

Information technologies *in teacher education*

Issues and experiences for countries in transition

Edited by Betty Collis, Iliana Nikolova, Katerina Martcheva



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Communication and Information Technologies as Change Agents

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Abstract

Technological developments and new training paradigms have a strong influence on society. Information technology (IT) is evolving toward an integrated communication and information technology (CIT). Training is evolving from a separately planned external activity toward an integrated learning-working activity. Education and the teaching profession have to take such developments into account. As a consequence the teaching profession is evolving from an emphasis on delivering information to an emphasis on creating learning environments.

1. Need for teacher education

There is a critical need to train more and better teachers. As Rawley (1992) indicates: "Throughout history, teachers have been held in high regard. But today teaching holds a low status. The teaching profession is generally not well paid, conditions are poor, and career paths are uncertain. In particular, it is difficult to attract qualified and highly motivated people to the profession at the primary level" (p.2).

Recently the Dutch Parliament discussed the recommendations of a report prepared at the request of the Dutch Minister of Education about measures to improve "the attractiveness of the teaching profession in the Netherlands" (Commissie Toekomst Leraarschap, 1993). The main recommendation was to bring more variation into the profession and to provide explicit career perspectives. Specifics related to the creation of more differentiation in the career of a teacher and of extra efforts in terms of inservice training.

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Perhaps information technology can help to come to grips with these problems. But first of all, we have to be sure that information technology even deserves a place in the educational system.

2. Information technology and education

Preparing pupils for their future occupations, translated into the process of passing on knowledge and skills, is the main force that drives the engine of instruction. How to do this most efficiently and most effectively is 'the' central question to be solved. Introducing technology into schools has been one of many reform suggestions to deal with this problem.

2.1 Disillusionment with technology

In his book "Teachers and machines: The classroom use of technology since 1920", Cuban (1986) sharply analyses the introduction and use of technology in education. The following quotes illustrate his thinking:

'Many educators have dreamed of making instruction both productive and enriching: wishing that children somehow could learn more and faster while teachers taught less. This dream has persisted from the invention of the lecture centuries ago to the early decades of this century when reformers sought efficiency through film, radio, and television. The dream persists into the 1980s with promoters boosting desk-top computers for each student.' (Cuban, 1986,p.3).

'The promises implied in these aids caught educators' attention: individualized instruction, relief of the tedium of repetitive activities, and presentation of content beyond what was available to a classroom teacher.' (Cuban, 1986,p.4)

'Claims predicting extraordinary changes in teacher practice and student learning, mixed with promotional tactics, dominated the literature in the initial wave of enthusiasm for each new technology. Seldom were these innovations initiated by teachers....Reformers, more often than not, were foundation executives, educational administrators, and wholesalers who saw solutions to school problems in swift technological advances.' (Cuban, 1986,p.4)

'Marring the general favor and scientific credibility enjoyed by the innovation, however, would be scattered complaints from teachers or classroom observers about the logistics of use, technical imperfections, incompatibility with current programs, or similar concerns. At a later point, surveys would document teacher use of the particular tool as disappoint

ingly infrequent Such surveys would unleash mild to harsh criticism of administrators who left costly machines in closets to gather cobwebs, or stinging rebukes of narrow-minded, stubborn teachers reluctant to use learning tools that studies had shown to be academically effective. ' (Cuban, 1986, p.5)

Although Cuban's book was published in 1986, his remarks are astonishingly actual and accurate in 1994. The following references are recent illustrations of Cuban's statements.

- A world wide inventory (Pelgrum & Plomp, 1993) illustrates that the introduction of computers in education has clearly flourished over the last 12 to 15 years .
- Among many others, Collis (1988) has explored, argued and illustrated the potential advantages of computer use in the teaching/learning process.
- However, at the same time, many researchers have reflected about the reasons why the introduction of computers in education has not been as successful as expected. According to Hannafin and Saveney (1993) the main reason for the failure to maximize the potential of the innovation is teachers' inability to adapt their teaching styles. Moonen and Stanchev (1993) relate the disillusionment that is being expressed to the lack of organizational flexibility within the educational system and a lack of theory about how interactive teaching-learning environments should be designed.

2.2 Reasons for the disillusionment

Cuban is right. But, how did this happen? Maybe investigators and reformers thought too much about technology so that computers became solutions in search of a problem. Maybe the teachers' expertise, built upon a 'pool of craft wisdom about children and schooling', was not sufficiently taken into account.

Often, introduction of computers in education has not started from an obvious educational need or a request by the teachers. Looking back to school reform over many decades, a pattern can be seen to occur whereby the governance and the curriculum of school changed considerably and regularly. However, changes in classroom practice have been much more modest: (a) in classroom organisation (more diversity in forms), (b) in teacher-student relationship (less formal), and (c) in instructional methods (a broader perspective). More significant is the observation that a persistent core of practice that teachers have found to be efficient and effective--traditional teacher-directed instruction, has not changed at all.

2.3 Reconsidering "change"

A part of the misinterpretation of what seems to happen or does not happen in schools occurs because the concept of 'change' is taken in too narrow an interpretation. Change is often measured in its direct relation to a specific reform-initiated input. On the other hand, change mostly occurs only after a considerable time. Neglecting all kinds of external pressures and many other unplanned events, and not given the time for changes to settle down and become measurable, adds to the misunderstandings and to the conclusion that change does not occur. Therefore educational research about change processes

in education should be of a longitudinal nature. Cuban said it very nicely: "Stability and change are interwoven into a seamless cloth difficult for the observer to disentangle at first glance, yet becoming more visible as time passes....". (Cuban, 1986,p.107).

Given this dubious state-of-affairs with respect of the impact of information technology in schools, is it worthwhile to continue efforts in this direction?

3. A longitudinal technology-enriched school project

Recently a longitudinal research project (the PRONTO Project) about the impact of computers on education has been completed at the University of Twente. The project preparation started in 1985, and the project itself was executed from 1987 through 1993. Two secondary schools in Enschede and the Faculty of Educational Science and Technology were involved.

The central idea of the project was to equip both schools with extra facilities (in hardware, software, and released time for teachers) to create a situation of a 'technology-enriched' school (TES) (Moonen & Beishuizen, 1992; Moonen & Collis, 1992). In that environment the main task of the project was to investigate the impact of a TES environment on the school as a whole and in an interrelated way. Researchers from the university, school administrators, and teachers worked closely together to formulate, discuss, and investigate several research questions. Five major questions became the focus of the TES project: (a) what are the implications of large-scale introduction of computers for the school organisation, the school curriculum and the tasks of the teachers?(b) what kind of implementation problems are occurring? (c) what type of educational software should be available?(d) how can the use of computers be integrated in the existing curriculum teaching practice?(e) what are the effects of intensive use of computers on the motivation of teachers and pupils, and on the learning results?

The project produced 25 scientific reports, 11 booklets with practical guidelines for teachers, more than 70 external reports, articles and presentations, and a final report (Moonen (ed.), 1993). In summary the conclusions of the project were the following:

3.1 From the positive side

Because of the introduction of educational and administrative use of computers in the school, many kinds of change processes have started which, when well-anchored into the school system, will lead to substantial changes. The computer thereby acts as a catalyst.

Pupils are thoroughly enthusiastic about using computers and express their willingness to spend more time with computers in schools.

When its usefulness and usability is clearly visible the use of computers, especially in its non-educational administrative use, spreads around quickly and becomes popular.

3.2 From the negative side:

Large-scale introduction of computers in education is a complex and lengthy operation. Even after many years of concentrated efforts and involvement of the great majority of

teachers and the school administration, the full integration of computers into the school system and the curricula is not yet realised. After reaching a certain level of implementation, further integration seems to be stopped.

3.3 Reasons and explanations for these conclusions:

3.3.1 Reasons

The main reason why the implementation process has come to a standstill is because of the insufficient didactical expertise of teachers with respect to the use of computers in their curriculum.

Other reasons are:

- the congestion in the computer laboratory
- a small minority of teachers (10 to 15%) keep rejecting the use of computers
- there is still a lack of 'adequate' educational software. The main problem hereby is that it is difficult to determine when educational software can be perceived as 'adequate'.

3.3.2 Side conditions

Teachers prefer to be trained in their own school environment, by their computer co-ordinator and together with their colleagues.

The implementation of computers in the school needs the support of specialised personnel: at least a computer co-ordinator and a technical support person.

Introducing computers in education needs to be backed up by an explicit schoolbased consultation structure in which the school management, teachers, and other personnel can plan and make arrangements about how to use computers in the school.

3.4 General conclusion

The introduction of computers in education has started a process that will lead to substantial changes in education. There are however, two accompanying conditions for this conclusion:

- the introduction of computers should continue to be cherished and remain supported so that it gets real chance in schools;
- how computers should be used in the educational process has still to evolve; computers still have to find their 'niche'.

The central reason for this conclusion is the fact that the two main actors in education, the teacher and the pupil, show an intrinsic enthusiasm for the third actor in this interplay, the computer.

Cuban said it in a different way: "After a storm has struck a beach, to get down on your hands and knees and look at the sand from an inch away will give a clear but limited view of the beach; it will not offer a whole picture of what the storm has done to the shoreline." (Cuban, 1986, p. 107).

After a long time and from a bird's-eye perspective changes are becoming visible in schools. Therefore, in spite of the many difficulties and disillusionments, the introduction of information technology in schools has to continue. As a consequence teacher training in this area should also continue.

4. Teacher training

How do training programs prepare teachers for the introduction of computers in schools?
How did training programs evolve?

4.1 Start-up

The beginning was the most difficult as there was no training to train the trainers. In many cases therefore, training was provided by those who were most close to the computing profession: mathematicians and computer scientists. As a consequence there was in the beginning a strong bias toward computer science in general and programming in particular.

4.2 Content

Specific training programs were formulated, heavily loaded with topics in relation to computer literacy. A typical training program (ACM, 1983) covered topics as: (a) what computers are and how they work; (b) a brief history of computers and technology; (c) an introduction to programming; (d) a survey of the application of computers in society; (e) a discussion of social issues in computing.

In addition it was believed that all teachers should get a minimal background about how computers could be used in education.

4.3 International Co-operation

The interest in computers and education grew very fast and most international organisations felt obliged to actively participate in discussions, each of which resulted in specific recommendations, also about the teacher-training component in that context. Reference can be made to OECD conferences in 1984 (OECD, 1986) and in 1986 (OECD, 1987); the Fourth Conference of Ministers of Education of Member States of the Europe Region (UNESCO, 1988); and the UNESCO World Congress in 1989 (UNESCO, 1990).

In a study prepared for the UNESCO Congress, Nalletamby (1989) concludes that "the evolving situation in which informatics and information and communication technology finds themselves today makes it difficult for a solid training foundation to be provided for teachers, and for reliable and permanently valid materials to be produced in the subject...Therefore any training programme designed to meet present-day requirements will need to be reviewed periodically and adapted to changing needs" (p. 23). Based upon his research, the following principles and guidelines in planning and organising national teacher-training schemes were formulated (p. 23-24):

- Hardware provision must be backed by an adequate strategy of teacher training.
- The priority is for in-service training but pre-service training is also needed. Equally, teacher trainers need training and their institutions need equipment.
- Teacher training and school development are not separate but inextricably linked. Training must follow identified needs but must itself be developmental, helping teachers to create new ways ahead.

- The pace of informatics development does not allow for a leisurely catching-up by teacher training. Needs are immediate. A school-based model of training has been used in certain countries and has much to recommend it.
- Centralised monitoring and centralised production of teaching material is an important element in ensuring quality control.
- It is now possible to acquire a level of competence which allows a teacher to retain control over teaching programs and to modify them to fit particular learning needs. But it is not necessary for the teacher to acquire programming skills as such.

4.4 Side conditions

As addition to the above, Strange, Tucker, Uhlig, and Feldman (1988) have investigated alternative approaches for teacher training in technology. They found that key elements in successful training efforts included:

- effective administrative change agents
- stable, long-term internal funding
- provision of "psychic rewards" to teachers receiving training
- direct involvement and support by principals
- training in basic applications, not programming languages
- an informal support and training network
- easy access to technologies both at school and at home
- flexible administrative rules and procedures
- a fellow teacher as trainer, one not seen as a "technologist".

Their main policy recommendation is that "training in the use of technologies as tools must be provided to all teachers". In a remarkable way the results of the PRONTO Project (see Section 3) coincide exactly with these recommendations.

4.5 Current situation

The current state of affairs (Hebenstreit et al, 1992) for pre-service training is that it is argued and assumed that students will get acquainted with the new information technologies in the course of their study. Not only should they learn about the technology, they should also be exposed to it as part of their own learning process in order to stimulate them to reproduce the approaches used by their instructors when they are teaching themselves.

For in-service training it is suggested that the first level of training deals with introducing teachers to information and communication technologies. Teachers must be prepared to operate a micro-computer and manage distributed software. Where possible, they should also learn about networking and telecommunications. It is recognized that there is a lack of teacher-training capacity. Therefore other training approaches should be explored: use of self-learning packages, videotapes, forms of open learning. In addition teachers must be prepared for the pedagogical use of computers. Because of time and money constraints, a kind of "cascade"-model should be applied: some teachers of each discipline should get an in-depth training and in turn train their colleagues. However, there is little consensus on the content of the courses these selected teachers

should be offered (Levrat, 1992). To compensate for the lack of training material, Levrat also suggests that multi-media packages for teacher trainers should be developed.

4.6 Problems and solutions

According to Rawley (1992) there are over 19 million teachers employed in the primary education sector world-wide, of which more than 9 million are in low-income countries. Given these numbers it is obvious that the training effort needed is enormous. The consequence of this enormity is that it is necessary, certainly from a logical point of view, to agree upon a balance between a generally acceptable and comprehensive description of the goals, the objectives and the content of training programs, and a kind of permanent and widely accessible training approach and scheme.

From that perspective, it is necessary to have a good insight into how technology and its interrelationship with education most likely will evolve. At the same time, it is necessary to explore training approaches that can handle the large amounts of trainees, not only in a physical sense, but also from a costing and financial point of view.

In the next section a future perspective of technology that relates to the above point of view is sketched.

5. Technological developments

5.1 Predicting change

From one perspective, technology is continually changing, which brings difficulties for educational planning. However, from another perspective the changes we are seeing in technology are very predictable, at least when the predictions do not exceed a reasonable number of years (5 to 10). There are many examples of predictions in the computer industry whereby in reality the technology is living up to its expectations and even doing better than was predicted (Moonen & Stanchev, 1993). The main reason for this is because most of the technological features that are necessary for the realisation of a prediction exist already in a laboratory setting at the moment of the prediction. Therefore, what is being predicted in the area of technological developments had better be taken seriously. The chance that society will be confronted with the predicted new services and products in the area of information technology is fairly reasonable.

5.2 Coming together of technologies

Years ago, Negroponte, then the Director of the MIT Media Lab, predicted that by the year 2000 three industries would integrate their activities: (a) the print and publish industry, (b) the broadcasting and motion picture industry, and (c) the computer industry (Brand, 1988). Reading the newspapers, we can watch how this is happening right now. The emergence of multimedia is the typical example of this movement.

In addition, the telecommunication industry is joining this merging operation. In the USA, as well as in Europe, the "electronic highway" through which masses of all

kind of information and communication will pass, has become the typical metaphor for these kind of activities.

The most visible developments for the rest of this decade will be the continuing developments with multimedia and the merging of communication and information technologies (CIT). The irresistible push of information technology (IT) in the 1980s has resulted in an even-more powerful push of communication and information technologies (CIT) in the 1990s.

As has been apparent in the past, education will not be able to resist this new technology push. How should education, and in particular teacher training, deal with this?

6. Technology and its relation to educational objectives

6.1 Objectives and continual change

Taking a generalised point of view, the organisation of the school, its curriculum, and its instructional strategies are based upon educational goals, which in turn are based upon philosophical perspectives and developments in society. These perspectives and developments are changing over time. As a consequence, educational goals are also repeatedly changing and education thus experiences reform after reform (Cuban, 1990). The introduction of computers in education, as a specific reform movement, is no exception to this general rule. The objectives about how to use computers in schools have shifted over the years. Bork (1990) describes the consecutive phases as: (a) let's get lots of hardware; (b) let's teach languages; (c) let's teach computer literacy; (d) let's train the teachers; (e) let's use advanced hardware; (f) let's develop small programs for use in standard courses; (g) let's use authoring systems; (h) let's catalogue existing software; (i) let's evaluate the small programs; (j) let's teach students about tools; (k) let's use networks; (l) let's develop management systems.

In this framework of a changing focus the PRONTO project concluded that computers in school still have to find their specific niche.

6.2 Moving target

Schools and their goals and objectives are a moving target, which makes it difficult to agree upon general educational policy, instructional strategies, and the development of specific instructional material. The current discussion and controversy within instructional design and instructional theory (Gustafson, 1993), is a typical illustration of the pendulum movement so characteristic for education at large (Moonen & Stanchev, 1993). Also Schoenmaker (1993) points out that "although the field of cognitive psychology includes a number of interesting viewpoints, there is no unified theory supporting formal-design methods which are necessary at the level of functional and technical design in order to produce a concise, consistent, and complete set of specifications (for learning and training material)" (p. 191).

Therefore, the choice of instructional strategies and the development of instruction/learning material should be much more based on usability and pragmatism; prag-

matism based upon available and affordable resources such as communication and information technology, and based upon available teacher expertise. Integration of technology as the third intelligent partner--besides the teacher and the pupil--in the school could have a stabilizing effect on the goals and objectives of the educational system.

Philosophical opinions and societal arguments will always keep having their influence on the school's objectives and goals, and therefore create a kind of moving target. The contribution of technology to education could be that it forces that moving target to move in a predictable direction (Moonen, 1991). In that perspective, a new technology push created by the evolving communication and information technologies should be appreciated.

How do these developments influence teacher-training paradigms?

7. New paradigms

7.1 Learning when needed

In commerce and industry new paradigms with respect to training are appearing. Training and training departments should less be conceived as separate activities and units, but become more integrated with working activities and occur whenever help or training is necessary. Such activities could be labelled as activities in a context of "open and flexible" learning.

7.2 JITOL

New activities always create new concepts and new terms. A new concept to indicate these continuing learning and training activities is "just-in-time" open learning (Lewis, 1993). In this model an individual learner is allowed to communicate with a tutor or tutors, or facilitator(s), with other learners and with a series of resources when he needs to.

7.3 EPSS and UPS

Another concept is the "electronic performance support system" (EPSS; Gery, 1991). Gery describes a EPSS as a system whose goal is to provide integrated information, tools, and methodology, electronically, on demand, at the moment of need. Many variations of these new types of environments exist (Collis & Verwijs, 1994; Educational Technology, 1993).

Schoenmaker (1993) indicates that "relating training, information, and support services to performance needs has now become more urgent given the fast changes in product-market combinations which companies have to face" (p. 182). Therefore there is a need for what he calls an "integrated performance-support environment" (IPS) that has to become available to the worker and that can provide the worker with dedicated training, advice, information, and tools, when these are requested and needed.

7.4 Human requirements

This new paradigm of "just-in-time" learning and training is based on the use of existing technology and facilities, but also anticipates new developments in technology, especially with respect to communications facilities (e.g., ISDN). In addition to the availability of resource material, a number of actors play a central role in this approach: (a) the learner, (b) a tutor or expert, (c) a counsellor, and (d) a resource manager. The learner and the counsellor are part of the learner environment, the others of the resource environment.

Given the specific circumstances of the training effort that is needed with respect to information technology and education, in particular to teacher in-service training, an approach based upon these new concepts should be investigated.

8. New directions for teacher training

Following such an just-in-time approach, teachers could get help and training whenever they needed it. The training could be received in the teachers' own school environment, whereby the computer coordinator could act as the counsellor. The resources could be produced and made available through a centralized effort (locally/regionally--by a number of schools in a city or region; or nationally--initiated by the ministry of education). The important task of resource manager could be organised at a centralised level, as would be the availability of tutors/experts.

Following this approach, teachers should be able to get access to a broad range of resources, not only to be trained, but also as a database of examples of good practice. Given these examples, teachers get new opportunities to create and design their own learning/teaching environments.

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