

Trends in using new technologies in school education

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Abstract

Information and Communication technologies (ICT), i.e. computer networks and hypermedia systems (World Wide Web in particular) and the pervasiveness of the Internet have stimulated a vast quantity of investigations into the opportunities and challenges that might be offered or met into the field of education. It is argued that most investigations are focused on questions like “given a technology T, what are the successful applications A(T)?”. On the contrary, we believe that the “marriage” between the “technology push” and the “learning pull” should be dominated by the latter. The educators should be conscious of the unique pedagogical/learning advantages offered by ICT when deciding to use them and not use them because of “technolove” or “technological determinism” or even “techno-lust”. In this paper, the effort will be on analyzing analyze the trends in applying new technologies in school environments thus creating a conceptual framework which the educators can use to justify the ICT choice in education.

1. Introduction

In 1983, when the Internet and World Wide Web (WWW) did not exist, the board of Ministers of Education from all European countries decided about the actions for the introduction of the computers in school environments [EEC 256, 24-9-1983]. Since then a huge number of initiatives and activities have been taking place in order to find the most suitable ways for using computers in schools as well as for evaluating the effectiveness of their use. In the recent EU report addressed to the European Ministers of Education, the difficulties in merging technology and pedagogy were mentioned [EEC COM (2000), 27-1-2000]. It is strongly emphasized, however, that the most innovative and learning effective uses of the information and communication technologies (ICT) can be found in school environments and mainly in primary schools. This is due to the fact that one teacher is responsible for the instruction of a group of pupils, he/she has flexibility in following the curriculum as well as he/she can use ICT to leverage the socio-cultural knowledge and skills of the pupils [16].

Nowadays, instructional systems make extensive use of network technologies, especially the Internet and the World Wide Web, because of their potential, in advancing interactivity between learners and tutors, in offering flexibility concerning the way of learning, and in providing easy, one-stop maintenance and reusability of resources [15]. Thanks to such technologies as interactive simulations, streaming media, and virtual reality, educators have the opportunity to go where none have gone before. We can introduce representations of a great variety of complex phenomena into school settings that would have previously required expensive field trips and only limited opportunities for meaningful interaction. We can apply voice recognition technology to foreign language training and use conversational interfaces so that learners can practice

speaking skills in realistic settings. We can record and replay noteworthy events from all over the world. Rich digital resources exist for nearly every topic of concern while technology development continues at a mind-numbing pace [17].

ICTs are certainly a catalyst for change, helping to bring about a new revolution in education. A revolution that deals with the philosophy of how one teaches, of the relationship between teachers and students, of the way in which a classroom is structured, and the nature of the curriculum.

The educational use of ICTs could be socially and educationally "blind" if it is based on nothing but "technolove", i.e. to introduce technology in the school environment because it is "a la mode". Nevertheless, the complete denial of technology in education because of "technophobia" is almost unacceptable for the people of the Information Society. We already live in and experience it through many of its applications [19].

The educators and policy makers should take consideration of the added value that ICT can offer to the school system as well as to design the proper action lines that will guarantee, on the one hand the most appropriate uses from pedagogical perspective, as well as the most efficient uses from technological aspects, on the other hand. This paper aims to provide ways of using ICT in schools and to propose action lines that should be followed so as to enable the "marriage" between technology and pedagogy.

The structure of the paper is as follows: Section 2 will describe some statistical data about the introduction and usage of computer systems in school environments. Section 3 will describe the main ways of using ICT in schools. Section 4 will present real examples of the use of technology in schools offering references to a rich set of on-line resources. Section 5 consists of remarks about the issues that the educators and policy makers should think of when designing action lines for the introduction of ICT in schools. Section 6 contains some ideas on how to proceed with applying ICT to education.

2. Computers in Schools- Some data

Unfortunately there is a limited number of official statistical data about the use of computers in schools as well as about the number of teachers, trained to use them effectively. The data presented below comes from recent reports from the EUN and the USA Ministry of Education.

Table 1 shows the ratio of students per computer station as well as the percentage of schools connected to the Internet. Note that sometimes a school connection to the Internet might mean just a PC (perhaps in the director's office) connected via a modem to an Internet Service Provider.

Country	Num of students per computer station		Percentage of schools connected to the Internet	
	Primary education	Secondary education	Primary education	Secondary education
Belgium	25	13	24%	72%
Denmark	14	6,6	75%	100%
Finland	12	10	90%	95%
France	31	17	10,5%	53%
U.K.	13	8	62%	93%
Sweden	13	6	56%	91%
USA	6	unknown	89%	<50%

The Hellenic School Network consists of 800 schools out of 3767. They, all, have computer equipment and networked infrastructure. Till the end of 2001, this number will augment to 2116 schools. Speaking of national targets:

- All schools in Germany and the UK are expected to be connected to the Internet by the end of 2002.
- In Belgium, the ratio of students per computer station will be 10 students per PC by the end of 2002.
- All Greek schools will have internet connection by the end of 2004.

Concerning the percentage of teachers that have computer skills, very few are known. However, in Sweden, 8 teachers out of 10 declare that their knowledge is limited. While in Finland, only 20% mention that they hold the necessary skills, their British colleagues report that they are computer-literate by 68%.

Taking into account the above figures, one could expect that each country has taken (or has planned) specific actions. The main national projects concern:

- Infrastructure. Nations invest quite large amounts of money in their effort to create good technical infrastructure at schools. For example, in Denmark since 1994, the school network has cost 67 million Euros. In some cases, collaboration among governmental and industrial parties, which are mainly content providers or telecommunication companies, has significant results. For example, in Germany, Deutsche Telecom and in Eire, the Telecom Eiraan, have supported the governmental effort for creating school networks by 12 million Euros (each).
- Teacher training. Such projects have already started without significant results, as yet.
- Development of educational services and software and tools. Such projects are fewer in number than the previous ones. However, Great Britain and France have done significant achievements in the field, because of the projects Educnet [<http://www.educnet.education.fr/>] & Educasource [<http://www.educasource.education.fr/>] and the National Grid for Learning [<http://www.ngfl.gov.uk/>], respectively.

In Greece, a big national effort has started in 1997, mainly by the Ministry of Education, being helped by the Informatics and Telematics Institute, and the Pedagogical Institute. One of the initiatives, actually an umbrella of projects, has been called Odysseia.

Apart from national projects, EU funds European partnership collaborations. Since 1995, a large number of European organizations have granted funds within various programmes such as:

- Task Force «Educational Software and Multimedia» (1995-1998). The budget was 49 million Euros and 46 projects have been accomplished. One of the biggest accomplishments was the *EUN:European Schoolnet* [<http://www.eun.org>]. EUN focuses on schools collaboration activities, planning open architecture and technical developments for schools networks, and promoting innovation and change in the EUN networks.
- The Telematics application programme (1994-1998), which funded 86 projects and 700 organizations.
- The Esprit programme started in 1998 for the creation of innovative school environments. The Esprit grant was 13 million Euros.
- Other programmes like Socrates, Leonardo Da Vinci, Lingua, Comenius, etc. supported European partnerships which emphasized in teacher training, new pedagogical methods using new technologies, etc.

All the aforementioned programmes along with the current IST programme, Minerva, etc., which already run, are expected to offer know-how, experiences and answers to the questions about the effective and efficient ways to use computers and ICTs in school environments.

3. Ways of using computers and ICTs in school environments

Computers and ICTs, in general, are used in schools for both administration and instruction [www.iste.org]. Computer can facilitate the administrative tasks within a school such as accounting, record keeping, e-mail communication with authorities, etc.

This paper is concerned with the instructional use of computers and ICTs. Computer can be seen in a school environment in two distinct ways:

- Computer as a subject
- Computer as an instructional tool

In the first case, students learn the essentials about the computer science: how a computer works, b) how to use it and c) socio-economic implications of ICT usage (e-commerce, e-learning, etc.) In the latter case, ICTs are being used to support and partially automate the instructional process and cover the learners and teachers needs.

It is absolutely wrong to believe that computers in schools can be used for enabling students to acquire computer skills as well as to learn text editors, spreadsheets, etc. With the dramatic advances in ICTs, especially the Internet and World Wide Web (WWW), new kinds of instructional systems have been arisen which emphasize on the interactivity in learning. The added value of technology is that they enable the enrichment of the learning paradigm in order to [5]:

- Support open, flexible and learner-centered pattern of study;
- Provide new ways for learners to work collaboratively;
- Facilitate the development of communication and coordination skills;
- Encourage the development of technological skills

An ICT-based educational system should provide a number of features to teachers, students, tutors, educational managers, etc., in order to:

- Create, operate and administrate an on-line course.
- Support the collaboration between students and provide motivation and resources for team building.
- Create, deliver and automatically assess on-line questions and tests.
- Organize educational, financial and human resources.
- Administer virtual, distributed classes where the students are geographically scattered and communicate via the Internet.

More specifically, ICT can be used in classroom in various ways thus creating models of educational systems that can be categorized as follows:

- Information based models. Networked computers are used for retrieving information from sources like Virtual Museums, digital libraries, etc.

- Teaching media based models. Networked computers are used only for dissemination/acquiring educational and informative material, i.e. course descriptions, educational software, etc.
- Virtual classroom models. Networked computers are used with emphasis on collaboration and computer mediated human interaction)

The use of ICT can change the teacher's role: "From a sage on the stage to a guide on the side". As shown in Figure 1, in a traditional classroom, learners have actual social contact with the tutor, all being at the same location. The most important shortcoming of this schema is what has been called "the tyranny of the single textbook" and of course, the constraints in time and place of the instructional process.

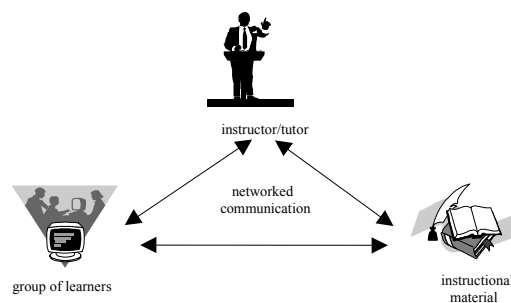


Figure 1. The instructional schema of traditional learning

In an ICT based learning environment, the access to the instructional material as well as the interaction between the instructors/tutors is being achieved via the Internet and the World Wide Web (WWW). Creating such environments is aimed at providing instruction in place and time that are convenient for the learners. Using ICTs, students can benefit by accessing knowledge from many points of view and many sources (experts). Therefore, ICTs eliminate time and geographical barriers. They provide learners with access to provide the learners access to information and learning resources When, Where, How and As Much as they want. ICTs can be the basis for a wall-less and paper-less classroom [9], "open" to a wide variety of learners. Disadvantaged students (due to geographical, financial, socially and health reasons) can have a means of learning at their own convenient way. Having built a learner-centered ACT based learning environment, they are not excluded from the instructional process.

Moreover, the teacher and the tutors can communicate with the students at their preferable time of the day and they have, as a result, more time to devote to their research or other activities. It is also stated that off-line interaction between teacher and students has better results concerning the quality of the messages exchanged than when they interact on-line or face to face [7]. The main reasons for this are that both agents have more time to think before sending a message, and in some cases students are reluctant to participate to classroom conversations. Figure 2 presents the concept of transforming the traditional ex cathedra model to an open more learner-centered one, which is based on the ICT.

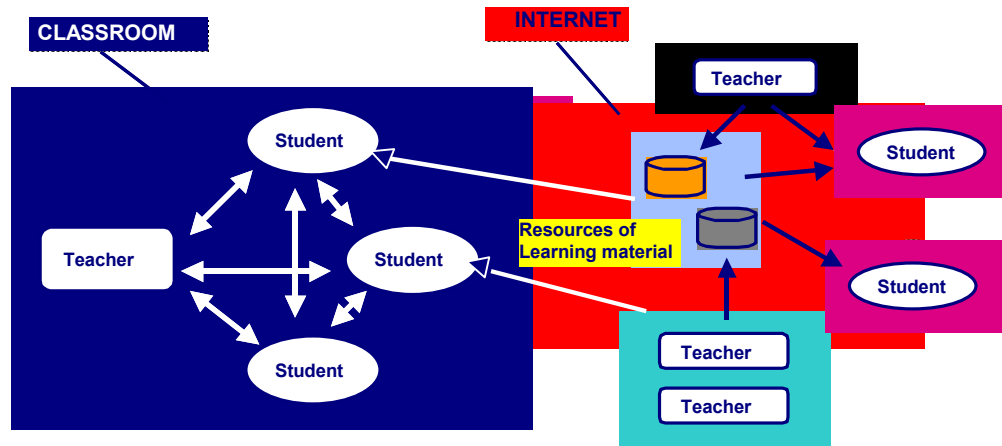


Figure. 2. The ICT based learning paradigm

4. Uses of ICTs in education

The educational use of ICTs lies on the added value that they can offer when appropriately used. First of all, there are plenty of portals where children will go in order to play and learn, such as the ExtremeKids.com [<http://www.extremekids.com/>], ALFY [<http://www.alfy.com/index.asp>], Disney [<http://www.Disney.com>] and a lot more.

Moreover there are portals, which contain resources of learning material as well as guidelines for teachers and parents on how to introduce them in classroom activities. Such portals are:

- *A to Z Teacher Stuff* [<http://atoZTeacherStuff.com/>]

This one-stop website provides a variety of teaching resources for the online educator. Original lesson plans for grades pre-K-12, thematic units and theme resources, teacher tips, educational articles, children's literature activities, top educational sites, and teaching materials can be found at this website with the aid of a search feature. Educators can also interact with others on the message boards, or join a collaborative project. The Theme section is attractively displayed in chart form. Categories featured here include: New Themes and Recent Updates, Social Studies, Language Arts/Literature, Science/Health, Math and Misc. Themes. A lot of unique themes here that teachers really appreciate.

- *Eduscapes* [<http://eduscapes.com/>]

A great starting point for teachers beginning their unit and lesson planning is on this website. A marvelous collection of topics for K- 12 students exists. Each week new topics are posted and previous topics are listed alphabetically and according to the date it was posted.

- *Digital Education Network (DEN)* [<http://www.actden.com/>]

The ACTDEN site is made up of seven DENs or subject categories. Each offers information and interactive features that encourage students to learn and to think:

- MathDEN - presents challenging math problems.
- WritingDEN - teaches students how to write effectively.
- NewsDEN - presents current events in exciting new ways.
- GraphicsDEN - introduces students to cool digital art.

- SkyDEN- offers a visually stunning introduction to basic astronomy.
- InternetDEN - shows teachers how to use Internet Explorer 4.0.
- TestDEN - creates personalized study guides for TOEFL (Teaching of English as a Foreign Language) students

- *AskEric (Educational Resources Information Center)* [<http://ericir.syr.edu>]

The AskEric website belongs to the Educational Resources Information Center (ERIC) which is sponsored by the U.S. Department of Education, Office of Educational Research and Improvement and administered by the National Library of Education. The ACCESS ERIC site contains the largest education database in the world, with over one million abstracts of documents and journal articles. The place for educational research. The AskEric site was the first registered education site on the World Wide Web. The Virtual Library link contains more than 1,100 lesson plans, more than 20 listserv archives, 250 AskERIC InfoGuides and the AskERIC Toolbox.

- *Classroom Connect* [<http://www.classroom.com/>]

Classroom Today and the Connected Teacher are two of the main areas of this site. Classroom Today provides Internet links to the curriculum through student activities such as Daily and Weekly Questions, Kids' Quiz, Mystery Media, Survey Says, Connections and other activities. A Topics section provides topics to match curriculum. An Email Newsletter lets you find out more about Classroom Today topics each month. There is also a Teachers' Lounge with planning tools, a teaching guide and tips and ideas on measuring student progress. The Connected Teacher section of the website links teachers to the latest in state-by-state discussions on education as well as keeping teachers informed on the latest ideas from fellow educators and world class keynoters at Connected Classroom Conferences. There is also an opportunity to read the presenters' handouts and participate in discussions from past conferences.

- *Community Learning Network* [<http://www.cln.org/>]

The main menu of the Community Learning Network is a well-organized source of educational resources for the K-12 teacher. The following links: Educational WWW Resources for K-12 Students and Teachers, Integrate the Internet into the Classroom, Learn More about the Internet, Professional Development in Information Technology and Province of British Columbia's K-12 Educational Community are followed by detailed descriptions and key words.

- *DiscoverySchool.com* [<http://www.discoveryschool.com/>]

Resources for grades K-12 are easily available through a search engine, which covers major subjects in the curriculum. Eight categories of links offer resources to make classroom teaching easier and fun. The link to the Puzzlemaker category is one of the most favorite destination. This wonderful tool can save many teachers' hours of work. It's fun, easy to use and the puzzles can be a hit with students. There are word searches, word searches with hidden messages, computer generated mazes, criss-cross puzzles, number blocks, math squares, cryptograms, letter tiles and more!

- *ePlay* [<http://eplay.com/>]

ePlay is a unique site on the Internet for three groups of people: teachers, parents and kids. It's a free educational site that has teaching resources, parenting help and homework tips, games, activities and more.

Several other portals exist for specific subject domains such as Maths, Environment, Physics, etc, like the following:

- *Math Goodies* [<http://www.mathgoodies.com>],
- *Mega-Math* [<http://www.c3.lanl.gov/mega-math>]
- *Little Planet* [<http://www.littleplanet.com>]
- *COVIS – Learning through Collaborative Visualization* [<http://www.covis.nwu.edu/>].

Moreover, ICT can enhance the collaborative learning among pupils or between students and teachers or tutors. The *European Schoolnet* is made up of people from all over Europe, and beyond [<http://www.cn.eun.org/eun.org2/eun/en/index.html>]. At present, people involved in EUN are focused on five areas of activity:

- Running the EUN website and schools collaboration activities,
- Planning open architecture and technical developments for schools networks,
- Promoting innovation and change in the EUN networks,

Several similar portals exist such as the *Lightspan.com* [<http://www.lightspan.com/>]. This site can rightly claim to have some of the best collaborative online projects, tools and resources for teachers on the Internet. Click on *From the Teacher's Desk (K-2, 3-4, 5-6, 7-8)* link and read about collaborative student projects, online field trips, expeditions, and more.

5. Thoughts about action lines

Like any other technology, ICTs have advantages and disadvantages. Implementations that capitalize on their strengths and that circumvent or adjust to its limitations can be expected to be educationally effective [3]. However, people often believe that it is sufficient to take a course syllabus and course material, transform them into digital format and deliver it via the Internet. On the contrary, ICT based learning, is not an easy task; neither has their effectiveness been proven. Careful experimentation along with well-planned and methodic action lines should be made in order to be better able to evaluate what succeeds or fails when using ICT in school environments as well as to recognize the reasons [6]. Some of the action lines on which the policy makers and educational managers should focus are the following:

1. Prioritizing the funding of infrastructure. It is evident that the security, the management, and the maintenance of computer equipment and network infrastructure cost a lot. It is necessary to find the appropriate funding schemas with the involvement of industry. We should overpass the obsession of diminishing the ratio of school children to computer. It is more essential to invest on school networking facilities, on well-equipped laboratories (even small ones) and on administrative facilities for schoolteachers and directors.
2. Utilization of well documented, widely accepted development methodologies and quality criteria for creating educational software, tools and services so as to ensure the creation of a quality end-product within certain limits of resources. The development process has evolved from an intuitive approach to a very sophisticated process which depends on theories and practice from research fields such as pedagogy, courseware engineering, and software engineering. Collaboration with educational industry content providers is needed so as to produce high quality end product. Amateur products only harm the efforts of introducing the ICTs in school education.

3. Services for teachers' information and training are essential. Lots of portals that serve this goal can be found on the Internet. What is lacking is the governmental initiative in building a nation-wide portal to better support the teachers' tasks.
4. *Teachers' training* is too crucial and indispensable. All efforts in introducing ICTs in education will fail unless teachers are well trained and motivated for their new role [3].

All the actions lines that will be decided should fit in a general long-term strategic plan. Various agents can contribute in such a plan, such as teachers, pedagogues, educational technologists, educational managers, policy makers, and so on. Money, volition and clear thinking are the necessary skills that should govern if we desire the experiment in using ICT in education to be successful [18].

6. Concluding remarks

The use of Internet and WWW can widen the horizon of the community or world of information. Netizens have access to information sources and learners have the possibilities to find learning resources widely dispersed in the cyberspace written by experts. ICTs augment the broadcasting possibilities. Everyone can set up a Web page and distribute information-material. Moreover, computer-mediated communication (CMC) enables people with shared interests to form and sustain relationships and communities. Despite the lack of physical space, the CMC facilities allow students to exchange emotional support, information and to "realize" a sense of belonging [2,14].

However, it is common knowledge among researchers that ICT assisted learning is still facing numerous shortcomings and there is certainly a long way ahead of us until it can be claimed that technology will make education better. Consequently the application of ICTs does not comprise a panacea to the problem of accomplishing knowledge-driven education and training and performing the "educational shift" from teacher to learner-centered [10,13].

The educational community has a lot to learn regarding how, and in what ways technology can enhance the instructional process. Systematic methods for performing experimentation and evaluation studies about the learning effectiveness of a web-based system should be followed. Evaluation should be a planned systematic and open endeavor [1]. It should concern the learning event at a holistic level, taking into account the context of learning and all the factors that go with it. [11, 12].

Concluding, we should also take into consideration that an educational system that was been working for centuries cannot become obsolete; it can be enriched, however, with ICT based educational tools, services and learning resources and this should be the main research and development target [4, 20].

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