significant for three reasons. First, it signals the value placed on teacher's perspectives and supports the idea that teachers should be key figures in determining what they need to improve their practice. Second, it increases the relevance of the programs to teacher's

needs, schedules, and classroom settings. Third, it fosters ownership of and commitment to the programs, where planning team teachers have personal contact with many of the intended participants.

The teacher development program should include four main components: (a) classroom visits, (b) hands-on technology training, (c) group discussions, and (d) participant collaboration. For many teachers, hands on work with students can ease their initial concerns about technology in the classroom. Group reflection activities not only allotted time for participants to think about the new information they were processing but also safe forum for them to express concerns and accomplishments. (Sandholtz, 2001)

Teacher development programs outcomes can be considered effective when measured by three common criteria; (a) participants evaluation of their experiences; (b) participants gain in skills during the course of the program, (c) participants plans for using technology in their classrooms.

John Rust of Dundalk Learning Network argues that curriculum has to be placed ahead of technology. By placing curriculum first, teachers do not have to be fearful of the need to "learn" as the curriculum is something they are comfortable with. Rust proposes first introducing technology for parts of the curriculum that are easier to handle before venturing into a full-scale effort. "There has to be a greater effort to empower teachers. Teacher training has to be more inter-disciplinary. The teachers have to come out of their bubble,: he says.

Prof Stephen Heppel of Anglia Polytechnic University proposes that teachers be empowered to come up with their own technology and software. According to him, it is easier to balance technology with people than people with technology. When you empower them to do it, they will not criticize but accept it. The problem, according to him, is that people try to standardize things. Technology should be used creatively to encourage further creativity and not to standardize content and approach. Prof Heppel says, arguing that people have to engage as active participants in the creation and use of technology.

4.4 Infrastructure and technical support

It is very difficult to focus on integrating ICT to support teaching and learning if you cannot overcome basic technological equipment and facilities issues. As a prerequisite to integrating ICT into the classrooms, a teachers needs access to a computer, printer, internet and software. The schools require major infrastructure investment to implement computers in classrooms. Recent estimates suggest that in the OECD as a whole, approximately US$16bn are invested annually in hardware, software and communication links in education. The very flexibility and interactivity of the new forms of learning with ICT, and the demanding nature of teaching and teaching that goes with them, suggest that intensive investments in people and organization are needed over and above the investment in hardware and software.

Technical support is important to encourage teachers to use ICT in teaching and learning. Teachers often become discouraged when the technology wouldn't work. In some cases, teachers sense of self-efficacy quickly diminished, making it less likely that they would continue using technology. The lack of technical support and the resulting technical difficulties significantly impeded teacher's abilities to implement what they had learned. When teachers could not obtain sufficient technical assistance, they frequently altered or abandoned plans to use technology in their classroom.

4.5 Collegial Support

Collegial support for teachers who are implementing ICT in teaching and learning is crucial. Teachers can turn to each other for help with troubleshooting equipment, for lesson ideas, and more for emotional support. Informal teacher networks that involved teachers communicating by phone, online, or regular meeting to share success stories, demonstrate new skills, and receive additional training. Informal teacher networks can also become school base as more teachers are trained in ICT. Informal networks also can emerged across subjects and grade level as teachers began e-mailing each other for curricular and instructional ideas. The collegial support that developed among teachers can enhance teacher's sense of efficacy with technology. To enhance the informal network, schools can establish formal structures for collegial support and teachers could choose among three options: (a) to observe another teacher, (b) to team-teach with another teacher, or (c) to stay in their class for peer coaching by a more advanced technology user.

4.6 Constructivist Environment

Prof Heppel, says that learning environment too plays a central roe in the education process, 'Our contention is that is that the qualities of the environment in which we learn and in particular, light, space, colour and sound, makes a real difference to how quickly w learn and how much we enjoy learning. The classrooms of the future must make students feel comfortable and provide a positive and supportive learning environment with challenges. The classroom of tomorrow environment will be inspirational and challenge teachers and students to exercise their creativity

To effectively integrate ICT in teaching and learning, a constructivist environment should be nurtured in the classroom. The most important features of the constructivist environment include opportunities to explore, reflect, collaborate with peers, work on authentic learning tasks, engage in hands-on, and active learning. The benefits of constructivist environment include collaborative learning groups, the flexible schedule, plans developed according to group needs, and the ambiance as contributing to an environment that fosters curiosity and openness to inquiry.

The constructivist environment provide teachers a chance to practice and try new approaches in a non-threatening, supportive environment-a particularly vital element in learning to incorporate technology into classroom instructions.

4.7 Continuous monitoring and feedback

Schools need to regularly gauge progress towards ICT integration. Monitoring the progress can help teachers reflect on where they are and where they need to go with their ICT initiatives. In the belief that helping teachers reflect on their progress could potentially accelerate the rate of ICT adoption among teachers an instrument need to be developed that measures the main domains of ICT integration in teaching and learning. Regular monitoring and feedback can indeed make a difference in program planning and implementation

5. ICT and its Impact on Student Achievement

Research on the impact of technology on student achievement is still in its infancy but numerous studies done show positive impact namely in the areas of language learning and teaching mathematics and science.

5.1 Kulik's Meta-Analysis Study

James Kulik (1994) used a research technique called meta-analysis to aggregate the findings form more than 500 individual research studies of computer-based instruction. Kulik drew several conclusion form his 1994 work:

Positive findings

- On the average, students who used computer-based instruction score at the 64^{th} percentile on tests of achievement compared to students in the control conditions without computers who scored at the 50^{th} percentile
- Students learn in less time when they receive computer-based instruction
- Students like their classes more and develop more positive attitudes when their classes include computer-based instruction

Negative Findings

- Computers did not have positive effects in very area in which they were studied

5.2 Sivin-Kachala's Review of Research

Jay Sivin-Kachals (1998) reviewed 219 research studies from 1990 to 1997 to assess the effect of technology on learning and achievement across all learning domains and all ages of learners. He reports the following consistent patterns:

Positive findings

- Students in technology rich environment experienced positive effects on achievement in all major subject areas.
- Students in technology rich environment showed increased achievement in preschool through higher education for both regular and special needs children
- Student's attitudes toward learning and their own self-concept improved consistently when computers were used for instruction

Inconclusive findings

- The level of effectiveness of educational technology is influenced by the specific student population, the software design, the educator's role, and the level of student access to the technology

5.3 The Apple Classroom of Tomorrow (ACOT)

In their evaluation of the Apple Classrooms of Tomorrow, Baker, Gearhart, and Hermans (1994) assessed the impact of interactive technologies on teaching and learning in five schools sites across the USA. They report the following findings:

Positive findings

- The ASCOT experience appeared to result in new learning experiences requiring higher level reasoning and problem-solving, although the authors claim this finding was not conclusive
- ACOT did not have a positive impact on student attitudes and did not have an impact on changing teacher teaching practices towards more cooperative group work and less teacher stand up lecturing

Negative findings

- On standardized tests including vocabulary, reading comprehension, mathematics concepts, and work-study, ACOT students performed no better than comparison groups or nationally reported norms who did not have access to computers.

5.4 West Virginia's Skills/Computer Education (BS/CE) Statewide Initiative

Dale Mann's (1999) study of the state of West Virginia's Basic Skills/Computer Education (BS/CE) program analyzed a representative sample of 950 fifth-grade student's achievement from 18 elementary schools across the state. These fifth-grade students had been participating in the West Virginia BS/CE program since 1991-92. data was also collected from 290 teachers to show the influence that West Virginia's Integrated Learning System technology had on student achievement. The findings for West Virginia's statewide initiative were as follows:

Positive findings

- The more students participated in BS/CE, the more their test score raise on the Stanford 9
- Consistent student access to the technology, positive attitudes towards the technology (by both teachers and students), and teacher training in the technology led to the greatest student achievement gains. All students test scores rose on the Stanford 9 because of BS/CE with lower achieving students scores rising the most
- Half of the teachers n the sample thought that technology had helped a lot with West Virginia's instructional goals and objectives. These teachers also reported that they become more enthusiastic about BS/CE as time passed
- Although the relative advantage of girls is a regularity of the technology literature, girls and boys did not differ in achievement, access, or use of computers in the West Virginia's study

Lewis Solmon's (1999) cost benefit analysis of the West Virginia's Basic Skills/Computer Education program compared the cost of BS/CE and its achievement gains to the use of other reform programs and their achievement gain. Salmon demonstrated that:

- BS/CE was more cost effective in improving student achievement than (1) class size reduction from 35 to 20 students, (2) increasing instructional time, and (3) cross age tutoring programs

5.5 Harold Wenglinsky's National Study of Technology Impact on Mathematics Achievement

Harold Wenglinsky (1998) assessed the effects of simulation and higher order thinking technologies on a national sample of 6,227 fourth graders and 7,146 eight graders mathematics achievement on the National Assessment of educational Progress. Weng linsky controlled for socioeconomics status, class size, and teacher characteristics. Thus, all relationships between technology and educational outcomes reported the value added by technology for comparable groups of students with comparable teachers in comparable class sizes. Wenglinsky reported:

Positive findings

- Eight-grade students who used simulations and higher order thinking software gains in math scores of up to 15 weeks above grade level as measured by NAEP
- Eight-grade students whose teachers received professional development on computers showed gains in math scores of up to 13 weeks above grade level
- Higher order uses of computers and professional development were positively related to students' academic achievement in mathematics for both fourth and eight-grade students

Negative findings

- Fourth-grade students who used technology to play learning games and develop higher order thinking performed only 3 to 5 weeks ahead of students who did not use technology
- Both fourth and eight-grade students who used drill and practice technologies performed worse on NAEP than students who did not use drill and practice technology

5.6 Scardamalia & Bereiter's Computer Supported Intentional Learning Environment (CSILE) Studies

Marlene Scardamalia and Carl Bereiter's (1996) Computer Supported Intentional Learning Environment (CSILE), the most widely studied collaborative computer application in school today, had entire classrooms of children conceive, respond to, and reframe what is said and written over time on computers. CSILE students ask questions, search for other students' answers to their questions, comment on and review other students' work, and then restructures and formulate answers to their original inquiries. Eight years of research on CSILE has demonstrated that:

- CSILE students surpass students in control classrooms on measures of depth of understanding, reflection, and also on standardized reading, language, and vocabulary tests
- CSILE maximizes student reflection and encourages progressive thought, taking multiple perspectives ,and independent thinking

5.7 The Learning and Epistemology Group at MIT

Seymour Papert, Mitchel Resnick, Yasmin Kafai, and Idit Harel have employed learning by design principles to educational technology by having students become creators and designers of educational software. These researchers use computers as the machine to be acted upon and students as the actors. Thus, students learn through design activities by programming computers to create applications that other children use and learn from.

Research by Idit Harel (1988, 1991) introduced Logo programming to design software to teach fractions to younger students. Students had to structure their computer program, maintain connection between content and functionality, and design the user interface and activities. In addition, students needed to consider different ideas about how to teach fractions to younger students. Harel's research demonstrated that:

- Students who designed fraction software for other students using Logo learned better than students taught using conventional methods
- Students who used Logo to design software learned better than students who received Logo programming instruction only

5.8 Missouri ed-program is raising student achievement

An analysis of student test scores in Missouri offers solid evidence to suggest that using technology, to facilitate an inquiry-based approach to learning can boost student achievement. Students who participated in Missouri's educational technology program scored "consistently higher in very subject" on the state standardized test compared with students not involved in the program. The study, called " Analysis of 2001 MAP Results for eMINTS Students" compared the results of Missouri Assessment Program (NAP) fo more than 6,000 third and fourth graders. The eMINTS program which stands for Enhancing Missouri's Instructional Networked Teaching Strategies was found to have " a positive impact on student achievement"

eMINTS combines multimedia and computer technology, an inquiry-based approach to teaching, and extensive professional development. Each eMINTS classroom is equipped with a teacher's desktop computer and laptop, a scanner, a colour printer, a digital camera, an interactive whiteboard, a high-lumen digital projector, and one computer for every two students. Student computers are loaded only with basic productivity software, such as Microsoft office, and all computers have high-speed internet connections.

eMINTS teachers undergo 200 hours of professional development along with in-class coaching and mentoring over a two year period. Teachers learn to integrate technology and emphasize critical thinking and problem-solving skills in their instruction.

Acer in conjunction with Balwyn High School and the University of Melbourne conducted a two year case study by asking Year 7 students to use laptops computers across the curriculum. Both girls and boys indicated an interest in computers and positive effects when using the tool for learning. The findings indicate that there are a variety of ways in which the computer becomes part of and influences how students learn.

During the academic year 1996/7 a sample of teachers in the Leeds L.E.A was surveyed to identify their perception of the impact of computers on students work the survey was carried at Boston Spa Comprehensive School (BSCS), City Comprehensive School (CCS) and an LEA professional development centre (PDC). (Cuthell, 2002). Response questions: (1) What do you think has been the main impact of computers on students'

work ? (2) what aspects of students work has been improved by the use of computers ? and (3) Do you think that the sue of computers has had a negative effect on student work?. For details see Table 4, 5, and 6

5.9 Internet use and student Grades

Equipping schools with a million computers and connecting them all to the internet has had little, if any impact on standards, according to a study commissioned by Britain's Education Department. It was reported that it could find no consistent relationship between computer use and pupil achievement in any subject at any age. The study's most optimistic conclusion was that computers could help to raise the national test scores of primary school children by a meager three marks in English if they used the device regularly. In sciences, on the other hand, 11 years old were likely to perform worse if computers were used, it found. Although there was some evidence that computers helped 14 years olds do marginally better at sciences, even this finding was inconclusive. Pupils made greater progress at some schools that made little or no use of computers. But teachers committed to information and communications technology said that its principal virtue was that it motivated pupils whose attention had previously been hard to engage.

6. Conclusion

The literature suggests that computer technologies is the promise for transforming teaching and learning (Means, 1994). But Larry Cuban in his latest book, "Oversold and Underused: Computers and Classrooms" has succeeded in injecting healthy skepticism into current debates on ICT in schools. Massey and Zemsky's (1995) prescription for effective use of IT in universities requires lecturers to modify teaching and learning processes. As students are joint participants in the teaching and learning process, they too will be required to modify the processes by which they learn. First, to be truly effective, ICT integration need a holistic approach which involved investment in hardware, software and brainware. In short, we should begin with teaching and learning, not with hardware and software. Secondly, schools should think of their students as customers who will be in as much control of how they learn as e-commerce customers are in control of what they buy. Third, changing our mindset regarding using ICT in teaching and learning. Fourth, to make responsible decisions about introducing technology into the classrooms, educators and policy makers must begin to take the "why" into account. This will require a great deal of critical thought and discussion about how information technology might affect learning environment-both positively and negatively-than appears to be occurring at present.

Although teachers are the most important change agents at the educational work floor, what is perhaps even more important in the early stages of integrating ICT is the role played by leadership "gatekeepers" such as school principals. In addition to what extent does the school management offer a supportive climate for the use of ICT in the school.

In discussing about the connection between technology and education and that its impact is limited solely to how it is used in the classrooms, that it is merely a new tool at the teacher's disposal. Micheal W. Apple notes that:

"The new technology is not just an assemblage of machines and their accompanying software. It embodies a form of thinking that orients a person to approach the world in a particular way. Computers involve ways of thinking that under current educational conditions are primarily technical. The more the new technology transform the classrooms into its own image, the more a technical logic will replace critical political and ethical understanding. The discourse of the classroom will center on technique, and less on substance. Once again "how to" will replace "why"

At this relatively early stage in the introduction of ICT into schools, perhaps all we can say about the impact of ICT is that:

- We don't yet know about what the ultimate effects will be
- It is almost certain that there will be major effects which have not been anticipated
- There is absolutely no inevitability as long as there is a willingness to contemplate what is happening.

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APPENDICES

Table 1

Expected change from education in the industrial society to education in the information society.

Actor	Education in the Industrial society	Education in the information society
School	• Isolated from society • Most information on school functioning confidential	• Integrated in society • Information openly available
Teacher	• Initiator of instruction • Whole class teaching • Evaluate student • Places low emphasis on communication skills	• Helps students find appropriate instructional path • Guides students' independent learning • Helps student to evaluate own progress • Places high emphasis on communication skills
Student	• Mostly passive	• More active
	• Learns mostly in schools	• Learns at school and outside school
	• Hardly any teamwork	• Much teamwork
	• Takes questions form books or teachers • Learns answers to questions • Low interest in learning	• Ask questions • Finds answers to questions • High
Parent	• Hardly actively involved in learning process	• Very active in learning process

	• No steering of instructions • No life-long learning model	• Co-steering • Parents provide model

Source: Pelgrum, ten Brummelhuis, Colins, Plomp, Janssen Reinen (1997)

Table 2

List of obstacles sorted by average percentage respondents across countries

Obstacle	Percentage
Insufficient number of computers	70%
Teachers lack of knowledge/skills	66%
Difficult to integrate in instruction	58%
Scheduling computer time	58%
Insufficient peripherals	57%
Not enough copies of software	54%
Insufficient teacher time	54%
WWW: not enough simultaneous access	53%
Not enough supervision staff	52%
Lack of technical assistance	51%
Outdated local school network	49%
Not enough training opportunities	43%
WWW: no time teaching axplores	41%
WWW:no time school schedule	41%
Lack info about software	38%
WWW: not enough connections	35%
WWW: insufficient technical support	34%
Not enough space to locate	32%
Weak infrastructure (telecommunications,etc)	32%
Quality teacher training too low	31%
Software not adaptable enough	29%
Stud.Know more than teachers	29%
WWW: slow network performance	28%
Lack of interest of teachers	27%
Difficult use low achieving studies	22%
Telecom infrastructure weak	21%
WWW: difficult finding information	21%
WWW: information overload	20%
Software curriculum incompatible	19%
Lack of administrative assistance	19%
Software not in language instruction	18%
Lack support school board	17%
No Plan prevent theft/vandalism	15%
Software culturally incompatible	12%

Software too complicated to use	10%
Materials WWW poor quality	9%
WWW: complicated to connect	8%
WWW: mail baskets overload	4%

Table 3

ICT-related Topics addressed

Curriculum

- ICT-related objectives of the school
- Presence of types of teaching and learning practices
- ICT attainment targets
- Realization of ICT-related objectives
- Use of e-mail/WWW for instructional
- percentage of students/teachers using WWW
- Internet-related activities of students
- Use of technology applications by student

Infrastructure

- Needs and priorities
- Perceived obstacles
- Expenditures
- Software
- Maintenance
- Number and types of computers
- Operating systems
- Processor type
- Hardware
- Access to e-mail/WWW
- Existence and content of web home page
- Number of computer in use
- Availability of peripherals
- Availability of software types
- Availability of software for school subjects
- Hardware and software related obstacle

Staff Development

- Prescriptions regarding training of teachers in the school
- Attendance by teachers
- Expenditures on staff development
- Types of internal information exchanges

- Availability of in-house/external training courses
- Self-assessment of ICT skills

Managing and Organization

- existence of written policies
- priorities for external support
- ICT-related policy measures
- Principal attitudes towards ICT
- Use of ICT for administration monitoring
- Technical support infrastructure
- Priorities for external support

Innovative Practice

- Most satisfying ICT related learning activities experienced

Table 4

Impact of computers on student work

Impact	ALL (n=116)
Presentation	37%
Motivation	17%
CD-ROM Research	10%
Word-processing	4%
Project work-documents	3%
Computer Literacy	1.7%
Control Technology	1.7%
Integration of syllabus topics	1.7%
Understanding of concepts	1.7%
Computer as an extra tool	0.86%
Drafting to improve content	0.86%
Statistical modeling	0.86%
Variety of teaching styles	0.86%

Table 5

Aspects of student work improved by computer use

Aspect	ALL

	(n=116)
Legibility	66%
Organization of work	56%
Spelling	41%
Integration of text, tables and charts	10%
Grammatical structures	2.5%
Design graphics	2.5%
Increased problem-solving skills	2.5%
Statistical application	
Application to detail	1.7%
Increased output	1.7%
Detailed research	1.7%
Examination revision	0.86%
Enhanced self-esteem	0.86%
Enhanced conceptualization	0.86%
Use of evidence	0.86%

Table 6

Negative effects on student work

Yes	15% (17)
No	78% (91)
No response	7%