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THE TURTLE STANDS ON AN EMERGING EDUCATIONAL PARADIGM

Abstract. This chapter contains a characterization of the current popular policy visions on ICT and education. A description of the potential implications for educational reform are given and empirical data from recent national and international assessments are used to estimate what elements of this rhetoric are accepted by educational practitioners. The fuzzy character of the reform discussions is reviewed as well as potential implications for research.

INTRODUCTION

In many national educational policies that existed around the millennium change (Pelgrum & Anderson, 1999; Plomp, et al., in press) the stimulation of the integration of ICT in education was a high priority item. The first wave of introducing ICT in education started around 1985 (Pelgrum & Plomp, 1993). At that time this innovation was mostly technology-oriented. In many schools new subjects (called introductory informatics or computer science) were introduced that enabled students to learn how to operate and program computers. Near the end of the 1980s it appeared that many governments became less oriented towards encouraging the integration of ICT in education. The second wave of ICT-stimulation started around 1995, when the Internet rapidly became very popular in business and society at large. This was accompanied by a huge production of policy documents from many different sources (European Commission, 1995; ERT, 1997; Panel on Educational Technology/PCACT/PET, 1997). Most of these documents pointed in the same direction of a common underlying rhetoric, which can be very briefly characterized as follows: as a result of ICT the life-cycle of knowledge will increasingly diminish and therefore all citizens need to be prepared for life-long learning. This can only be realized if the prevailing educational paradigm will change from a focus on reproduction to production of knowledge.

The aim of this chapter is at first to describe potential elements of a new educational paradigm and secondly to offer – on the basis of empirical data from an international comparative assessment – a judgment of the extent to which educational practitioners are ready to adopt these elements. This will be followed by a discussion on the question of how the current fuzzy definitions of a new educational paradigm can be further clarified.

A. Aviram and J. Richardson (eds.), Upon What Does the Turtle Stand?, 53–68.

POLICY ORIENTATIONS AND ELEMENTS OF AN EMERGING EDUCATIONAL PARADIGM

Our society is changing (and in some countries already has changed) from an industrial society, in which industrial production (making of 'things') is the central focus, *towards an information society* in which dealing with information has become a key element in the functioning of people, both in their profession and outside. Western economies can be characterized as 'knowledge' economies. As more and more manual and cognitive activities have been taken over by computers and other ICT applications, a new balance has evolved between men and machine in the area of information retrieval and information processing. Knowledge is no longer knowing facts and theories by heart and being able to reproduce them when necessary (*'old' knowledge*), but knowledge has become the ability to find relevant data and to derive meaning or information from it (*'new' knowledge*). The information society demands from its citizens not only *reproductive* skills, but also *productive skills,* enabling them in new circumstances to generate and evaluate answers to open, non-standardized questions. This necessitates analytical, creative and synthesizing skills. It also calls for a more *student-controlled*[1] teaching-learning process, as opposed to the (traditional) *teacher-controlled* approach.

Today's education system faces the challenge to prepare individuals for the information society in which a *new balance* is needed between 'old' knowledge and 'new' knowledge and therefore between the mastery of reproductive skills and of productive skills. It is not a trivial change that is needed, as our present education system evolved over a long period of time in an industrial society. This implies that changes needed in education refer not only to *what* has to be learned, but also to questions of *how* to learn, and also for upper secondary education, higher education and adult learning on *when* and *where* to learn.

Within the society the mission of the education system is to provide balanced, personal, social, and vocational education, facilitating personal growth and development of citizenship, and providing preparation for a profession. *Quality of education* can be defined as the amount to which education is capable of realising these goals. As these goals have to be worked out differently in an information society than in an industrial society, our notion of good quality education has to change accordingly.

Beside the challenge of preparing individuals for the information era, the education system is also facing other challenges (COMMITT, 1996), such as the expectation of contributing to the solution of social, cultural and economic problems of society, offering individualized and flexible forms of education suitable to specific needs, and meeting the needs for life-long learning.

The challenges for the education system are resulting in a need for new definitions of education with a new balance between 'old' and 'new' knowledge, and between existing and alternative forms of education. They are also calling for new forms of teacher education and new forms of support in education. ICT has the potential to play a role in every stage of the change process needed.

At present the organization of the learning process in most educational institutions can be characterized as predominantly 'teacher controlled': usually the

teachers (or lecturers) are acting as 'tellers' and orchestrators. Adjusting education to the needs of the future (the information society) means that schools have to enable learners to become more active and to make them more responsible for arranging their own learning process (student-controlled). Only in this way can learners acquire 'productive' skills, problem solving skills, independent learning skills and/or skills for life-long learning. Stimulating and supporting these processes of active learning implies organising learning processes in which the learner learns how to become more or less the architect of his/her own learning process, with the help of professional coaches.

Voogt and Odenthal (1998) have summarized, on the basis of an extensive literature review, potential elements of education of the future, in the following list of characteristics:

Goals and contents

1. Skills are accentuated in education (information-, investigation-, communication and social skills, meta-cognitive skills).
2. School subjects and parts of school subjects are combined with each other.
3. Boundaries of subjects are crossed.
4. Existing/new contents are linked with real life.
5. Existing/new goals are tested with a variation in learner evaluation (open test methods, portfolios, diagnostic and summative tests).

Roles of students

1. The student is active.
2. The student is independent (plans learning path).
3. The student is responsible (plans and monitors own progress).
4. The student is a team member.
5. The student becomes an expert on certain topics or aspects.

Roles of teachers

1. The teacher uses mainly instructional methods directed at stimulation of active learning (group- and individual assignments, practical work).
2. The teacher focuses his/her transactions on interests and needs of the individual student.
3. The teacher actively creates a learning environment for students (organiser).
4. The teacher guides the cooperation between students.
5. The teacher supports the learning process of students actively and interactively (gives direct feedback, stimulates reflection, evaluates progress).

6. The teacher shares responsibility with students for their learning process.

Materials and infrastructure

1. ICT applications are user-oriented.
2. There is a variation in the use of ICT.
3. No/less structured information sources (other than ICT) are used.
4. Use of ICT creates a learning environment for the students.
5. There is use of study pointers promoting independent learning.
6. Physical environments are suitable for learning individually or in small groups.
7. Learning is flexible in time.
8. Learning is flexible in location.
9. Multidisciplinary teams of teachers work together.

According to this review, learning is seen as a process of active knowledge acquisition; as a social activity and not just an individual one; as not bound to specific content and context, because for transfer of knowledge and skills a variation of situations and contexts is needed. In such an approach more emphasis on independent and self-directed learning and good self-regulation is important.

The terms 'teacher-controlled' and 'student-controlled' refer to the actor who is most active and responsible for the arrangement of the greater part of activities belonging to the learning process. There is no absolute distinction between both approaches; they represent the opposite dimensions of a continuum. This means that both teacher-controlled approaches and student-controlled approaches have many different representations and that, in an information society, a new balance between the two is needed.

POTENTIAL OF ICT IN EDUCATION

It is assumed (in many policy documents, amongst others European Commission, 1995; ERT, 1997; Panel on Educational Technology/PCACT/PET, 1997) that a shift from teacher-controlled towards more student-controlled arrangements of the learning process can be facilitated by ICT. Until now the potentials of ICT have hardly been utilised in education. Many of the current ICT-applications are used to facilitate teacher-controlled arrangements of the learning process. Applications of ICT are adapted to the existing education beliefs and teaching routines, and are being used just as a *substitute* for other media. The beliefs and attitudes of teachers towards their teaching practice have not changed, and basically in elementary and secondary schools the teaching and learning process itself has not changed (ten Brummelhuis, 2000; Pelgrum, Janssen Reinen & Plomp, 1993).

It is important to note that the use of ICT as a substitution of current teaching and learning activities can be seen as the first of three phases through which the implementation of new technologies generally diffuses (Itzkan, 1994). These three phases of technological diffusion are shown in Figure 1 here-below.

In the substitution phase, the technology replicates or automates the existing instructional practices. The technology is used for already existing educational activities, for example, drill and practice exercises on the computer refer to the use of computers as electronic paper. In the transition phase, new instructional methods begin to evolve, like the use of e-mail in foreign language classes to communicate with peers who are native speakers. In this phase the technology is used for activities for which it was not necessarily brought in, and it is challenging old instructional practices. In the transformation phase, the technology provides completely new instructional situations and the old customs become obsolete. According to Itzkan (1994) the instructional tasks for which the technology was originally acquired, may no longer be desired.

The underlying rationale of the phases of technological diffusion is that it is a mistake to suppose that new technologies will continue to fit existing or old practices. And the other side of the coin is that when we continue to use ICT for substituting existing practices, ICT will not contribute to solutions for today's problems in education.

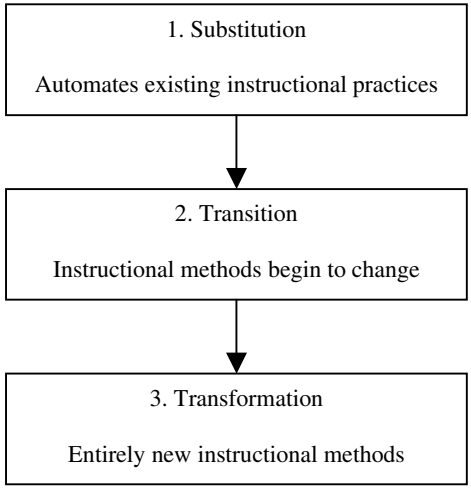

Figure 1: Phases of Technological Diffusion (Itzkan, 1994)

Conscious and carefully planned actions are needed to get beyond ICT use just for substitution. There are many possibilities to use the new technologies in a 'transition' phase serving a student-controlled, constructivistic approach to education.

ELEMENTS OF REFORM IN EDUCATIONAL PRACTICE

Of the many initiatives that were taken by national governments one would expect that they would (ultimately) result in visible changes in educational practice. In order to determine the developmental trends in educational practice, one needs to monitor nationally representative samples of schools, teachers and students.

At the end of 1998, the IEA[2] collected in a project called SITES (Second Information Technology in Education Study) data regarding indicators of 'pedagogical practices and ICT' from national samples of schools (at the primary, lower secondary and upper secondary level) in 26 countries. The intention is to recollect part of these indicators in 2004, so that developmental trends can be made visible. The IEA has also conducted other studies that contained a few indicators of ICT-availability and use (TIMSS-1995, TIMSS-1999). As at this moment there are no other international agencies that conduct ICT-assessments in education, this means that at the international level hardly any trend-data on pedagogical practices related to ICT are available. Hence, for the international assessment, we need to rely on the base line data that were collected in 1998. A potential source for getting an impression of developmental trends is a recent report from the so-called Dutch ICT-monitor (Pelgrum & ten Brummelhuis, 2001). In this monitor, currently for a period of three years, data on ICT-indicators are collected from national representative samples of school principals, ICT-coordinators, teachers, and students.

The data from IEA and the Dutch ICT-monitor will be used to address the following questions[3]:

1. To what extent are educational practitioners aware of and willing to adopt (elements of) a new educational paradigm?
2. To what extent is ICT facilitating the implementation of (elements of) a new pedagogical paradigm?
3. What are the obstacles for realizing the ICT-related objectives of schools?
4. What expectations exist for the (near) future?

Awareness and adoption

From the data that were collected in SITES as well as in the Dutch ICT-monitor there are clear indications that the policy discussions have also affected educational practitioners. A first observation comes from SITES. In this study, school principals were asked to write down their most satisfying experience with ICT in terms of, amongst others, content, student activities, and what teachers and students gained from such activities. From the analysis of these data (Voogt, 1999), it appears that:

> *Quite a number of school principals across countries reported on the contribution that ICT made to new curriculum approaches (such as cross-curricular[4]), different roles for teachers, and productive learning activities for students.* (Voogt, 1999, blz. 215)

Another observation stems from the Dutch ICT-monitor, which included questions to school administrators and teachers about their expectation for the future with regard to characteristics of teaching and learning. Two indicators were constructed, that contained judgments of the current and future relevance of certain practices expressed in the following two sets of items:

Teacher-controlled teaching and learning:

- Testing the whole class at the same time
- All students start with new content at the same time
- Students sit in fixed seating arrangements
- Whole class teaching
- All students work at the same time and on the same content
- The teacher is the most important source of information

Student-controlled teaching and learning:

- Student frequently apply self-monitoring
- Students work at own pace
- Students work in groups or individually
- There are enough work places for group work
- There are different work places for group work
- Students at risk get separate instruction
- Instructional materials are available in the corners of the classrooms

From the results (see Figure 2 for illustration) it appears that teachers (at secondary level) see teacher-controlled education as the main characteristic of the current educational settings, but they expect that student-controlled education will be much more important in the future. The same observations were made on the basis of judgments that were made by school principals for the same two sets of items.

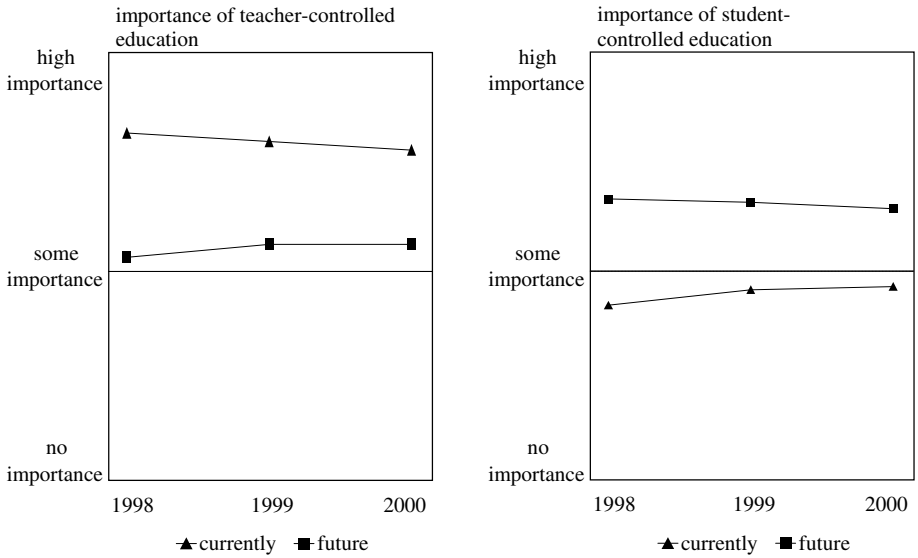

Figure 2: Indicators of teachers' perceptions (in three consecutive years) of relevance of teacher-controlled and student-controlled education, now and in the future (Pelgrum & ten Brummelhuis, 2001).

From the above, one may tentatively conclude that there seems to be an awareness and even willingness among educational practitioners to accept the importance of student-controlled learning.

A next question is, to what extent student-controlled learning practices have already been adopted in schools. The data from SITES may throw some first light on this question. School principals from lower secondary schools in 24 countries were asked about objectives, presence and ICT-facilitation of a number of pedagogical activities that are potentially indicative of student-controlled learning. For the purpose of our presentation, here we will focus on the practice of independent learning by students.

Table 1 shows the percentages of school principals per country who answered that it was their school's policy to encourage independent learning by students. It also shows the percentage of school principals who indicated that this activity was already present a lot in their school**.**

Table 1: Percentages of school principals (in lower secondary schools) answering affirmatively to questions about policy, presence and ICT-facilitation with regard to independent learning.

Country	Policy to encourage	Present a lot	Realized a lot with ICT
Belgium-French *	62	28	7
Bulgaria	71	45	21
Canada *	70	46	28
China Hong Kong	85	4	13
Chinese Taipei	80	22	30
Cyprus	67	27	40
Czech Republic	65	15	24
Denmark	68	44	16
Finland	92	27	15
France	78	20	13
Hungary	82	65	39
Iceland	82	8	5
Israel *	92	20	34
Italy *	72	24	10
Japan	67	5	12
Lithuania	89	24	16
Luxembourg	62	16	12
New Zealand *	75	39	12
Norway	87	64	16
Russian Federation *	33	31	13
Singapore	89	15	25
Slovenia	90	46	15
South Africa *	66	38	16
Thailand	62	37	24

ICT-FACILITATION

At this stage we need to be cautious with interpretations because not much empirical evidence on the validity of the questions in table 1 is yet available. However, it is interesting to note firstly the variation between the items and, secondly, the variation between the countries. In many countries school principals at the lower secondary level indicated that is was their school's policy to encourage independent learning by

students. In general, the percentages of principals indicating that this practice was present a lot was much lower, but in quite a number of instances it was already substantial.

As readers will see from the figures in Table 1, we can tentatively conclude that student-controlled pedagogy is starting to be adopted in educational practice, but is not yet implemented in most countries. However, the extent to which this is the case and the implications for the traditional curriculum (e.g. how much is dropped?) need to be much more intensively studied in-depth.

In the policy rhetoric that was reviewed above, the facilitating role of ICT has been mentioned. Interesting is the question to what extent educational practitioners perceive ICT as helpful in realizing student-controlled pedagogy. An indicator of the extent to which this is the case is the perception of school principals. As shown in Table 1 it seems that quite a number of school principals (when compared with those who said that the practice of independent learning was present a lot) attributed a lot of facilitating power for realizing this goal to the help of ICT. This could be taken as an indication that according to educational practitioners' perceptions, there is some faith in the tenability of the policy assumption about the facilitating role of ICT. Another indication of this 'faith' comes from the Dutch ICT-monitor, in which school principals' and teachers' opinions were elicited about the current and future role of ICT in teaching.

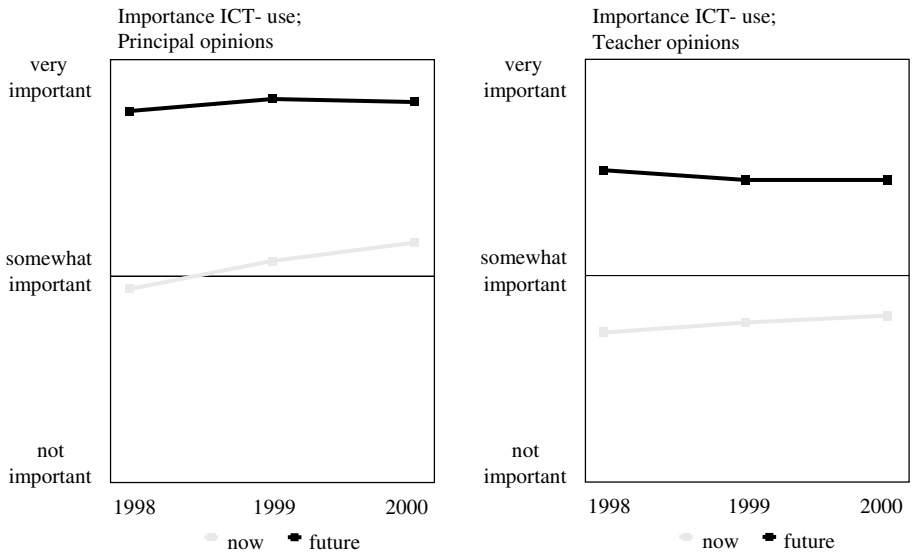

Figure 3: Indicator of perceptions of school principals and teachers on the current situation and the future with regard to the importance of ICT-use in education.

OBSTACLES

On the basis of the IEA CompEd surveys that were conducted in 1989 and 1992 (Pelgrum & Plomp, 1993), it was concluded that ICT was mainly an add-on to the existing curriculum: most schools had introduced courses to teach students about computers. However, the integration of ICT in the teaching and learning of existing subjects hardly occurred at that time. Indicative evidence for this conclusion was that students hardly used computers for learning mathematics and even less for other school subjects. This situation had hardly changed in 1995 when evidence from the IEA Third International Mathematics Study (TIMSS) became available. TIMSS was repeated in 1999 and allows for a further inspection of the integration of ICT in mathematics learning. Table 2 contains the percentages of students who indicated that they used computers at least once in a school year for learning mathematics. The increase in this indicator over a period of 4 years is for most countries quite low. The most notable increase occurred in Singapore, which is an exceptional case in terms of the huge investments and very ambitious plans for ICT-integration that have been in operation since 1998.

Also from the Dutch ICT-monitor, it appears that the integration of ICT in regular instructional practices is more or less stagnating. Over a period of three years (1998-2000), notably in a period of intense governmental stimulation of ICT in education, the percentage of teachers using ICT in their lessons hardly changed and remained stable at a level of about 30%. On the other hand it appeared that teachers as well as students increasingly use computers, but this occurs mainly outside the instructional practice.

This observation leads to the question of why the integration of ICT in education is changing so slowly. Our hypothesis at this moment is that this is caused by a combination of factors of which the most important are:

- Difficulty to integrate computers
- The lack of teacher skills
- Insufficient number of computers

The reasons for highlighting these potential causes are theoretical as well as empirical. Theoretically one may argue that *the integration of computers is difficult*, because a traditional pedagogical paradigm does not offer much room for ICT use at the secondary educational level. Whole class teaching presupposes that all students do roughly the same things at the same time. ICT can be supportive in such a paradigm for demonstration purposes, drill and practice for remedial purposes. However, usually the rather rigid scheme of lesson schedules and the location of computers in a few computer rooms hardly allow for much flexibility for students to sit apart for individual drill and practice. So, if teachers want to apply ICT they need to apply pedagogical methods for which *most do not have the skills*. Moreover, if teachers really did frequently use ICT, most schools would *not have enough equipment*.

The empirical argument for pointing to these three obstacles is that they were in the top three of a list of 38 obstacles which were rated by respondents who participated in SITES-1998 (Pelgrum, 1999).

Table 2: Percentages of students using ICT for learning mathematics at least once in a school year, measured in 1995 and 1999.

	1995	1999	Difference
Australia	23	29	6
Belgium (Fl)	6	7	1
Canada	18	33	15
Cyprus	27	19	-8
Czech Republic	12	16	4
England	55	54	-1
Hong Kong	9	25	16
Hungary	8	8	0
Iran, Islamic Rep.	8	4	-4
Israel	24	33	9
Japan	23	24	1
Korea	7	17	10
Latvia (LSS)	9	5	-4
Netherlands	19	20	1
New Zealand	21	27	6
Philippines	22	20	-2
Romania	22	7	-15
Russian Federation	6	3	-3
Singapore	10	54	44
Slovak Republic	6	5	-1
Slovenia	11	19	8
Thailand	9	15	6
United States	31	39	8

REFLECTIONS

In the section above, we have tried to argue that a new educational paradigm is looming before our imagination as a result of societal changes that emerge from an increased embedding of many aspects of life in an information technological infrastructure. We have described the main features of this new paradigm in terms of characteristics that seem to be embraced by substantial numbers of policy-makers and educational practitioners. In this section we offer a critical reflection on the notions that were introduced earlier in this chapter by posing a number of questions that may be critical in gaining a further understanding of the current developments.

A first question is whether ICT is really essential for implementing the new educational paradigm. An associated question is how new the paradigm actually is. One may argue that the characteristics, which we described in earlier sections, resemble very much the approach that was adopted and implemented by many

reform schools that followed approaches developed by educational visionaries such as Montessori, Freinet, Dalton, Steiner, etc. As these approaches never gained real momentum (in terms of large-scale adoption in the educational system), one may wonder whether it is realistic to expect that suddenly, as a result of ICT, large-scale implementation of analogous principles would be possible. The reform movements have often be seen as elitist because, amongst other reasons, mainly students with a high degree of self-discipline and who are stimulated and supported by motivated parents are able to survive in these systems. On the other hand, maybe the hypothesis is tenable that large-scale implementation of these reform-pedagogies was not possible, in part because of the load it places on teachers in terms of coaching large groups of students with individual learning tracks. Such problems might be overcome by ICT-applications that take over part of the administrative and monitoring tasks of teachers.

A second question relates to the potential risks that could be associated with adopting the new paradigm. Although educational practitioners seem to underscore the importance of the new paradigm (as argued in previous sections), there are also indications that they are aware of potential dangers. In a recent workshop in the Netherlands (November 2000) on the future of education, where many participants were in favor of the new paradigm, a teacher asked: 'Do we want to put a whole student-generation at risk?' Related to this is the question of whether an educational change as implied by the new paradigm can be introduced gradually or whether it is more a matter of switching the new paradigm on while at the same time switching the old one off, more or less analogous to changing road traffic from driving left to driving right. One may wonder whether gradual change is possible: one may hypothesize that the new paradigm requires a lot of curriculum time and adequate sequencing of learning situations from primary to secondary education. This additional time is needed for students to acquire basic competencies related to higher order skills inherent to the core objectives of the new paradigm, such as: cooperation, autonomous learning, teamwork, communication, information handling, etc. A pertinent question is how much of the traditional curriculum content needs to be sacrificed in order to free-up time for creating opportunities (over a prolonged period of time) for students to acquire these competencies. An indication that such sacrifice is needed, comes from Singapore. Teng & Yeo (1999) wrote:

> *To facilitate the development of such a learner-centered environment (supported by the availability of technology and digital resources), a 10 to 30% reduction in curriculum content was instituted towards the end of 1998.*

Unfortunately there is not yet empirical evidence available that documents the extent to which the new paradigm could be successfully implemented. Even worse, at the moment of writing this chapter it is not known how to measure (reliably, validly and efficiently) the competencies that are at the core of the new paradigm. Still many countries have not yet started the voyage of discovery beyond the horizons of the current educational system. Sometimes only a few schools are involved in such operations aimed at exploring the future. But also examples are known of countries

where major parts of the educational system are involved in this mission, for instance the Netherlands and Singapore.

From qualitative and quantitative studies that were collected in the Netherlands (e.g. Voogt & Odenthal, 1998; Brummelhuis, 2000) one may tentatively infer that innovating schools according to the new paradigm is a very complex process. The qualitative studies in the Netherlands indicate that:

- Teachers are not very much in favor of multidisciplinary approaches
- Teachers need good examples of learning environments that are based on the new paradigm
- Teachers need new approaches for monitoring and evaluating the progress of learners
- Teachers do not have a good understanding of their new roles

The quantitative studies in the Netherlands point out that, at the secondary school level, a proper balance between three crucial factors (ICT-infrastructure, teachers' beliefs, and teachers' knowledge and skills) is lacking.

At this moment the knowledge base for answering the exemplary questions that were posed above hardly exists. Even the knowledge base for testing new skills is hardly available. Also widely accepted definitions of core concepts of the emerging paradigm are lacking. This means that in many countries discovery tours to unknown territories are undertaken, while the navigation tools are lacking or in a preliminary stage of development. Only by intensive cooperation between developers and researchers and with a program of large-scale monitoring (in an international context) is there a chance to offer information about the actual position of the education system and to minimize the risks of serious navigation errors in these operations.

On the basis of information that is currently available, it seems that in the forthcoming years the reform of the education system around the world may pose several challenges for educational designers. Reflecting on our experiences so far, it seems that special attention is needed for an approach that fully acknowledges the implementation perspective. Among the major challenges, the following especially seem to be important:

1. Crossing the boundaries of the traditional subjects is a central theme in the emerging paradigm, but not yet for the current generation of teachers. Therefore, good examples of (multidisciplinary) learning environments with learner-controlled ICT use need to be developed.
2. New approaches of learner evaluation are needed because a number of the new educational goals are process goals.
3. Teachers are still uncertain about their new roles and do not possess new routines yet. Therefore, new didactics are needed.
4. With respect to *in-service* education, it seems important to pay attention to:
    a. influencing beliefs of teachers, especially addressing the question of what is 'good' education for the future.

b. focus on pedagogical knowledge and skills related to ICT use.

5. Given their new roles, teachers have to develop as designers of learning environments.
6. School boards and administrators need to develop school policies reflecting a better balance between the three factors mentioned above (factors: ICT-infrastructure, teachers' beliefs, and teachers' knowledge and skills).

NOTES

[1] The terms student-controlled and teacher-controlled are still quite fuzzy, but are used in this paper as alternatives for terms such as 'student-centred' and 'student-oriented' respectively 'teacher-centred' or 'teacher-oriented', which one often encounters in relevant literature.

[2] The International Association for the Evaluation of Educational Achievement, see http://www.iea.nl/

[3] For space considerations, the focus in this section will be on lower secondary education

[4] That is: approaches that are multidisciplinary and address content from several school subjects at the same time.

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