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DISTANCE EDUCATION IN SCHOOLS: PERSPECTIVES AND REALITIES

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Introduction

The phenomenon of Distance Education (DE) in schools is strongly related to the rapid developments in the area of Information and Communication Technologies (ICT). During the last two decades, an immense number of students and teachers got access to advanced ICT and this dramatically changed the ways they communicate as well as use and create information. ICT creates conditions for technology and minds to work together, and the capacity of this synergetic system could be much higher than the single mind. The school is no longer the sole and most attractive source of information and knowledge. Quick access to unlimited sources of information is obtained due to modern technologies. The traditional concept of literacy has been gradually extended to *multimedia literacy* referring to students' abilities to read, write, and communicate with digitally encoded materials – text, graphics, still and moving images, animation, sounds (Nikolov, 1997). Mioduser, Nachmias, and Forkosh-Baruch (2008) in this handbook extensively discuss the so-called new literacies for the twenty-first century.

The technological developments provide a ground for an educational reform that can help citizens prepare better for living in the global information society (see also Anderson, 2008 in this handbook). Such a reform will break the monopoly of the *print- and paper-based educational system* and will rely on learning environments incorporating *asynchronous space and time, interactivity, and virtual reconstruction* (McClintock, 1992a). The main characteristic of such a learning environment is the virtual reconstruction of the school space by building virtual places: auditoriums, labs, workshop rooms, cafes, libraries, etc., where students and teachers from different locations can meet, interact, and work together, as if they were face-to-face.

Looking back at ICT history one can clearly notice that the main attention of researchers and technologists has gradually moved from hardware to software, next

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– to human–computer interaction, and recently – to social issues related to global communication and collaboration (Nikolov, 2001). Communication is the most typical activity in a community. Computer-mediated communication may support the establishment of virtual communities, which are formed on the basis of common interest, collaborative work, or other joint activities (Fernback & Thompson, 1995). These communities are transnational and transcultural and need reconceptualization of the social life, including education.

A core assumption in education is that learning is a social process, rather than an individual one. Therefore, DE in K-12 education, facilitated by ICT, may foster the creation of learning environments where communication is easy and leads to meaningful learning activities closely related to the predefined educational goals.

Defining the Area

The rapid development of ICT and their applications to teaching and learning has led to evolution of terminology (see also Voogt & Knezek, 2008). Terms that are not yet well defined and are still part of scholarly debate are used in practice by policy makers and professionals. *Distance education* is defined by Moore as "*all forms of education in which all or most of the teaching is conducted in a different space than the learning, with the effect that all or most of the communication between teachers and learners is through communication technology*" (Moore, 2003, p. xiv). Moore's definition comprises the use of ICT as a means to realize teaching spatially separated from learning, which distinguishes DE from the distance correspondence mode, which was common practice before the widespread infusion of ICT in society. In addition to Moore's definition, Butcher and Wilson-Strydom (2008) in this handbook also added temporal separation between teachers and learners. By adopting the above definition, we accept *distance education* as a generic term that emphasizes on the separation (in space and time) of learners and teachers, and includes the wide use of ICT. According to Moore, most other terms used in the literature express subordinate concepts related to different aspects of DE but they are not considered as synonyms of DE. Because DE nowadays is closely related to the use of ICT, other terms have emerged as well. For instance, *online learning, e-learning*, and *telelearning* emphasize the use of a particular communications technology; *distributed learning* and *distance learning* focus on the location of learners; *open learning* and *flexible learning* point out the relative freedom of learners to exercise more control over their learning than is normal in conventional education. Butcher and Wilson-Strydom (2008) in this handbook illustrate the confusion that can be generated when concepts such as distance education/learning, open schooling, and open learning are used interchangeably. They argue that DE can be very much instruction-driven, not allowing learners to take control of their learning, and therefore could not always be a convincing example of open learning.

Another term that is closely related to DE in the school setting is virtual schooling, which is defined as "an educational environment in which K-12 courses and other learning activities are offered mostly or completely through distance technologies"

(Roblyer, 2008, in this handbook). A similar concept is open school which could be defined as "… an educational institution delivering primary and/or secondary education, providing courses and programmes predominantly through use of distance education methods" (Butcher & Wilson-Strydom, 2008, in this handbook). According to Roblyer (2008), the rapid growth of virtual schools in the last decade has become an unanticipated success story in the history of ICT integration in education. Roblyer also argues that the spatial and temporal separation of teaching and learning, as main features of DE, also cause problems such as a high dropout rate. This was one of the reasons for mixed forms to emerge and the term blended learning was born. Singh defines the features of blended learning: "Blended learning programs may include several forms of learning tools, such as real-time virtual/collaboration software, self-paced Web-based courses, electronic performance support systems (EPSS) embedded within the job-task environment, and knowledge management systems. Blended learning mixes various event-based activities, including face-to-face classrooms, live e-learning, and self-paced learning. This often is a mix of traditional instructor-led training, synchronous online conferencing or training, asynchronous self-paced study, and structured on-the-job training from an experienced worker or mentor" (Singh, 2003, p. 51). Blended learning is typically associated with corporate training and higher education, but it quickly penetrates the school education as well (see for instance: http://en.wikibooks.org/wiki/Blended_Learning_in_K-12). "It is also possible that the blended model may prove to be attractive to K-12 schools, especially those that are struggling with issues of online learning quality, student readiness, and teacher professional development" (Picciano & Seaman, 2007, p. 20).

In summary, the evolving definitions and terms show the dynamics in the DE area of research, as well as the common understanding that the main feature of DE is the use of ICT to facilitate the teaching and learning process when teachers and learners are separate in terms of space and time. In this chapter we will use the term ICT-based DE for distance education which uses ICT for facilitating the teaching and learning process.

The Phenomenon of ICT-Based Distance Education in K-12 Schools

ICT-based DE is considered "*the most significant development in education in the past quarter century*" (Moore, 2003, p. ix). According to Powell and Patrick (2006, p. 3), there were more than 500,000 enrolments in online courses in grades K-12 and more than one third of public school districts offered some type of e-learning in the USA during the 2005–2006 school year. A study of the North American Council for Online Learning, which surveyed over 30 countries, showed a fast growth of ICT-based DE initiatives in many countries, such as: Australia, Canada, Japan, China, Kazakhstan, Nepal, New Zealand, Singapore, Zimbabwe, etc. (Hedberg & Ping, 2004, pp. 200–205). The United Nations Educational Scientific and Cultural Organization (UNESCO) has established a database with 90 ICT in education projects in Asian countries (http://www.unescobkk.org/index.php?id=1562).

Based on this database, the countries in this region could roughly be categorized into three types:

- Countries already integrating the use of ICT into the education system and increasingly delivering education online, facilitated by wide access to the Internet (Australia, South Korea, Singapore). South Korean schools, for example, have universal access to Internet.
- Countries that are starting to apply and test various strategies (China, Thailand, Japan, Malaysia, the Philippines, and India). Online learning (ICT-based DE) in these countries is still not widely applied.
- Countries that have just begun and are more concerned with ICT infrastructure and connectivity (e.g., Vietnam, Cambodia, Bangladesh, Maldives, Bhutan). There are countries, especially in the Pacific, which have not started online learning yet.

Delrio and Dondi (2008) in this handbook describe several ICT-based DE initiatives of the European Union as part of their chapter of the ICT policy of the European Union.

The ICT-Driven Educational Reform

McClintock describes the emergence of the traditional print-based school system as follows: "Around 1500, a major pedagogical transition began as printing with movable type made an unprecedented era of educational development possible. But the transition was not a quick and simple change: to bring it off, innovators had to develop a complex of different, yet interrelated, educational strategies, which together eventually made mass schooling for all a practical reality" (McClintock, 1992a, p. 3). The main features of this educational system are: using printed textbooks; grouping children primarily by age, and secondly by ability, dividing curriculum into subjects, packaging the subjects into annual installments, and mapping them onto a sequence of grades the students should climb up. The basic unit of the school space is the classroom, where one teacher teaches about 25 students. The time units of such schools are: school period, school day, and school year. McClintock considers the traditional schools as a logistic construction to ensure (in most cases) students and teachers to be at the same place at the same time. In his words, the school is "a means for synchronizing diverse activities in space and time. That is what scheduling is all about, and within a particular class, a teacher needs diverse arts for synchronizing effort on the subject at hand" (McClintock, 1992a, p. 52).

ICT-based DE in schools is conceived as a phenomenon that catalyzes new educational reforms all over the world. It is also driven by three major factors – asynchronous space and time, responsive environments, and virtual reconstruction, which can "*powerfully transform the way schools work*" (McClintock, 1992a, p. 52):

- *asynchronous space and time* – the ability of people, who are not synchronized in the same place at the same time, to easily communicate with each other in a variety

of responsive ways. This means that the classical schools would gradually lose their role as instruments for synchronizing the school learning activities.

- *responsive environments* – interactive learning environments, customized to the learners' needs, which will help them to learn and communicate better. "*Such personalization of the electronic environment can carry over from the personal computer to a network. When the user logs onto the network, he activates configuration programs that set the environment to his style and need, regardless of where in physical space the workstation may be*" (McClintock, 1992a, p. 54). Punie and Cabrera further develop the concept of *learning spaces* as one of the main features of the future learning (Punie & Cabrera, 2006, p. 12). Downes also analyzes the future role of the personal learning environments: "*The idea behind the personal learning environment is that the management of learning migrates from the institution to the learner*" (Downes, 2007, p. 19).
- *virtual reconstruction* – the ability to use interactive multimedia components to redesign and reconfigure the human experience of existing physical spaces without physical or structural changes in buildings. The virtual spaces could complement the physical spaces when designing an effective, student centered, learning environment.

The beginning of the new educational reform could be found in the late 70s, when worldwide the introduction of computers in education started. As Aston reports, microcomputers have been used in schools since 1979 (Aston, 2002, p. 62). An example of an early project in ICT-based DE is the project of the Research Group in Education (RGE) in Bulgaria, carried out between 1979 and 1988 (Nikolov, 1987, 2001; Nikolov & Sendova, 1988); see Fig. 1 for a description. The RGE project did not change substantially the Bulgarian educational system as a whole, but it gave rise to several innovative educational initiatives and projects both at school and university settings. The early RGE experiences of IT in schools described above were embedded in the traditional concept of schooling where the printing technology and textbooks were still dominating and the (physical) classroom was the main place where learning activities took place. Some explanations of the RGE failure to achieve a complete educational reform in Bulgaria could be found in the words of Seymour Papert, whose book "*Mindstorms: Children, computers, and powerful ideas*" (Papert, 1980) and the experience of his research group at MIT substantially influenced the RGE experiment. Papert argues that "*the shift from a stance of reform to a stance of evolution does not exclude active intervention, but the role of the change agent becomes less like the architect or builder and more like the plant- or animal breeder whose interventions take the form of influencing processes that have their own dynamic*" (Papert, 1997, p. 421). He also states that many components of the educational system have to be appropriately changed and this would need time.

RGE introduced some of the principles of the pedagogical re-engineering, which characterize ICT-based DE now, but were introduced in the RGE experimental schools nearly 30 years ago. The RGE experience also proved that the educational innovations related to the ICT-driven reform could be hardly revolutionarily

The Research Group on Education (RGE) carried out a large scale experiment in twenty nine schools in Bulgaria between 1979 and 1988. The main assumption in the experiment was that due to the advent of mass produced microcomputers the educational system should be reformed as a whole as to embed their potential in education as an integrative component. A major educational principle of RGE was the integration of school subjects and enabling students to see world objects and phenomena from many sides while learning. Students looked for answers in various fields of human knowledge; took the role of researchers and experienced that knowledge was infinite, changing, and that nobody could possess it totally, including the teacher. A learning environment was created in which different activities were mixed in a mosaic that kept the students interests awake. The students learned individually and in teams, solved problems, designed, drew, played, sang, and used computers. The new role of the school was defined as to guide students how to learn by themselves. Learning was defined as an active process. The interaction in class was considered as a way for students to overcome the information overload with the help of teachers and their schoolmates. The teachers and learners were given more freedom, but their responsibility increased. A learning environment in informatics was created as an integrated mix of computer equipment, information resources, educational software, textbooks and other learning materials. Although computer resources were limited by that time, some innovative approaches of school activities were introduced (Nikolov & Sendova, 1988), e.g. working on a project, collaborative learning, dividing students into groups of different size, collective discussions, experimenting in mathematics, filling up a database, language games, publishing a student magazine, students' software house, teaching students in a university laboratory, competitions, a final students' computer performance, etc.

Fig. 1 Educational reforms in 29 Bulgarian schools with the help of microcomputers

implemented, but should rather be a matter of evolutional changes at all levels of the school educational system.

Technologies have made a remarkable progress since the early days of ICT in education. The current ICT-based DE relies mostly on large online electronic libraries and rich multimedia resources rather than on printed materials. Students can study on their own using aesthetically formatted and interactive multimedia learning materials. They can construct their own knowledge, study individually according to their needs, learning styles, skills, interests, and cognitive characteristics, and *learn how to learn*. Students can control their learning process, work in teams with other students, take part in discussions, and search for effectiveness in the learning process. *Co-operative learning* dominates over *competitive learning* (McClintock, 1992a, p. 82). Today's student can work in a dynamic and interactive multimedia learning environment where aside from the tutor and the other students he/she can communicate and work with his/her virtual friends all over the world. A new feature of the current stage of the educational reform is defined by McClintock: "*Now, thinking about educational time and space leads to conceptions of flexible groupings, across ages and locations, as people interact according to their interests, needs, and curiosities*" (McClintock, 1992b, p. 34).

Virtual Learning Environments for ICT-Based DE

For teaching and learning to take place, a learning environment needs to be created. Lai (2008) in this handbook describes the relation between ICT and the learning environment. He notices that in ICT-based DE the learning environment often does not have a physical space but is a virtual environment designed and developed to facilitate teaching and learning when teachers and students are separate in time and place.

When designing a Virtual Learning Environment (VLE), one could use different mental images (metaphors) of teaching and learning. The Internet and the Web gave rise to the *cyberspace* metaphor, i.e., an extension and a substitute of a physical environment. Dillenbourg emphasizes that: "What is specific to virtual environments compared to any information space is that it is populated. The users are inside the information space and see a representation of themselves and/or others in the space. As soon as students see who else is interested by which information, the space becomes inherently social" (Dillenbourg, 2000, p. 5). Another metaphor for a learning environment is *place*, which could be defined (in the physical world) as the "setting that transforms mere spaces and activities into unique sociocultural events: the coming together of people to the same location, at the same time, for the purpose of participating in a common, authentic, one-of-a-kind, memorable activity" (Kalay, 2004, p. 195). The document metaphor (used by the designers of the Web) sees information as separate from the people who use it and from the environment in which it is used. Kalay makes a conclusion that "place-making, rather than page-making, is a more appropriate metaphor for designing cyberspace: in addition to communication and information management, this metaphor affords a contextualized locus for situating the activities themselves, much like physical places do. Thus, the virtual places will include socio-cultural and perceptual qualities, enriching them to the point where they may approach – perhaps even surpass – comparable physical settings" (Kalay, 2004, p. 196).

Gachev and Nikolova (2005) report results of a comprehensive survey of appropriate software tools to support learning activities in Web-based Collaborative Environments (CEs). CEs can be seen as one possible form of ICT-based DE. The analysis shows that the majority of CEs are *user-centric* rather than *task-centric*, i.e., they comply with the user needs, but tend to miss the learning activities and task compatibility. The main conclusion was that while *CE–to–user* interfaces are sufficiently well developed, *CE–to–task* interfaces still need substantial further development.

The emergence of adaptive and intelligent Web-based educational systems is observed as well. They "attempt to be more adaptive by building a model of the goals, preferences and knowledge of each individual student and using this model throughout the interaction with the student in order to adapt to the needs of that student. They also attempt to be more intelligent by incorporating and performing some activities traditionally executed by a human teacher – such as coaching students or diagnosing their misconceptions" (Brusilovsky & Peylo, 2003, p. 156). (See also http://aied.inf.ed.ac.uk/aiedsoc.html).

We can argue that ICT-based DE tends to be mostly related to designing and using VLEs. A very important role in effective use of VLEs is played by the instruc-

tional designers who should apply an appropriate learning theory in the design of the VLE.

There are many examples of pure VLEs, designed for ICT-based DE. However, in many situations, VLEs are also used to enrich the traditional school curriculum. In this case, VLEs integrate not only a variety of software tools but also all the physical tools that can be found in a classroom (Dillenbourg, 2000, p. 12), such as:

– a variety of noncomputerized learning resources: concrete manipulation tools, instruments, books;
– a variety of interactions that are not computer-mediated: face-to-face discussion among students, lectures by the teacher, group discussions;
– traditional media – letters, TV, phone, and fax;
– a variety of activities that are not computer-based: field trips, role-playing, etc.

In the context of the above said, Nikolov and Nikolova (1996) proposed a conceptual model for *Virtual Environment for Distance Education and Training* (VEDET) that offers a comprehensive metaphor to be used both for human–computer interface and instructional design purposes. The model suggests restructuring traditional education and training by complementing traditional education with a virtual component. Thus, VEDET does not intend to replace the traditional school, university, or training department, but rather extend their facilities and tools and make learning activities more flexible and technologically enriched. As such VEDET is not an example of ICT-based DE in its pure form, but the model gave rise to a number of developments for reshaping academic practices through multi- and hypermedia (Nikolova, 1999).

The concept of VLE, either to be used in ICT-based DE or as an enrichment of traditional schooling, could be found in many research works and projects, as well as in many documents related to educational policy in schools. For instance, the British Educational Communications and Technology Agency (http://www.becta.org.uk) published an analysis of the current research related to the use of VLEs in education (British Educational Communications and Technology Agency [BECTA], 2003). The European School Net (http://www.eun.org/), a nonprofit consortium of 28 ministries of education in Europe, organized a survey comprising more than 500 schools and 17 ministries and national agencies for using VLEs in Europe (European Schoolnet [EUN], 2003). Some of the findings are (see p. 4):

- In-house development of VLEs is booming in the European school sector. Ten out of 17 national agencies fund the development and localization of VLEs at the national level, and about 60% of them have a high priority for VLEs in their national policies. About two thirds of responding schools use an in-house or open source VLE, whereas commercial products represent about one third of the VLEs in the field.
- Teachers in the secondary education use VLEs mostly with their pupils in classes, suggesting that teachers mix different teaching styles such as computer-supported teaching with face-to-face teaching. Teachers use VLEs more than students. Teachers use them for administrational tasks also, and as a means of communicating with other educational staff in both their own and other schools.

In many cases, this exchange takes place in the framework of international and European-wide school collaboration programs.

- VLEs are mostly used in teaching ICT and cross-curricular subjects. About 90% of teachers said that they teach ICT regularly and sometimes using VLEs, whereas for cross-curricular education, VLEs are used regularly by 44% and sometimes by 40% of respondents.

Pedagogical Dimensions for VLEs in ICT-Based Distance Education in K-12 Education

When designing VLEs, educators mostly refer to one of the three most popular learning theories: *behaviorism*, *cognitivism*, and *constructivism*. Dede (2008) in this handbook describes and discusses how different uses of ICT comply with these different approaches to learning. Nowadays many researchers and professionals refer to *constructivism* as the most popular theory in the area of ICT-based DE. The theory states that by reflecting on our experiences and participating in social activities we construct our knowledge about the world around (Duffy & Cunnigham, 1996). In a constructivist classroom, the teacher searches for students' understandings of concepts, and then structures opportunities for students to refine or revise these understandings by posing contradictions, presenting new information, asking questions, encouraging research, and/or engaging students in inquiries designed to challenge current concepts (Brooks & Brooks, 1993, p. 3).

Among the most important recently developed learning paradigms and theories, derived or related to ICT, are: *cognitive flexibility theory*, *anchored instruction theory*, and *minimalism theory. Cognitive flexibility* theory is a constructivist-based theory of learning and instruction that emphasizes on the real-world complexity and ill-structuredness of many knowledge domains (Spiro, Feltovich, Jacobson, & Coulson, 1992). Some of the basic assumptions in this theory are that understandings are constructed by using prior knowledge that go beyond the information given and the prior knowledge that is brought to bear is itself constructed, rather than retrieved intact from memory, on a case-by-case basis. The core of the cognitive flexibility theory is that "*revisiting the same material, at different times, in rearranged contexts, for different purposes, and from different conceptual perspectives is essential for attaining the goals of advanced knowledge acquisition (mastery of complexity in understanding and preparation for transfer)*" (p. 64). The authors claim that the design of hypertext learning environments could be done in a systematic way in order to make them "*sensitive to and dependent upon the cognitive characteristics necessary for advanced knowledge acquisition in ill-structured domains*" (p. 69).

Anchored instruction, also based on constructivist approaches to learning, is a learning theory which emphasizes on the importance of motivating learners by involving them in problem-solving (including by using technology) in a meaningful context (Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990). The instructional designers should use "anchors" based on a concrete problem-solving situation where students are actively involved.

The *Minimalist* theory of Carroll is closely related to the constructivist approaches to learning as well. It was developed on the base of studies how people are learning to use a variety of computer applications, such as word processing, databases, and programming, and it has been applied to the design of computer documentation and training materials for computer users (Kearsley, 1994). The basic theory principles are: all learning tasks should be meaningful and self-contained activities; learners should be given realistic projects as quickly as possible; instruction should permit self-directed reasoning and improvising by increasing the number of active learning activities; training materials and activities should provide for error recognition and recovery; and, there should be a close linkage between the training and actual system. Hedberg and Ping emphasize that during the process of designing learning tasks, it is important to take into consideration when the knowledge and skills are going to be used (Hedberg & Ping, 2004). Instead of focusing on *just-in-case* learning, *just-in-time* learning may be more effective – it provides students with more personal and relevant reasons for learning.

Figure 2 provides an example of applying constructivist instructional strategies in the design of a VLE.

Changes toward the information or knowledge society (Anderson, 2008, in this handbook) also lead to views on learning. Siemens observes that in the information or knowledge society:

The VLE created in the frames of the European project WebLabs (http://www.weblabs.org.uk/) (Mor, Hoyles, Kahn, Noss & Simpson, 2004). The WebLabs learning model and the VLE supporting it, facilitate the scientist in the learner to be enhanced. 10-12 years old students, together with their teachers and geographically dispersed researchers are involved in science and mathematics explorations by means of technology (a software environment for visual modeling). The students are partners in a research process and get used to pose questions and search answers no matter how sophisticated they might be. They develop an understanding of mathematics as a science in which formulating hypotheses, carrying out experiments, and attacking open problems plays a crucial part. They communicate and share their experiences with peers, teachers and researchers locally and globally through wplone, a Web based collaborative system, by the so called Webreports (http://www.weblabs.org.uk/wlplone). During this communication they acquire specific social experience and are stimulated to build valuable personal skills such as:

- ability to generate and verbalize ideas;
- to present their results according to a concrete standard;
- to share their experience by means of electronic communication;
- to discuss their work and work in a team;
- to be (self-)critical to the work published in the virtual environment.

When facing a typical e-learning problem while trying to learn collaboratively over distance – the language problem - in an attempt to overcome it, the students reach(ed) the idea of designing a graphical scripting language, Weblabetics, for expressing and sharing their experience (Sendova, Nikolova, Gachev & Moneva, 2004).

Fig. 2 The European WebLabs project

- Informal learning is a significant aspect of our learning experience. Formal education no longer comprises the majority of our learning. Learning now occurs in a variety of ways – through communities of practice, personal networks, and through completion of work-related tasks;
- Learning is a continual process, lasting for a lifetime. Learning and work-related activities are no longer separate. In many situations, they are the same;
- Technology is altering (rewiring) our brains. The tools we use define and shape our thinking;
- The organization and the individual are both learning organisms. Increased attention to knowledge management highlights the need for a theory that attempts to explain the link between individual and organizational learning;
- Know-how and know-what is being supplemented with know-where (the knowledge of where to find knowledge needed just in time) (Siemens, 2005).
- According to Siemens (2005), these changes might induce the development of new theories of learning, which he calls *Connectivism*, and this may also lead to new forms of ICT-based DE.

Effectiveness of ICT-Based Distance Education

The fast growth of the number of distance learning students and the well-recognized role of e-learning for education pose the need to carefully study the factors that influence student learning in an e-learning environment. After a meta-analysis of 19 experimental and quasiexperimental studies in K-12 schools, it was found that DE can be expected to result in achievement at least comparable to traditional instruction in most academic circumstances (Cavanaugh, 2001). Cavanaugh (2001) found an exception for three foreign language studies reporting that students learning with DE systems performed demonstrably lower than students learning in traditional classrooms. Generally, the meta-analysis showed that the DE programs could be used to complement, enhance, and expand education options for students, at least at intermediate, middle, and upper grade levels. ICT-based DE, particularly when designed in an interactive format, can be a vehicle for including the family and community in a learning conversation.

A case-based study aiming to examine the effectiveness of virtual schooling in comparison with conventional schooling was conducted in three conventional and six virtual secondary schools in Canada (Barker & Wendel, 2001). Effectiveness was defined as "*the degree to which the school is able to meet the differing and various expectations of both providers and users or clients*" (p. 6). It was reported that there was enough evidence that virtual schooling could provide excellent learning opportunities to all children and improve the process and content of learning. Students in conventional schools and virtual schools acquire the same curricular content but it appeared that they learn different skills. For instance, the students in virtual schools showed greater improvement than their conventional school counterparts in personal responsibility, critical thinking, researching, technological competencies, learning independently, problem-solving, creative thinking, decision-making, and time

management. Less improvement was observed in the academic and communication skills of listening and speaking. The students in virtual schools could rely on quick feedback, instant work records, equal opportunity to participate in "class," increased access for students with special needs, greater opportunity for parental involvement, etc. In addition, all stakeholders in the virtual schools (students, teachers, parents, and administrators) declared that they were very satisfied with and enthusiastic about virtual schools. The most common reason for selecting a virtual program was dissatisfaction with conventional schooling. It was also found that the costs per student in virtual schools were less compared to the ones in conventional schools, e.g., the cost for the school staff was between 20% and 40% less.

According to Cavanaugh, Gillan, Kromrey, Hess, and Blomeyer (2004), virtual schooling, has had limited success in some situations. They found that students may feel isolated in an online environment; parents may have concerns about children's social development; students with language difficulties may experience some disadvantage in a text-heavy online environment; and subjects requiring physical demonstrations of skill such as music, physical education, or foreign language, may not be practiced well in a technology-mediated setting (p. 5).

Roblyer (2008) in this handbook points out that typically, among the students entering DE, most successful are those who achieved high in a traditional school environment and who are well self-organized, motivated, and technology literated. She argues that "virtual courses, like most other distance learning activities, are usually primarily text-based, which can present difficulties for students with lower levels of literacy, who are non-English speakers, or who have English as a second language." Roblyer also states: "As virtual schooling plays an increasingly large role in their total education options, students will need to make the transition from "learner" to "Information Age learner" and some will need help with this transition. Since distance learning is also growing in popularity in business and industry training, the ability to learn well in virtual classrooms is becoming a "basic skill" of the future." She also points out: "When the first virtual schools sought startup funding in the mid-1990's, they often cited the potential for increased access to high quality education for all students, regardless of their location or the quality of local resources. Some ten years later, it is still not clear that this promise has been fulfilled."

The Future of ICT-Based Distance Education

A future vision for the design of VLEs for ICT-based DE is the incorporation of the concept of *learning spaces* (Punie & Cabrera, 2006). Learning spaces are:

- *Connecting and social spaces*: Since learning is a social process, it needs to bring different actors together to share learning experiences. Learning spaces are both physical and virtual ones that favor a learner-centered learning model but connected with the other actors involved in learning and with other social networks. As such, learning spaces should also link learning individuals with learning communities, organizations, and even learning cities and learning regions;

- *Personal digital spaces*: Every learner should have a personal, digital learning space where all learning material is accessible anywhere, anytime, anyway (via multiple devices and media);
- *Trusted spaces*: Learning spaces should provide trust and confidence (e.g., on quality and reliability) in a world where learners are connected digitally, and where learning content is coproduced and shared;
- *Pleasant and emotional spaces:* ICT could make learning content more attractive (e.g., via media-rich virtual environments and simulations) and more emotional (e.g., by connecting people);
- *Creative/flexible spaces*: Learning spaces should be creative spaces, rather than focusing exclusively on reproducing knowledge;
- *Open and reflexive spaces*: Future learning spaces would need to be open and module-based, enabling people to plug in again whenever they can;
- *Certified spaces*: Future learning can only be different from learning today if the current accreditation systems and learning assessment systems are adapted to the requirements of the knowledge-based society. The acquisition of ICT skills, digital competence, and other new skills, be it through formal or nonformal education, should be demonstrated, evaluated, and also certified (see also Roblyer, in this handbook);
- *Knowledge management systems*: The strength of most organizations lies in their people, hence the need to share experience and knowledge among colleagues, within the organization, and even across organizations.

The concept of learning spaces is built upon a learner-centered educational model. The new feature is that the learners are considered not only as consumers of learning content but rather as coproducers of such content. This concept is incorporated into the new generation of the Web, Web 2.0. Nowadays, Internet users can collaborate via getting access also to Web services, such as:

– Building digital collections and content (Wikipedia, Wikibooks, YouTube, Flicr).
– Joining and creating social networks (Linkedin, del.icio.us, MySpace, Facebook, Piczo).
– Publishing one's own journals (Blogger, RSS, LiveJournal).

Following O'Reily's (O'Reily, 2005), we define Web 2.0 Schools as "schools that use predominately Web 2.0-based educational applications and services in their educational activities" (Nikolov, 2007, p. 3). The Web 2.0 virtual learning environments provide opportunities for students, teachers, parents, and other stakeholders to contribute to creating useful and 24/7-available educational resources (Freedman, 2006). Students can produce a new resource or edit existing ones for other students while they are learning themselves. Even the well-known computer applications, such as word processors and spreadsheets, come to a new life in the Web 2.0 world. For instance, with Google Docs and Spreadsheets (http://docs.google.com/), one can get access to the nearest link to Internet computer and use them for creating and sharing documents in the global Web 2.0 environment.

A lot of Web 2.0 School-oriented portals providing access to Web services and content for educational purposes in different school subjects are emerging, such as: Schoolforge (http://www.schoolforge.org.uk), Change Agency (http://www.ed421.com/), Web 2.0 for the Classroom Teacher (http://www.kn.pacbell.com/wired/fil/pages/listweb20s.html), Shambles: Education Project Asia (http://www.shambles.net/), Edu 2.0 (http://www.edu20.org/), etc.

The fast growth of the new generation technologies in school education, such as the Web 2.0 technologies and mobile technologies, triggered a new wave of pedagogical research. (See, for instance, http://mlearning.noe-kaleidoscope.org/). The DE stakeholders should also use these technologies in order to harness their collective intelligence for improving the quality of education.

Conclusions

To make use of the new opportunities offered by ICT-based DE, educators should gradually improve the educational system as a whole. In a world with powerful instruments for producing and getting access to any kind of information at any time and any place, the knowledge structure and content as well as the skills of people, capable of effectively using this information, have to be different from the ones obtained through the traditional educational system. The developments in the technology suggest that a *re-engineering* of the education system is necessary, focusing on better integrating physical and virtual learning environments.

There are many concerns that the most important driver for ICT-based DE in schools is increasing demand rather than advanced pedagogical principles and best practices of DE in different settings. Virtual schooling attracts mostly students who are able to learn in any learning environment and not always those who are in disadvantaged position. Still worrying is the high dropout rate of virtual schooling. There are many cases for applying ICT-based DE in a teacher-centered and material-centered learning environment. Therefore, teacher education could be the major way to struggle for excellence in ICT-based DE.

References

Anderson, R. (2008). Implications of the information and knowledge society for education. In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education*. New York: Springer.

Aston, M. (2002, August). The development and use of indicators to measure the impact of ICT use in education in the United Kingdom and other European countries. In *Proceedings of the UNESCO Consultative Workshop for Developing Performance Indicators for ICT in Education* (pp. 62–74). 1st, Manila, the Philippines. Retrieved July 7, 2007 from http://www2.unescobkk.org/elib/publications/ICTindicators/ICTindicators.pdf

Barker, K., & Wendel, T. (2001). *E-learning: Studying Canada's virtual secondary schools*. Society for the Advancement of Excellence in Education, Research Series #8. Retrieved July 7 from http://www.saee.ca/.

Bransford, J. D., Sherwood, R. D., Hasselbring, T. S., Kinzer, C. K., & Williams, S. M. (1990). Anchored instruction: Why we need it and how technology can help. In D. Nix, & R. J. Spiro (Eds.), *Cognition, education, and multimedia* (pp. 115–141), Hillsdale, NJ: Erlbaum.

British Educational Communications and Technology Agency. (2003). *A review of the research literature on the use of managed learning environments and virtual learning environments in education, and considerations of the implications for schools in the United Kingdom*. Retrieved July 7, 2007 from http://www.becta.org.uk/page_documents/research/VLE_report.pdf

Brooks, J. G., & Brooks, M. G. (1993). *In search of understanding: The case for constructivist classrooms*. Alexandria, VA: Association for Supervision and Curriculum Development.

Brusilovsky, P., & Peylo, C. (2003). Adaptive and intelligent web-based educational systems. *International Journal of Artificial Intelligence in Education, 13*, 156–169.

Butcher, N., & Wilson-Strydom, M. (2008). Technology and open learning: The potential of open education resources for K-12 education. In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education*. New York: Springer.

Cavanaugh, C. (2001). The effectiveness of interactive distance education technologies in K-12 learning: A meta-analysis. *International Journal of Educational Telecommunications, 7*(1), 73–88.

Cavanaugh, C., Gillan, K., Kromrey, J., Hess, M., & Blomeyer, R. (2004). *The effects of distance education on K–12 student outcomes: A meta-analysis*. Naperville, IL: Learning Point Associates.

Dede, C. (2008). Theoretical perspectives influencing the use of information technology in teaching and learning. In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education*. New York: Springer.

Delrio, C., & Dondi, C. (2008). IT and educational policy in the European region. In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education*. New York: Springer.

Dillenbourg, P. (2000). *Virtual learning environments*. EUN Conference 2000: "Learning in the new millennium: Bringing new educational strategies for schools". Workshop on Virtual Learning Environments. Retrieved from July 7, 2007 from http://tecfa.unige.ch/tecfa/publicat/dil-papers-2/Dil.7.5.18.pdf

Downes, S. (2007). Learning networks in practice. In *Emerging technologies for learning, V.2*. British Educational Communications and Technology Agency, UK. Retrieved July 7, 2007 from http://partners.becta.org.uk/page_documents/research/emerging_technologies07_chapter2.pdf

Duffy, T. M., & Cunnigham, D. J. (1996). Constructivism: Implications for the design and delivery of instruction. In D. H. Jonassen (Ed.), *Handbook of educational communications and technology* (pp. 170–198). New York: Simon & Schuster Macmillan.

European Schoolnet. (2003). *Virtual learning environments for European schools. A survey and commentary*. Retrieved July 7, 2007 from http://www.eun.org/etb/vle/vle_eun_feb_2003.pdf

Fernback, J., & Thompson, B. (1995). *Virtual communities: Abort, retry, failure?* Paper presented at the Annual Convention of the International Communication Association, Albuquerque, New Mexico. Retrieved July 7 from http://www.well.com/~hlr/texts/VCcivil.html

Freedman, T. (Ed.). (2006). *Coming of age: An introduction to the new World Wide Web. Featuring case studies and how-to articles by leading practitioners in the world of education*. Terry Freedman Ltd. http://edu.blogs.com/edublogs/files/Coming_of_age.pdf

Gachev, G., & Nikolova, I. (2005, November). *An approach for evaluating web-based collaborative environments*. In Proceedings, KAL Workshop (pp. 31–38), Sofia, Bulgaria.

Hedberg, J. G., & Ping, L. C. (2004). Charting trends for E-Learning in Asian schools. *Distance Education, 25*, 199–213.

Kalay, Y. (2004). *Virtual learning environments*. ITCon, Vol. 9. Special issue ICT supported learning in architecture and civil engineering, pp. 195–207. Retrieved July 7, 2007 from http://www.itcon.org/2004/13/

Kearsley, G. (1994). *Minimalism (J. M. Carroll)*. Retrieved January 7, 2007 from http://www.gwu.edu/~tip/carroll.html.

Lai, K-W. (2008). ICT supporting learning processes: The premise, reality and promise. In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education*. New York: Springer.

McClintock, R. (1992a). *Power and pedagogy: Transforming education through information technology*. New York: Institute of Learning Technologies.

McClintock, R. (1992b), *The educators manifesto: Renewing the progressive bond with posterity through the social construction of digital learning communities*. New York: Institute of Learning Technologies.

Mioduser, D., Nachmias, R., & Forkosh-Baruch, A. (2008). In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education*. New York: Springer.

Moore, M. G. (2003). Preface. In M. G. Moore, & W. Anderson (Eds.), *Handbook of distance education*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Mor, Y., Hoyles, C., Kahn, K., Noss, R., & Simpson, G. (2004). *Thinking in progress*. Micromath, 20, 2, 17–23.

Nikolov, R. (1987). *A learning environment in informatics*. Unpublished doctoral dissertation. Sofia University, Sofia, Bulgaria.

Nikolov, R. (1997, April). *Distance education via Internet – Education without borders*. Proceedings of the 26th Spring Conference of Bulgarian Mathematicians (Invited paper) (pp. 53–66), Plovdiv, Bulgaria.

Nikolov, R. (2001, August). *Learners in a global knowledge space*. In C. Norris, G. Knezek, N. Campbell, I. Nikolova, R. Nikolov, & S. Schrum (Eds.), *The issues in online learning, reader (First edition)*. Denton: University of North Texas.

Nikolov, R. (2007). *Towards Web 2.0 schools: Rethinking the teachers professional development*. Proceedings of IMICT 2007, Boston, MA.

Nikolov R., & Nikolova I. (1996, September). *A virtual environment for distance education and training*. IFIP WG3.6 Conference "Collaborative Learning and Working with Telematics", Vienna, Austria.

Nikolov, R., & Sendova, E. (1988). Can the teachers' creativity overcome limited computer resources. *Education & Computing, 4*, 179–184.

Nikolova, I. (1999). Reshaping academic practices through multi and hypermedia. In *Proceedings of world conference on educational multimedia, hypermedia and telecommunications 1999* (pp. 36–49). Chesapeake, VA: American Association for the Advancement of Computing in Education.

O'Reilly, T. (2005). *What is Web 2.0: Design patterns and business models for the next generation of software*. Retrieved January 7, 2007 from http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. New York: Basic Books.

Papert, S. (1997), Why school reform is impossible. *The Journal of the Learning Sciences*, *6*, 417–427.

Picciano, A. G., & Seaman, J. (2007), K-12 online learning: A survey of U.S. school district administrators, Sloan-C™, http://www.aln.org/publications/survey/pdf/K-12_Online_Learning.pdf

Powell, A., & Patrick, S. (2006). An international perspective of K-12 online learning: A summary of the 2006 NACOL international e-learning survey. North American Council for Online Learning. Retrieved July 7, 2007 from http://www.nacol.org/docs/InternationalSurveyResultsSummaries.pdf

Punie, Y., & Cabrera, M. (2006, October). *The future of ICT and learning in the knowledge society*. Report on a Joint DG JRC-DG EAC Workshop. Sevilla, Spain. EC, DG JRC-IPTS, EUR 22218 EN

Roblyer, M. D. (2008). Virtual schools: Redefining "A place called school". In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education*. New York: Springer.

Sendova, E., Nikolova, I., Gachev G., & Moneva, L. (2004). Weblabs: A virtual laboratory for collaborative e-learning. In C. D. Kloos, & A. Pardo (Eds.), *EduTech: Computer-aided design meets computer aided learning* (pp. 215–221). Dordrecht, the Netherlands: Kluwer Academic Publishers.

Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning, 2*(1). Retrieved January 7, 2007 from http://www.itdl.org/Journal/Jan_05/index.htm

Singh, H. (2003). Building effective blended learning programs. *Educational Technology, 43*(6), 51–54.

Spiro, R. J., Feltovich, P. J., Jacobson, M. J., & Coulson, R. L. (1992). Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. In T. M. Duffy, & D. H. Jonassen (Eds.), *Constructivism and the technology of instruction: A conversation* (pp. 57–76). Hillsdale, NJ: Lawerence Erlbaum Associates.

Voogt, J., & Knezek, G. (2008). IT in primary and secondary education: Emerging issues. In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education*. New York: Springer.