Chapter 5

Information and Communication Technology

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Information and Communication Technology

The emergence of Information and Communication Technology (ICT) has ushered in a new era. It has influenced every sector of the society, that is trade, Industry, Science, Technology etc. including Education. ICT in education is an emerging area, which needs careful consideration and meaningful debate. ICT in education needs to be generic in content and multimodel in operation with a view to increase output and effectiveness of presentation. Initially ICT will be a tool for communication and presentation bringing teacher, student and teacher educators on a common platform for exchange of views, presentation of ideas (through chatting or e mail) and increase the effectiveness of presentation and feed back (include interactive mode of presentation and feedback software development and uses).

5.1 Concept

ICT stands for information and Communication technology used both as singular and plural nouns. It is used almost synonymously with IT or information Technology. The terms IT (ITES or information technologies enabled services) is used more in business contexts and in America, whereas ICT is used in development parlance, and in Europe and Oceanis. Various authors have Attamped toward defining ICT – Drew and faster (1994); Mansell and Silverstone (1996); Hamelink (1997); Duncombe and Heeks (1999); UN ECA (1999); Chaudhary (2000), among others. According to Drew and faster (1994) “the term “ Information Technology” embodies a convergence of interest between electronic, computing and communication, all of which are leading to the rapid development of micro-electronic. These technologies are being utilize to restructure and recognize the sphere of production, distribution and circulation.”Mansell and Silverstone (1996) observe that ICTs includes electronic networks – embodying complex haredware and software – linked bya vast array of terminal protocols.” UNESCO defines, Information and communication technology, or ICT, is defined as the combination of informatics technology with other, related technologies, specifically communication technology.

Hamelink (1997) classifies according to five distinct functionalities-

(a) **Capturing Technologies**: Input devices that collect and convert information into digital form. Such devices include keyboards, mics, trackballs, touch screens, voice recognition system, bar code readers, image scanners and palm size camcorders.

(b) **Storage Technologies**: Devices to store and retrieve information in digital form. Among these are magnetic tapes, floppy disks, hard disks,
RAM Disks. Optical disks (such as CD – ROMs) erasable disks and smart cards (credit card size card with memory and processing capacity for financial transactions or medical data.)

(c) **Processing Technologies:** Creating the system and application software that is required for the performance of digital ICT.

(d) **Communication Technology:** Producing the device, methods and network to transmit information in digital form.

(e) **Display Technologies:** To create a variety of output devices for the display of digitized information. Such device include display screens for computer, digital television sets with automotive picture adjustment, set top boxes for video on demand, printers, digital video discs, voice synthesizers and virtual reality helmets.

Duncombe and Heeks (1999) describe ICT as an “electronic means of capturing, processing, storing and disseminating information”.

### 5.2 Emergence

If we compare our world today with the world one hundred years ago, we would encounter amazing advances in science, commerce health care, transportation and countless other areas. But, if we compare the classroom of a hundred years ago with an average classroom today, we will observe that here the teaching-learning processes remains almost the same as the were then. Ever since the development of ENIAC by the University of Pennsylvania in 1946, the role of the computer has expanded to encompass tedious or dangerous tasks. Originally designed as an electronic calculator to solve complex mathematical formulae, today the computer can be found performing numerical computations, inventory control, point of sale transactions, manufacturing operations, word processing, and a variety of chores in the home. Of all the uses for Computers, their role in education has generated the serious consideration over the issues, as how to exploit it in various fields of education.

Patrick Suppers designed one of the first educational applications in the mid 1960s. A series of programs to drill arithmetic facts for elementary school children was developed and tested. This modest beginning touched off the debate that continues today about the proper role of the computer in the classroom. Regardless of the answer, it is certain that the microcomputer will be a permanent fixture and an important functional media in the classroom of tomorrow.

### 5.2.1 History of ICT in education - and where we are heading?

Why is the impact of technology on the way we learn so marginal, even though millions of dollars and euros has been spent on to develop educational computer technology? Could it
be that there has been some principle conceptual bias and all the minor changes made in to it do not help much, as the principle is wrong?

With an analogy: if you are sailing somewhere in equator and take a course by mistake to south, even that you should go north, it does not help much if you every year fix your course 5 degrees. You will still end-up to Antarctica.

Let’s try to make a critical analyse of the history of ICT in learning. How the history will look if we try to pull down the mental models and educational thinking behind the promises of different times?

I see four major phases in the history of using computers in education. The fifth: the era of social software and free and open content is still to come – I hope. The phases are:

1. Late 1970’s - early 1980’s: programming, drill and practice;
2. Late 1980’s - early 1990’s: computer based training (CBT) with multimedia;
3. Early 1990’s: Internet-based training (IBT);
4. Late 1990’s - early 2000: e-Learning;
5. Late 2000: Social software + free and open content.

From the history of media we know that new forms never replace the old one. TV didn’t kill radio and Internet didn’t kill TV. New forms of media rather complement the old once, but do not countervail them. This naturally leads to greater choice for people, but also causes fragmentation. Different media devices and formats also get mixed with each other and this way generates new forms that contain features from each of them. iPod is a good example of this. It is a kind of walkman of Internet era that can be used to have personalized radio shows (podcasting).

As noticed by my friend Pauliina Seppälä this seems to be the case with sub-cultures, as well. New forms of sub-cultures, such as youth cultures, are often considered to be some kind of fashion that come and go, but actually all the old forms seems to stay with us. We still have mods, punk rockers, pot- and acid heads with us, although we may consider them to be rather passé. They also mix to each other and formulate new forms of sub-cultures.

I think this is the case with educational technology, as well. All the old paradigms live with the new once and get mixed to each other. The old models just never disappeared but are present in a form or another in the new paradigms.

The old paradigms seem to get fashionable once in a while, too. For this reason we should not be surprised if many people are excited about the drill and practice exercises and quizzes online: they still live in our minds because we want to believe that the paradigm is right.

Let’s have a closer look on the phases in the history of computers in education.

5.2.1.1 Late 1970’s - early 1980’s: programming, drill and practice
This is the era when I got into computers in my own school. It was in the early years of 1980's and our math teacher was teaching also the new school subject called in Finnish "ATK". The abbreviation stand for "automated data processing" – and the name of the subject already tell you pretty well what it was all about. We were using Nokia MikroMikko. There were not many software at all, but there were the MS Basic for programming and naturally that was what the ATK lessons were almost all about.

The pedagogical reason to teach programming was not to train programmers, but the believe that it will develop students' logics and math skills, as it most likely does. In some point there were some educational software running on the MikroMikko. I think they were written by the teacher or maybe she got them from some colleagues. However, the software were very simple drill and practice exercises for math and language learning. These exercises didn't help much students to reach any deeper understanding, as they were mainly simulating students' short term memory and "trial, error, trial, error, trial, past" kind of activity. Anyway these programs kept the wild children quiet (for a while) when teacher was teaching those who were more into programming.

5.2.1.2 Late 1980’s - early 1990's: computer based training (CBT) with multimedia

Same point when the multimedia computers, with advanced graphics and sound came to the mass markets it was presented a claim that the drill and practice exercises failed to teach much because they didn't contain multimedia. It was said that students would learn if they could watch animations in colours, small video clips and then do the exercises.

This was the golden era of CD-ROMs and multimedia computers. This combination was seriously expected to have a huge impact on the ways we learn. The times were good for CD-ROM producers and of multimedia PC manufacturers. The pedagogical mantra behind this phase was that human are different and some students learn better by watching movies / animations and listening audios whereas some learn better by reading or watching still images. The drill and practice component (now in colours) was kept in there, too, but now it's role was more to control yourself if you learned what the multimedia was trying to teach you.

The multimedia CD-ROMs didn't either get people to deep learning and understanding. They failed to be useful almost in all other study subjects than language learning where part of the study work of many people really requires hard practicing and repetition (vocabulary, grammar etc.)

5.2.1.3 Early 1990’s: Internet-based training (IBT)

The third wave or hype of using computer in education came with the raise of the World Wide Web. The failure of CD-ROMs were claimed to be related to the challenges to update the content in the CD-ROMs. The promoters of the new paradigm claimed that
information changes so fast that one should update it almost every day. The solution is here: the Internet and the Internet-based training.

At this point computer-based training was brought to Internet, but again without the multimedia. All you could do on Internet, that time, was text and pictures and some early experiments with animations, video and audio. Pretty fast it was noticed that clicking and reading e-learning course materials online didn’t make people very smart. And again some people claimed that the problem was the lack of multimedia.

The educational ideas behind Internet-based training were not pedagogical at all. The purpose and reason to promote it was the believe that it is cost-efficient as there were no more travelling to training or absence from workplace. Finally it was not that cost-efficient at all. In the end of the day there was very little under the bottom line – people didn’t learn much.

5.2.1.4 Late 1990’s - early 2000: e-Learning

The Internet-based training got mature in late 1990’s and early 2000 in a form of e-learning. The hype around e-learning is a kind of classical example of creating needs. Thousands of websites, articles and companies made it clear for all somehow related to education that this is something you must be involved in. The IT managers of thousands of educational institutions and organizations were asked by the educational experts to come up with e-learning solutions and companies were happy to help the IT managers. The e-learning industry was build, even though it was not proven that anyone (except the IT managers) needed these products. The markets for e-learning courses and especially for Learning Management Systems (LMS) were created.

The pedagogical thinking around the e-learning is closely related to the computer-based training. The point is to deliver courses for students. Later on the learning platform developers has become more aware that learning requires social activities among the learners themselves and the learner and the teacher(s). Still the user interfaces of the LMS systems are at least implicitly telling you that you should first read the content and if there is something you do not understand you may ask your peers or your teacher.

On the otherhand the e-learning field is nowadays so wide that it is hard to say what is the pedagogical thinking behind it. E-learning is no more one. It could be said that all the earlier paradigms live inside the e-leaning plus some clues of the future: social software and open content.

5.2.1.5 Late 2000: Social software + free and open content

I really hope that in the late 2000 social software and free and open content will make a real breakthrough in the field of educational technology. Blogs and wikis have already brought web back to its original idea: simple tool for your personal notes that are easily accessible and even editable by your peers and your potential peers.
Such projects as the GNU-GPL, Creative Commons, Wikipedia and Opencourseware have shown that free content benefits all - and that people are willing to contribute to the common good. Digital content is such that when you give it away you do not loose it yourself. This makes giving much easier for many people.

The pedagogical thinking behind the social software and the free and open content can be located to the social constructivist theory and cultural-historical psychology. "Any true understanding is dialogic in nature" wrote Mikhail Bakhtin and Lev Vygotsky wrote that "all higher [mental] functions originate as actual relations between human individuals".

5.3 Dimensions/Issues

There are many emerging issues that necessitate integration of ICT in education, such as Technological, Processual, Pedagogical, Ethical and Economical.

5.3.1 Technological issues

The technological issues are in connection with the telephone network, power supply, machine maintenance, technical support and networking etc. Technology in all forms, young and old or simple and complex, can be potent tools that engage learners in meta-cognitive reflection. These tools engage learners to rethink their old beliefs, knowledge, and understandings. These tools might allow learners to compare new ideas with other individuals to assess whether new concepts and ideas are plausible and fruitful. Technologies can be educators’ tools in finding creative ways that encourage students to self-test, self-question, and self-regulate learning in helping them to create solutions to complex problems. Educators need to help students realize that understanding about knowledge and beliefs is essential to human growth and development. Technologies should not estrange us from our humanity or the noble profession of educating competent citizens. We should not become "high-tech, self driven slaves to technology." What will happen if education continues to steadfastly bend to higher enrollments over the quality of teaching and learning? What will happen if education immortalizes the student in education with an attitude of "the customer is always right"? Could the curtailment of the educational process and the collapse of the educational system is closer than we fear?

Today, various computing technologies provide much assistance in achieving these goals via the use of distance learning, computer-based training" (CBT), Computer -aided instruction or computer-assisted instruction (CAI), Computer-based learning (CBL), web-based training (WBT) or e-instruction, and the linking of other available technologies. For example, when using distance education technologies, a teacher might think of contrasting ways that promote interactions between students with teachers and students with students. Teachers might link these activities with Internet tools, i.e., listserv, chat rooms, and group discussions to stir thinking, learning, and creative problem solving. According to Comers, Jonassen, & Mays (1992), technologies must be used as mind tools that will
support, guide, and extend the student in cognitive operations as they simultaneously construct knowledge. Therefore, mind tools cannot be used singularly in studying the subject learning material without eliciting the tool of profound thought (Jonassen, 1996).

Changes in instructional design might integrate perspective theories, applications, and research related to learning, thinking, teaching, educating, integrating, mastering, and leading powerful technological advances upon the world's society. These changes may be used constructively to creatively lead the educational system to a brighter future and a more realistic information millennium.

5.3.2 Processual Issues

The Processual issues focus on the drafter of policy, driving force, programme formulation, time frame, resources and models of dissemination. A consensus holds that insufficient attention is paid to monitoring and evaluation issues and feedback loops during the program design process of most ICT in education initiatives. In general, many of the issues and challenges associated with ICT in education initiatives are known by policymakers, donor staff and educators. However, data on the nature and extent of these issues remain limited in most places because of the lack of monitoring and evaluation tools and methodologies dealing with the use of ICTs in schools and their impact on teaching and learning. There are no common international usage, performance and impact indicators for ICTs in education. Example of monitoring and evaluation indicators and data collection methods exist as appear from many countries.

The process for the development of ICT in education indicators is the same as the process for the development of indicators in other fields. There have been very few international evaluations of the impact of ICT use in education. Those that exist rely in large part on self-reported data. Quantitative data, typically related to the presence and functionality of ICT-related hardware and software, are seen as the easiest to collect, and most monitoring and evaluation indicators and collection efforts have focused on such data. In general, there has been a greater emphasis on technical infrastructure issues than on program design, monitoring and evaluation, training and on-going maintenance/upgrades issues.

5.3.3 Pedagogical Issues

The Pedagogical issues emerge out of special needs, gender, language, curriculum, literacy, role of learner, teacher, law maker, local community, parents, intellectual property, public domain, blasphemes and pornography. If we think about on-line education as just being a more efficient (or more entertaining) means of teaching the way we have always taught, then the pedagogical disadvantages of on-line education outweigh the advantages. What is truly exciting about on-line education is that it offers the potential to evoke a qualitative revolution in our teaching capabilities. Our current pedagogy has
evolved largely as the product of pragmatic constraints (e.g. time, class size, linear textbooks). Computers have lifted many of those constraints, and the new territory to be explored is vast and exciting. The questions of whether this potential will be realized, and whether the benefits can grow to the point where they can compensate for the inevitable losses from an on-line education, have yet to be answered. Success, I believe, depends upon bringing together sophistication in pedagogy, sophistication in technology, and an overt resolve that the quality of the educational experience is the most important criterion.

5.3.4 Economical issues

The Economical issues are emerging out of global domination and educational market. As the world approaches the 21st century, business and industry summon skilled workers who are creative and innovative thinkers. Structure and regimentation provide little tolerance for flexibility. Therefore, educators must rely on creative thinking and innovative problem solving skills in all domains to better meet the demands of a polymorphous information society. Thus, it is the responsibility of education at all levels, according to Postman (1996), to build a Universal American culture based on a common core of fact, history, literature, science, philosophy, war, and art.

An educated citizen in the year 2020 will be more valuable as an employee because he or she will be able to produce more builders of theory, synthesizers, and inventors of strategy than valuable as an employee who manages facts (Di Sessa, 1998). To remain competitive and innovative in their decision-making, educational administrators need to assess and implement new strategies that foster creativity and innovation. Insightful administrators might request that teachers, staff, and other personnel commit ideas from inception to completion, to formulate new products, or to use new technologies in classrooms.

Students need to step beyond the search for information to make connections and associations with information. According to Paul (1993), thinking accomplishes the purpose of thinking; it must have purpose, or it will wander endlessly. Students need to learn how to sort and categorize information and construct knowledge as design, while making applicable associations to solve unique problems. Therefore, students can be taught to learn with computers that function as cognitive technologies for broadening and reviewing how computers are used in the learning experience, while educators capture a better picture of how students think (Jonassen, 1996).

5.3.5 Ethical Issues

Computer ethics is a new branch of ethics that is growing and changing rapidly as computer technology also grows and develops. The term "computer ethics" is open to interpretations both broad and narrow. On the one hand, for example, computer ethics might be understood very narrowly as the efforts of professional philosophers to apply traditional ethical theories like utilitarianism, Kantianism, or virtue ethics to issues regarding the use of computer
technology. On the other hand, it is possible to construe computer ethics in a very broad way to include, as well, standards of professional practice, codes of conduct, aspects of computer law, public policy, corporate ethics—even certain topics in the sociology and psychology of computing.

Education is the most powerful tool for change and hence it must train the minds of those being educated to cope with the change. The educational environment is changing as a result of the computer and will continue to change. The world of modern day is often called as "Age of Communication and Information". Communication is the very core of the computer revolution. The exchange of data by computer gives fast, timely and accurate transmission capability for any subject area and by any organization or individual. The common language of the computer is enhancing the communication ability of man. Communication with telecommunication also offers the teacher, administrator, parents and the students the opportunity of informational exchange. The computer is one of the most powerful forces in society today. It's being put to use everywhere, it seems—in homes and in organizations of all sizes—and no one can doubt that this usage is having a strong impact on many people. There is no question that computer as an instructional device is going to have a profound effect on the students. The facility of access to information from anywhere at anytime and to have choice of output gives mobility to the mind.