ICT in Education: A New paradigm and old obstacle

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***Abstract*— In this paper, we review the phenomena and processes which, when viewed together, indicate the birth of a new education paradigm for students in higher education. Our approach to learning in particular is changed by digital tools. Our thinking process and learning methods are subject to development. This paper, while making references to this development, analyses the interactions between typical and atypical learning, in other words, formal and informal learning. It also explains the most important characteristics of the new education paradigm, which we symbolically call „Version 2.0" when addressing the new generation. When analysing these changes, we should review and interpret the most important participants and their roles (students and the teachers supporting them), old routines and future expectations and the new ICT solutions and their increasing role in supporting learning.**

Keywords-Digital education; Digital learning; E-learning; Competence; Education, Teaching; Learning, Learning styles; Learning network; Learning theory; Knowledge; Web 2.0.

I. INTRODUCTION

The new methods of e-learning and „edutainment" could be born as a result of digital development. Edutainment is based on the idea of disseminating professional (or legal) information to students in an entertaining audio-visual environment provided by multimedia tools. The method is based on the realization coming from the latest results of education science that the efficiency of traditional teaching methods (with special regard to oral presentations) and additional electronic devices is multiplied when placed into an entertaining framework. The interest of students may be maintained continuously by impulsive presentations where information transfer is aided by music or visuals added at given points, facilitating emotional identification, active participation and retrieval of information from the memory later on.

Being aware of new ICT trends and their constructive application are essential in modern teaching and learning; this is why a whole chapter is dedicated to these topics as well. Modernizing education and training does not mean that teaching and learning cannot be experiential. Another chapter formulates theories on „experiential education" in a digital environment and its results, also verified by feedback from students.

The section on ICT (Information and Communications Technology) and Web2.0 opportunities in language learning reflects the reforms in the syllabus. The guide based on the modern methodology of language teaching may be useful for both students and teachers in computer aided language education [1][13].

In our accelerated world, information transfer with special regard to presenting, communicating and receiving useful information items is of paramount importance. One of the most important practical issues in digital education is the development of micro-contents that correspond to the interests of students (culture, sport, specific professional topics) while fitting the screen of ICT tools and complying with content and format requirements. This is why the textbook on the topic written by András Benedek is now completed with a new chapter on developing and presenting micro-contents [2]. The information in this paper, presented without the reference to the books/papers, is our contribution and based on our own research explained in textbook cited.

The study will begin by outlining the new learning theories and contexts by examining new learning environments, forms and specific processes. The following sections will set out the altered time and space of learning as well as the use of modern, digital teaching materials. The paper ends with conclusions.

II. LEARNING THEORIES AND CONTEXT

A. Learning and knowledge – a new context

In our environment, new digital tools appear every day brining along new trends. This section explains how to recognize these trends and their potential uses.

In the 21st century, people of the modern era found themselves in a new work environment. The social and economic networks surrounding individuals are more complicated than ever. Learning theory analysis typically examines the characteristics of social learning, where new learning methods and techniques meet, as a result of current changes, with special regard to developments in ICT. In such an increasingly rich learning space, learning how to apply new learning methods consciously and efficiently/successfully may prove to be an investment with a good return on the long run.

Physical networks (like the urban environment) and their virtual counterparts have changed our lives in two important aspects.

 ISBN: 978-1-61208-346-9

We are able to connect to and communicate with much more people than previously. This is partly the result of our accelerated lifestyle and partly of the sophisticated hierarchies organized around our multiple roles in life.

A new, virtual dimension is now attached to learning. In this respect we should note that our multiple connections are now much less restricted in time and space. In the developed world in particular, we are now able to contact anybody, anywhere, exchanging information and organizing our lives, once the technical background is available (a smart phone or a broadband Internet connection will suffice; see Figure 1.)

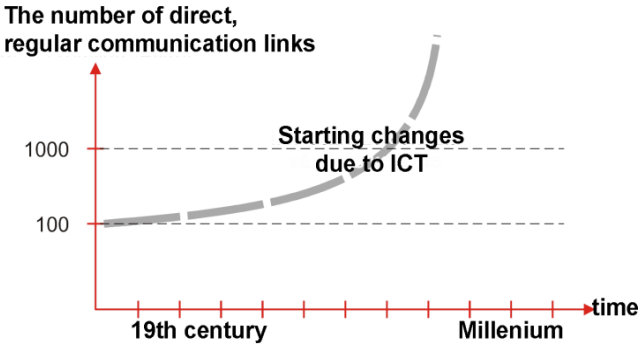

Figure 1. Changes in the system of our communication.

By now, knowledge has become a dynamic concept and acquiring knowledge a process with ever increasing spatial and temporal dimensions. On the one hand, education has diversified, corresponding to increasingly high levels; on the other hand, the time spent in education has almost doubled in the past hundred years, from 6-8 years to 12-16 years [3].

B. New Roles – Old Participants

In education, with special regard to institutionalized education, typically in schools roles (those who teach and those who learn) and participants (teachers and pupils or students) are relatively well defined. According to their age and acquired and acknowledged qualifications, teachers are formally positioned in the organization that has been created to establish the right conditions for teaching and learning. Traditional elements of the organizational structure of education, i.e. schools where the youth is educated, were founded as early as in the Ancient World and their development in the centuries to follow was slow, always paying heed to traditions.

Educational institutions perform several tasks related to preserving, transferring and updating knowledge. In addition to preserving knowledge and archiving its most valuable elements, participation in development is another important role of these institutions. It is only possible if education has a strong link with knowledge development and research, as several worthy traditions illustrate. The mission of higher education in this respect is particularly important; however, the quality of teaching and learning is also of paramount importance in primary and secondary education. In this respect, the direct and indirect, supportive presence of parents in addition to classic participants (teachers and students) is very important in the first school years, when the role of informal learning is taken over by formal education. In the period when the basics are learnt in particular, pupils, teachers and parents are the most important participants, with their roles and weight varying over time and according to specific conditions.

The progressive approach to education claims the increasing success of student oriented systems that rely on the indirect support of parents and the direct contribution from teachers [4].

Teachers, as representatives of a unique profession model and significant human factors having a strong influence on social performance, stand in the cross section of public education and higher education. This subject remains in the focus of interest, its actuality guaranteed by the interactions of profession, job and profession and the actual practice representing challenges in several fields. Continuous reforms in the teaching profession are necessitated by changes and their management and new communication tasks.

The quality of the applied educational process greatly depends on the qualification, preparedness and actual experience of teachers. Nevertheless, in the case of student centered education, the commitment, motivation and continuous learning activity of students are equally important. These factors are summarized in the table below.

TABLE I. PARTICIPANTS IN THE LEARNING PROCESS.

Most important direct and indirect participants of the learning process – ideal characteristics	
Teacher	prepared, with practical experiences, committed to education
Student	open minded, continuously active in learning, committed to fulfil learning objectives
Parents	support the learning process, also directly but mostly indirectly

C. Learning Environment

In addition to human factors, the direct environment of learning also significantly affects learning success. If we are asked about our learning environment, the answer is relatively simple. Those participating in institutionalized education usually refer to the features of their classrooms and list the tools available for them in the actual technical framework. The definition of „education tools" in Pedagogical Lexicon (Encyclopedia of Education) was phrased some 15 years ago but it still applies today. This definition offers a comprehensive, systemized approach and divides education tools into four major categories according to various criteria (physical nature of tools, their effect on sensory channels, required technical equipment and user).

 ISBN: 978-1-61208-346-9

When defining the learning environment and interpreting the related development directions, the widespread use of the Internet, this unique „public utility" and the Web 2.0 movement may be considered those changes that have had the most significant impact on modern times [5][6].

One distinct feature of the new info-communication environment is this new, *virtual learning* system, which is increasingly capable of systemizing and transferring „learning objects" and organizing communication between teachers and students/pupils.

These initiatives, also developing at institutional level, emphasis the expansion of the „space" for both teachers and students where the elements of teaching and learning that is creating interest, knowledge transfer, receiving knowledge, illustration-experience-experiment-research-practice, conclusion, systemizing may be arranged in some sort of a rigid didactic structure and organized according to pre-set algorithm. This change obviously affects teachers, too, they have to find a way to harmoniously use their various tools (traditionally in the framework of curricula and textbooks but now also the tools available in the new environment) in this expanding space, in institutionalised education in particular. In the new environment, students also occupy a specific position as they are opened to new information yet need orientation and possibilities to develop, see Figure 2.)

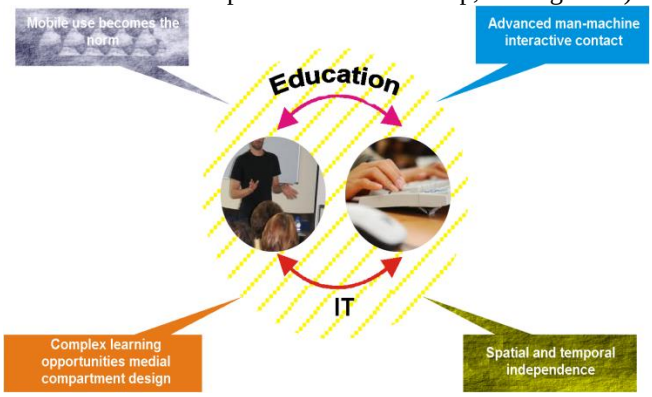

Figure 2. New features of education informatics.

As for future prospects, learning communities are expected to have an increasingly important role. These new communities are characterized by the common interest of the members above all. In these communities, learners interact, they learn together and create a shared collection of information sources.

The learning network is not just educational principle but also an environment where learning efficiently supports acquiring and continuously updating one's knowledge, using the new educational theory. Major current trends defining the interaction between education and informatics are:

- Developed forms of human-machine interaction.
- Independence in space and time.
- General use of mobile devices.
- Possibility to create complex, medial „learning environments" [7].

D. Learning Theories

There is no simple answer to the question „is there a theory for learning?" The relevant scientific papers, some based on empirical tests, some offering theoretical concepts mostly from psychology experts but also from educational scientists of course could fill volumes. Learning is discussed from several aspects, from cell biology through formal logic to organization theory, to name but a few. Human learning is one of the most complex fields, seconded by the well-known experiments on animal learning. In the present textbook we only discuss general theory though the results of animal tests are often applicable in the case of human learning .

In an educational sense, learning means acquiring or developing some ability. The knowledge thus created is defined as a change to be evaluated (in performance, behaviour or knowledge) and a product of external impact, experience or practicing [8].

Human learning being such a complex discipline, several theories have been conceived about it. Some of these concern age related learning while others to different learning levels as determined by the quality of knowledge. One of the earliest and most comprehensive general theories phrased by psychologists is behaviourism. It is related to Piaget's theory of cognitive development that emphasizes the importance of intrinsic motivation in learning. The concept states that human beings have an innate urge to see the world as coherent and stable and intellectual processes aim at creating equilibrium.

According to the traditional view, elementary learning in human beings is essentially associative. Our norms and habits have developed for millions of years by successfully or unsuccessfully associating phenomena to activities.

Indeed, the easiest way to learn is when at least two information inputs are active during the time of perception. In this case, the two processes are associated with each other in the brain.

Constructivism is a philosophic approach having a great influence at the same time on institutionalized education and learning in school. The theory states that students build up („construct") their knowledge relying among others on „learning-by-doing". This theory also emphasizes the importance of curriculum development and the important role of motivation to inspire students to acquire knowledge. The methodology of constructivism includes collecting and linking sources and the individual and group motivation of students. Constructivism offers a theoretical background for the teaching and learning of natural sciences and other educational programmes where experiments and project work are preferred.

In past decades, institutionalized education was based on the theory of cognitive learning, complying with the development of complex learning systems with diverse

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subjects and sophisticated organizational structures. The findings of cognitive psychology yielded numerous data proving the theory that learning is based on the human ability to form a mental picture of perceived phenomena and then manipulate these mental representations. Piaget's work [15] in developmental psychology also indicated the existence of well-defined stages in the cognitive development of children. The location in time and contents of these stages may vary, yet they are a general feature and their order is invariably the same for everybody [9].

Modern educational theory „passed" the slowly spreading, century-old paradigm of continuous learning with one swift step around the Millennium. Influenced by ICT, modern theorists (Downes, Siemens [16]) made a significant, impulsive turn, recognizing the role of networks while still relying on classic psychological and philosophic schools such behaviourism, cognitivism and constructivism. In the past decade, the taking up of the idea of lifelong learning both in theory and practice contributed to the successful integration of informal and non-formal education into the methodology of early development, socialization and social capital development via educational practice.

Connectivism (network based learning) has become an educational theory with a particularly significant impact providing an option for the educational exploitation of network theories, informatics and Web 2.0. According to the theory of George Siemens [16], published in 2005, connectivism is a learning theory specifically designed for the digital age. By defining the relevant terms, this theory is particularly important for the new educational paradigm as it focuses on network theory and its incorporation into knowledge management.

The modern time uptake of connectivism as a learning theory is also related to the swift in educational methods observed in progressive educational institutions with special regard to higher education institutions, where e-learning has been adapted in its entirety or in parts in the past two decades, complying with student attitudes, habits and new learning forms. Its impact may be detected in the application of electronic environments impacting an increasing number of students and with continuously diversifying functions. (This topic is discussed in detail in the last chapter of our book, Chapter VIII–The Use of Electronic Learning Environments in Education [12]). These online or Web-based learning support systems establish continuous, synchronous or asynchronous communication between the nodes of the network that is participants (teacher-student, teacher-teacher, student-student).

According connectivism, learning is a process defined by informal information exchange between nodes organized into a network and supported by electronic tools. Acquiring knowledge is a process where specific nodes are linked to sources of information. Participation in the network and access to software that promote the interpretation if information putting it into a context offers a brand new form of learning based on cooperation and self-organizing; see Figure 3.

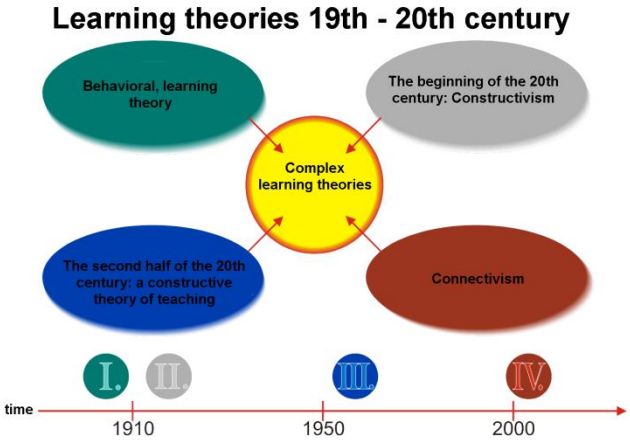

Figure 3. The system and history of complex learning theories.

Though the review in previous sections on educational theories is far from being comprehensive, it illustrates how diverse the topic is. These theories explain actual individual learning activities or the learning processes organized by institutionalized education together, sometimes slightly overlapping. The real processes become even more diversified when developmental stages are interpreted in a broader sense and the institutional framework of formal education is left behind. If we wish to use a simplified systemic approach we should conclude that modern educational theories originate in behaviorism, born more than a century ago, with constructivism catching up and showing an increasing impact with the development of institutionalized teaching and learning until cognitivism became the underlying concept of reforms in the second half of the 20th century. These days, with special regards to the years after the Millennium, the impact of connectivism has become increasingly important, specifically working through Web 2.0 and social activities and essentially defining the development of the new educational paradigm.

E. Forms and Specific Processes of Learning

It is also a useful approach to discuss learning in a less sophisticated way. How learning is incorporated into our lives? The answer claiming learning is the thing we do in school is oversimplified. It is more realistic and closer to the modern approach if we say learning is a basic human activity, which is present at each and every stage of our lives, even if to a varying extent. It is a fact that learning starts with life. The first and most important learning environment is our family. Basic skills (how to move, how to communicate) and behavioural norms are learnt in the initial stage of our lives.

It is important to note that the key to fast and successful learning is learning in a profoundly informal community. Family in childhood and groups of modern times provide such motivating and evaluating environments.

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Institutional education (nursery schools, schools) with its formal approach to learning and organized structure differs from informal learning. Though informal learning related to one's interests is also typical in adulthood, either in the framework of one' s family or group of friends, employers and other communities also offer learning options that comply with the needs of adults, known as non-formal learning.

- Forms of learning change with life or complement each other in a way that facilitates both direct and indirect learning.
- A well-defined learning strategy (such as being a student in higher education) manifests as a conscious effort made for career and success when selecting a profession or institution.

Even though technology and its social application change asynchronously, developed educational systems realized around the Millennium that the transfer of knowledge that places the individual into the focus of lifelong learning and its success may be significantly affected by educational framework systems. While traditional educational institutions have been mostly focusing on handing over knowledge, modern learning options and lifelong learning concentrate on individual abilities and the development of learning skills. The concept of lifelong learning focuses on enabling and encouraging people „to learn to learn".

- Atypical learning is not necessarily related to some educational institution neither does it presume a premade schedule timetable or exam schedule. Atypical learning does not rely on classes, lectures or seminars in the classical sense; instead learners decide themselves on how to create their own learning environment to their objectives and goals. Atypical learning is a form of lifelong learning. As adults usually work by learning and also need time for their families they cannot always attend institutional (formal) education.
- In addition to the activities of informal learning performed outside formal education (the school system), atypical learning includes all the methods that influence the intellectual and physical development of an individual (distance education, opened learning).

E-learning–is a learning process that combines traditional education distance education and the new options provided by the Internet. E-learning generally, means Internet applications that aim at communicating contents in new ways, administrating the learning process, monitoring individual learning in a way that facilitates evaluation and support and transparent operation at system level. The next figure, though only schematized, shows the varying impact of the 3 learning forms in time along the classic learning curve. We should note that any of the 3 forms may significantly contribute to acquire and update knowledge in any stage of life. As illustrated by the figure, early life is usually dominated by informal learning, followed by formal learning in the period before minimum school leaving time and while obtaining the highest school degrees. Adults typically learn in non-formal systems; see Figure 4.

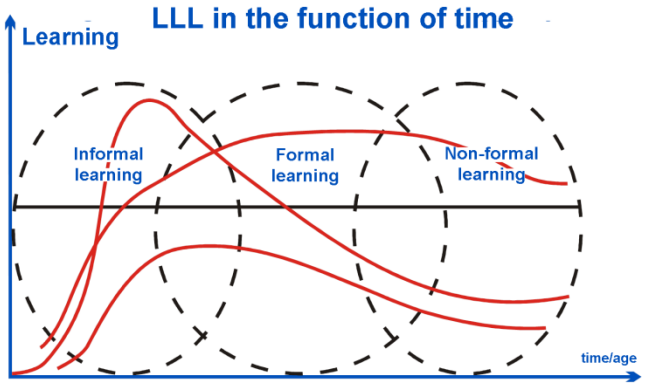

Figure 4. Lifelong learning as a function of time.

In addition to referring the nature of the learning process, we may also use the terms typical learning (learning activities related to formal education) and atypical learning. These do not relate to major teaching or learning forms in the same way. Informal learning typically presumes atypical learning while the terms typical and atypical learning may be used for both formal and non-formal education, depending on the actual activities of students. Terms referring to learning activities have a unique relevance in digital education where ICT use justifies the emphasized role of e-learning and m-learning methods. From the aspect of learning theory or learning forms, these are not more and not less than new, perspective methods that have a special relevance in modernizing education [10].

F. Learning–Time and Space

An important trend in our modern age is rising life expectancy and the increasing ratio of education and training processes within one's lifetime. People of the 21st century are expected to live 7-8 decades spending about one and a half or even two decades in formal education and returning to learning in adulthood increasingly often. In countries developing the learning environment in a broader sense and at the level of the whole society, social stability and coherence have reached a recognized high level while the state of economic development is also above the average (for example, in Northern European, Scandinavian countries). In these countries, the learning trail involves the entire life cycle of the social activities of an individual from the beginning of conscious activities till the end of social activities, all this according to a well-defined social and political strategy. This period may be as long as 60-70 years. Though we think we essentially understand this paradigm, the traditional way institutions operate and are operated is extremely hard to transform into a new educational approach that focuses on the individual. It is the task of the state to create the suitable environment for this, depending on the wide or restricted range of available tools. We should emphasise that in this respect it is not the

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magnitude of sources that matter but the approach that considers learning as an important activity in any life stage and is able to support learning by the appropriate tools.

When approaching these issues from social dimensions, we may conclude that a new generation of users committed to online trainings is being born (it may have already very well reached the growing up stage in fact). This generation is much more skilled in navigating in the info-communication space and is becoming increasingly informed and organized. Using this kind of knowledge, people may receive more information and support from each other than from any kind of institution. This is why the role of learning communities has been increasing and it is not too difficult to make projections for the future either. The new communities are essentially characterized by their members sharing the same interests. Learners can interact with each other in these communities, learning together and generating shared sources of knowledge. This newly formulating practice, however, is not incompatible with the learning possibilities offered by higher education structures currently being reformed [11][12].

G. The use of modern, digital teaching materials

One of the main characteristic of the atypical e-learning forms lies in suitable and up-to-date digital teaching materials. Our institute renewed numerous curricula related to a number of university courses to meet needs of e-learning. As a result, in 2012 and 2013 academic years Sharable Content Object Reference Model (SCORM) [1] standards-based e-learning materials were made available to students to support their learning with already familiar Moodle (Modular Object Oriented Electric Learning Environment) [4] e-learning environment. The following screenshot shows its appearance in mentioned learning environments; see Figure 5.

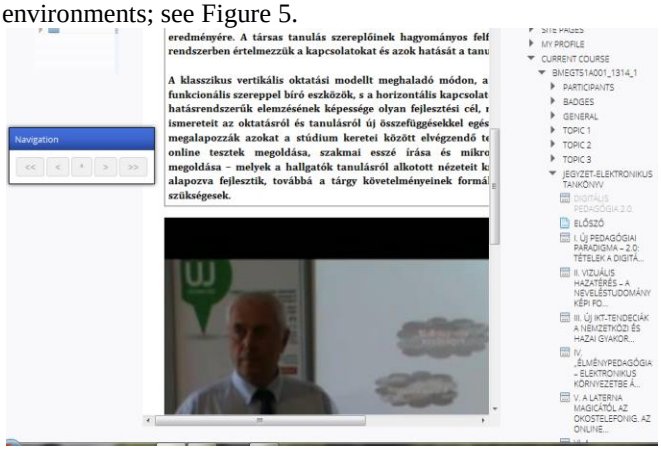

Figure 5. SCORM curriculum in a Moodle System

In autumn 2013, among students using the new curriculum, a satisfaction survey was carried using a digital micro-environment. The survey was carried out after the first semester of curriculum's introduction. The questionnaire was edited by Moodle (Modular Object Oriented Electric Learning Environment) system tools and the students were asked to send in responses using this system as well [14]; see Figure 6.

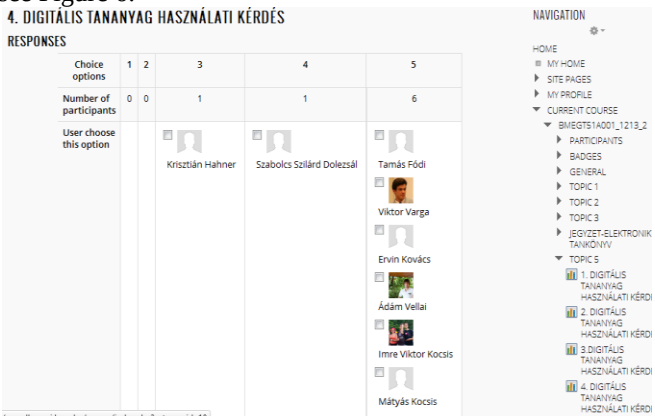

Figure 6. Student replies in Moodle System.

The survey aimed at examining the using efficiency of curriculum presented in new visual form. The survey results are shown below. About 70% of the respondents are fully or greatly satisfied with the use and professional accuracy of new developed curricula; see Figure 7.

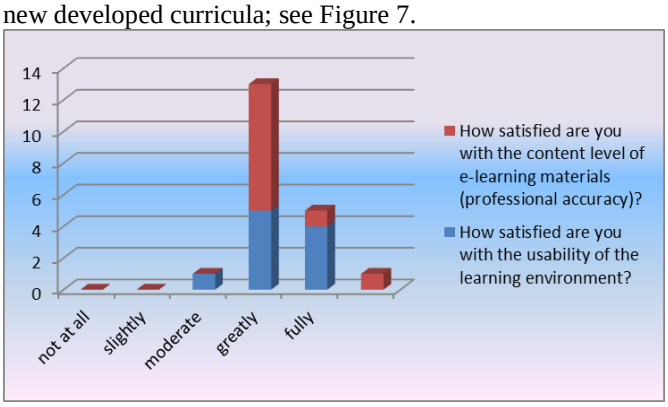

Figure 7. SCORM curriculum in Moodle System

The vast majority of responding students engaged with the curriculum 1-2 hours per day; see Figure 8.

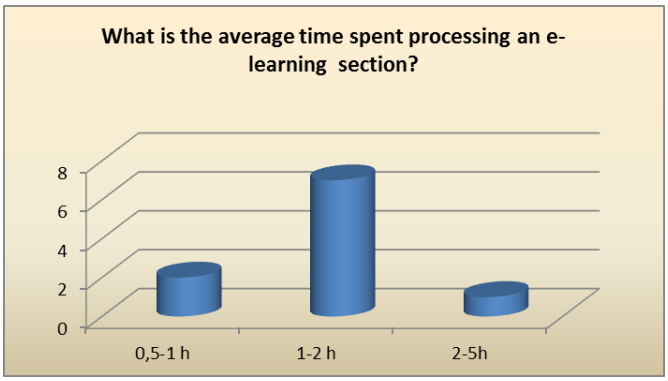

Figure 8. Student responses in Moodle System

Overall, based on the response of the students we found that they are responsive to a new type of digital teaching materials, which the same time motivates them. It is due to the functional design of media objects in teaching materials used.

III. CONCLUSION

In the framework of this paper, we place learning forms into the context of lifelong learning for students reaching the end of a long journey in the world of formal learning. We attempt to investigate why formal learning is losing its dominance and interpret the complementary role of informal and non-formal learning. We also demonstrate the learning forms and educational theories supported by virtual learning frameworks. A number of further key issues have been addressed, such as the possibilities of the rightfully demanded reform in education by means of analysing the impact of visual culture on learning combined with the analysis of the educational effects of demonstration in the context of the history of ideas. The change in approach is closely related to the new ICT application trends that generate changes almost immediately felt in expanding educational space. At the same time, the multimedia environment that can also be efficiently exploited in classroom education has a specific, efficient way to impact our individual worlds. This is what „experiential education" is about, already practiced at BME (Budapest University of Technology and Economics), and the methodology review that attractively describes the world of online language learning.

The opinions above have been of course phrased from the aspect of teachers. Although they address students, a doubt may be raised that we are biased, representing the views of „one side" only. Hence, to promote professional credibility, we close this chapter with the thoughts of a student from not so long ago that may be interesting for both students and teachers.

„… if you like learning, you will be able to get absorbed in almost any topic with the help of Web 2.0, utilizing blogs, Wikipedia and various content sharing sites. You can learn a lot from the experiences and writings of others as they followed the same track back when they were students, they wanted to learn and this way or that they acquired information they wanted. To increase the efficiency of learning, I think providing feedback to the authors is important, like for example sharing our experiences with them. If we are proficient enough in a topic and we feel like it, we can also start a blog or create a site to disseminate relevant items of information we find important so that others can exploit our knowledge. This is indeed the whole point: we should facilitate the flow of information."

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