

Learning and Teaching in the Digital Age

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Abstract: The paper emphasizes that new pedagogical possibilities are to be explored and tried. Research and development are to be focused on and at the same time the means of exchanging information among students, teachers and management on the educational institutions are to be provided. As technical universities have a research role, the academic staff are often caught between conflicting needs to conduct their research and teach students. The paper is based on the educational experience at the University Politehnica of Bucharest. It is proven that technical universities must become more involved with the other links in the Education Chain. They have a role to play in the diffusion of new e-learning technologies and should be seen as the normal base for training all teachers.

Key-Words: information, technology, communication, subjects, digital, education, qualification, proficiency, competency, standards

1 Introduction

In the Digital Age, the Information and Communication Technology qualifications, such as processing and handling of information, are becoming as important as the traditional basic qualifications: reading, writing and arithmetic. Therefore the students have to be ICT users. Furthermore, the rapidly increasing production of information in society makes a number of demands on the personal qualifications of the students. It is among other things a question about the ability of the individual to transform information into knowledge, to sort information, to cooperate, and to enter into a process oriented working method. Simultaneously it becomes necessary to revise the traditional idea of the role of the teacher. The role as organizer and distributor of knowledge is to be developed so that the future teachers can also act as guides and sparring partners (coaches) for the students [2]. At the same time the teachers have to be able to master the ICT tools themselves. In that connection it is also important to focus on the specific pedagogical possibilities, which become available with the use of ICT in the teaching.

2 Education for an Information Age

Regardless of age, educational background and geographical location, all teachers are to have the opportunity of participating in a wide range of educational activities on a continual basis. This can become a reality through virtual educational programmes, where

the physical presence is not imperative[5].

The rapid technological development means that knowledge is no longer a once in a life time experience for the individual. It is rather an asset, which constantly has to be updated. Therefore recurrent education will gain increasing importance for young people as well as for adults with a view to maintain and develop earlier acquired qualifications.

3 The Students and the Digital Age

From an overall point of view it is the object of the education system to qualify the individual human being for working life and for life in general. Thus, it is not solely the aim of the education system to qualify young people and adults to acquire and reproduce the knowledge, which is disseminated by their teacher[7]. The crucial new factor in connection with the information society is that young people and adults are to be qualified creatively to sort, select, process and use the great amount of information, which ICT give access to. Moreover, in connection with the basic education they are to acquire new methods of learning processes in order to enable them to take a material responsibility for a continual and lifelong updating of their qualifications.

The education system also has to take into account the so-called less advantaged groups of students, which for various reasons run the risk of becoming marginalised in the usual education system [8]. It is therefore necessary to initiate ICT-based

projects with the aim of developing new methods and teaching materials, which can support the learning processes of these groups [1]. There can e.g. be focused on individualized teaching programmes with a starting point in the specific needs of the individual student. In cooperation with other agents in the educational field, areas of special priority could be:

- Access to inexpensive and rapid network connections from the educational institutions as well as from the distance workplace.
- Development of and access to a comprehensive supply of quality services for educational purposes via network.
- Continual development of ICT-based teaching programmes and materials, which can generally support the learning processes on all levels, including especially the learning processes of the so-called less advantaged group of students.

4 The Teachers and the Digital Age

The teachers are to be educated concurrently with the increase in the use of ICT. New knowledge based on the latest research and new interpretations of existing knowledge can in a few seconds be distributed globally with the use of information technology and electronic communication. Knowledge is constantly changing or is becoming obsolete so rapidly that the distributors of knowledge - the teachers - can hardly be constantly updated. Knowledge is not static but dynamic and it moves at lightning speed in the information society. The very speed in which the amount of knowledge is increasing globally makes other demands on the teachers of today and of the future. Therefore it is necessary to revise the traditional understanding of the role of the teacher in the information society's education system[12]. The role of the teacher as organizer and distributor of the teaching has to be developed concurrently with the integration of ICT in the education programmes, because as a parallel to the development there will be an increasing need to sort information and to process collected information to serviceable knowledge. In the future the teacher also has to be capable of acting as adviser and sparring partner for the students. This new interpretation of the traditional distribution of roles between teacher and students is necessary if the students are to take a greater responsibility for their own learning and have the opportunity of displaying greater independence in the learning process. For a long time this has been the case within tertiary education, where learning is the responsibility of the individual student, and

the teachers are advisers and inspirators[3]. A similar development can be expected within the other educational areas; however, the demand that university is also an important factor as a place of socialization for students still contributes to uphold many of the traditional teacher virtues as highly necessary. It may be more precise to talk about the extended role of the teachers than about their changing role. Like other groups in society, the teachers have to personally master the ICT-tools and their possibilities concurrently with the fact that ICT is used as an integrated part of the individual educations and subjects. In addition to this a massive effort within in-service training is to be implemented with the purpose of focusing on the pedagogical possibilities, which lies in the use of ICT, including the importance of ICT to the content, didactic and pedagogical principles of the subjects. In that way a fundament is created, which makes it possible for the teachers to use ICT both in the personal planning process and as an integrated element in the teaching and in the learning process [13]. The starting point for the updating of the teacher and in-service training is that the teacher group in the education system is not a homogeneous group. The teacher groups on the various educational levels have a widely different educational background. Therefore the overall transverse objectives of the educational policy have to be supplemented and strategy and action plans have to be worked out, describing the updating of the teachers' ICT-qualifications on the individual educational levels. However, in the future there will be an increasing demand on the individual teacher to independently acquire new knowledge and methods within the ICT-area, just like other members of the labour market have to do. This requires that the management is responsible for ensuring that the teachers have the qualifications, which are necessary for the teaching in question, but also that each individual teacher is responsible for keeping his or her general qualifications on a state of art level. In this connection, it is necessary to look at the distribution of the teachers' working hours and find out if it is posing barriers to an effective ICT-integration. Areas of special priority could be:

- Ensuring that the general and basic ICT-qualifications of the student teachers in the beginning of the course of study are brought to that sufficiently high basic level, which the education necessitates.
- Formulation of minimum requirements as to ICT-qualifications, both general as well as subject related qualifications as a prerequisite for employment as a teacher.

- Formulation of requisite minimum requirements as to ICT-qualifications among the existing teacher groups. It is the aspiration that all teachers will be able to meet the minimum requirements at the end of the period.

5 The Subjects and the Digital Age

The concept of subjects is a part of the picture everywhere in the education system. In the school area and of course especially within the areas, which are based on research, theoretical thinking and philosophical abstraction, the subject notion is an operational way, in which to handle and categorize the scientific main areas.

Within the areas of research and science, subjects are also a scientific theoretical concept, as it is usual to operate with the subject notion within an 'education', characterized by a certain collection of 'subjects' [9].

When we speak colloquially about the integration of ICT in education and teaching, we speak primarily about the ICT-integration in the subjects (and the teaching/dissemination of them). It is therefore a crucial question, whether the integration of ICT has bearings on the self understanding and development of a subject and if it has, which ones and to what extent. The following areas are of special interest in this connection:

- A scientific basis and understanding (i.e. how to formalize and generalize within a scientific branch), which paradigms are the basis of the understanding of a subject, which values/conceptions are causing the fact that some theories are more acceptable than others, a general understanding of what is 'normal' within a subject,
- Aims for qualifications and proficiencies (i.e. which qualifications are the subject to provide - presumably this is also the proficiency dimension in a characteristic of the subject), and
- A dissemination aspect, which is a common or generally accepted way of representing/disseminating a subject.

There is an increasing need to formulate a set of concepts to describe new possibilities and problems in connection with the integration of ICT in subject-related connections and in the subject-related terminology. With the appearance of modern information technology, new ways of acquiring insight, obtaining qualifications and of learning working methods have appeared[11]. The qualification of the citizens, which

was formerly expressed by the fact that you knew a trade or a profession, is no longer quite so unequivocally associated with the concept of a trade or a profession or with a well-defined group of qualifications and knowledge. It is still more necessary also to describe and qualify working methods, qualifications in the relevant use of the new ICT-tools in traditional as well as in new processes, and not least the ability to survey large amounts of data, extract the relevant information and then present the knowledge in a way, which is part of a meaningful context. The education system is built on the subject as the principal element. The composition of the subjects are rarely discussed, but the content of the subjects - topics, concepts, methods - are often debated. There is of course an interdisciplinary cooperation, but mostly with the basis in one or more subjects, which guarantees the total quality of the interdisciplinary projects.

Even though many and relevant attempts to describe the influence of ICT on the methods and contents of the teaching are taking place, there is a need for a general discussion about whether, and if so, how, the new information technology affects the objectives of the education programmes at all levels[6]. Moreover, such a discussion will necessarily involve the question of the organisation, content, arrangement, methods and pedagogical means of the teaching. There will probably be a need for a level divided analysis of these circumstances, as there can hardly - not even today - be made any meaningful observations on subject-related quality and choice of methods, prevailing for the entire education sector. Research, development and counselling are sides of the same problem. In general we know too little of the new ICT-based education and teaching methods. Interim reports from a large number of pilot and development projects, which the Romanian Ministry of Education has initiated, show that education and teaching - and the derived organization of them - go through substantial changes. The sparse experience from recent projects, which the Romanian Ministry of Education has started, is only to a limited extent being gathered and processed.

Therefore there is a need for a strengthening of the research effort within education and teaching methods in general, including a special effort within the new ICT-based education and teaching methods[4]. In that way a systematic gathering and development of new pioneering education and teaching methods are ensured; this factor may form the basis of the development of the education sector, the education programmes and the teachings on the institutions of the XXIst century.

In the process of modernization of the University Politehnica of Bucharest important activities are

involved in the field of informatics and communications. The latest achievement consists in the network for the processing of learning, the creation of a special service for the University's Management of Informatics as well as the design of a superior computing centre (CoLab) as a National Centre for the Technology of Information. Among the most important results there are:

- the creation of the Council for Informatics Coordination and Development with a role in the analysis of the present situations and in the elaboration of a development and modernization program;
- the creation of the Department of Informatics and Communication;
- the setting up of the Committees of Coordination and Informatics Development with a role in local coordination for the faculties and in connection with the University's Informatics Service;
- the achievement of the management network in the learning process at a top level and in faculties with special endowment due to Tempus UNICAS program and to the modernization grant financed by the Education and Research Ministry and by the International Bank.

A significant achievement is the setting up of the newest form of education, the Faculty of Applied Sciences, within the University Politehnica of Bucharest, in 2005. The Faculty has two sections, Mathematics-Informatics and Physical Engineering. It has modern laboratories and computer networks. The students learn computing as well as the most important mathematical subjects, both fundamental and especially Applied Mathematics. They will become professionals in Computer Science, specialists in mathematical modelling or teachers of Mathematics or Informatics.

The practical achievements make us think that more informal approaches to education are also valuable in the digital age providing young people with an opportunity to learn through practical experience. Formal education systems need more flexibility to allow students to undertake and gain credit for such activities. Peer based education, where students help students, and student exchange programs are also beneficial and popular.

Following the same line of thought what is significant for the Automatics and Computer Faculty (University Politehnica of Bucharest) for 2008 - 2009 is that the learning curriculum will continue to modernize with a view to the requirements of the international academic community. The structure and the

services in informatics of the faculty will be modernized. Thus, in the course of the research activity several components will be developed:

- the research abilities at the level of departments and research centres;
- taking part in competitions for projects in the National Program of Research and Development or to obtain grants from the Education and Research Ministry, the Romanian Academy etc;
- the development of an international collaboration with well-known European Universities to take part in mutual research themes;
- supporting the national industry of products and services in the field of automatics and computers by offering new concepts, solutions, technologies, prototypes;
- supporting the National Centre for the Technology of Information.

Technology has changed the structure of the economy, making many jobs obsolete and putting people out of work. Yet the information society also increases flexibility, it emphasizes collaboration over hierarchy, it creates the need for ongoing learning at work, and it reduces the distinction between our home and workplace. New industries have been developed as a result of technological change. The information society is now a major part of our Pan European economy. Europe and North America are technology leaders, with more patents than other regions and a higher percentage of workers in knowledge-based or high-skilled jobs. These new industries are built upon innovation, and instilling a sense of entrepreneurship. A culture of risk-taking and the skills to take an idea and turn it into a profitable venture are vital to ensure the sustained growth of these industries and new ones not yet envisaged. For example the Faculty of Energetics (University Politehnica of Bucharest) has a Training Auto-desk Centre and several computer-assisted laboratories for design. We can mention some other courses and laboratories included in the syllabus at the University Politehnica of Bucharest:

- computer-assisted graphics (the Faculty of Energetics, I-st year)
- computer-assisted design in energetic field (the Faculty of Energetics, IV-th year)
- computer-assisted design of mechanic systems (the Faculty of Mechanical Engineering, IV-th year)

- AutoCAD (the Faculty of Transport Engineering, II-nd year)

Supporting young entrepreneurs in the developing world with education, financing, mentorship and encouragement is a critical pathway to bridging the digital division and fostering the creation of sustainable livelihoods.

Beyond the technological and infrastructural issues, there are crucial social, political, cultural and institutional dimensions. Different knowledge systems, cultures and civilizations enter into relations of dialogue and exchange, and these relations transform society. In this perspective, questions of social inclusion, gender, age, intercultural dialogue, cultural diversity should occupy a central place. As Kochiro Matsuura, Director-General of UNESCO wrote 'UNESCO's perspective are four key principles: equal access to education; freedom of expression; the guarantee of a strong public domain of information; and the preservation and promotion of cultural diversity, including multilingualism' [10]. The digital age is founded on respect for, and enjoyment of, cultural expression. New ICTs should stimulate multiculturalism and plurilingualism and enhance the capacity of the universities to develop activities to that end.

As a confirmation of this concern, the United Nations Educational, Scientific and Culture Organization (UNESCO) is in the midst of defining a set of global ICT Competency Standards for Teachers (CST). The objectives of the project are to:

- Constitute a common set of guidelines that professional development providers can use to identify, develop or evaluate curriculum or teacher training programs in the use of ICT in teaching and learning;
- Provide a basic set of qualifications that allows teachers to integrate ICT into their teaching and learning, to advance student learning, and to improve other professional duties;
- Extend teachers' professional development to advance their skills in pedagogy, collaboration, leadership and innovative school development using ICT;
- Harmonize different views and vocabulary regarding the uses of ICT in teacher education.

The UNESCO has teamed up with Cisco, Intel and Microsoft, as well as the International Society for Technology in Education (ISTE) and the Virginia Polytechnic Institute and State University (Virginia Tech), to set up the 'ICT Competency Standards for

Teachers' (CST) project. The goal of the CST project is to provide guidance on how to improve teachers' practice through ICT and giving a new dimension to their skills, regardless of where the classroom is located - resulting in better education and highly skilled students.

The United Nations, through the Millennium Development Goals (MDGs) and the UNESCO Education for All (EFA), World Summit for the Information Society (WSIS) and Literacy Decade initiatives, has set a high priority on the improvement of education world-wide. The G8 Heads of State concur and acknowledge the role that ICT can play in supporting educational improvement. The UNESCO ICT Competency Standards for Teachers project is developed in support of these priorities [14].

The goal of the 'ICT Competency Standards for Teachers' (CST) project is to improve teachers' practice. However, the Standards do not merely focus on ICT skills. By combining ICT skills with emergent views in pedagogy, curriculum, and school organization, the Standards are designed for the professional development of teachers who want to use ICT skills and resources to improve their teaching, collaborate with colleagues, and perhaps ultimately become innovation leaders in their institutions. UNESCO is giving a high priority to the use of ICT for more equitable and pluralistic development in education. The broad questions on which UNESCO focuses are:

- How can one use ICT to accelerate progress towards education for all and throughout life?
- How can ICT bring about a better balance between equity and excellence in education?
- How can ICT help reconcile universality and local specificity of knowledge?
- How can education prepare individuals and society to benefit from ICT that increasingly permeate all realms of life?

6 Conclusion

These questions concern us all - students and professors alike. Several points must be borne in mind as one pursues these questions. First, ICT are only a part of a continuum of technologies, starting with chalk and books, all of which can support and enrich learning. Second, ICT, as any tools, must be considered as such, and used and adapted to serve educational goals. Third, many ethical and legal issues intervene in the widespread use of ICT in education, such as ownership of knowledge, the increasing exchange of educa-

tion as a commodity, and globalization of education in relation to cultural diversity.

Digital Opportunities for All: Preparing Students for 21st-Century Skills is this year's theme for the UNESCO King Hamad Bin Isa Al-Khalifa Prize for the use of Information and Communication Technologies (ICTs) in Education [14]. The prize winners will receive their awards during an official ceremony scheduled for 14 January 2009 at UNESCO Headquarters in Paris. The significance of this prize goes beyond its concrete value. What is important is that technology is changing the way classrooms operate, integrating multimedia textbooks, online research, and students presentations with the assistance of ICTs, making learning and teaching more interactive and participatory.

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