МАТЕМАТИКА И МАТЕМАТИЧЕСКО ОБРАЗОВАНИЕ, 2011
MATHEMATICS AND EDUCATION IN MATHEMATICS, 2011
Proceedings of the Fortieth Jubilee Spring Conference
of the Union of Bulgarian Mathematicians
Borovetz, April 5–9, 2011

WEB 2.0 AND THE GLOBAL TRANSFORMATION OF EDUCATION*

Roumen Nikolov

The paper analyses the need of an institutional change of schools and universities in order to adapt to the current requirements of networked and knowledge society. The e-Learning phenomenon and the ICT driven global educational reform are analyzed as well in parallel with the needs of implementing new pedagogy models. The paper puts its attention on the Web 2.0 technologies and e-infrastructures and their impact on education and research in schools and universities. The teacher's professional qualification designed to meet the new challenges is considered as a key problem for a successful penetration of this phenomenon in the schools. It is emphasized on the importance of designing a life-long teacher training strategy adapted to the new achievements in the technology enhanced learning research and the new learning theories. Building social skills and competencies appropriate to work in a Web 2.0 based learning environment and other global social software is recommended to be included both in the school curricula and the corresponding teacher development curricula.

1. Introduction. Nowadays the schools and universities are no longer the sole and the most attractive source of information and knowledge. Quick access to unlimited sources of information is widely provided by Internet: digital and interactive TV, multimedia electronic messaging, electronic conference (asynchronous or on-line), computer-supported cooperative work systems, pay-per-view digital video programs on demand, full movies on demand, remote group computer games, generalized access to public digital libraries, topical news on demand, virtual access to real-time experiments, wikipedia, blogs, podcasts, social networks, etc. Communication is the most typical activity in a community. Computer mediated communications support the **establishment of virtual communities** formed on the basis of common topics of interest, collaborative work, or other joint activities [8]. These communities are **transnational and transcultural** and need re-conceptualization of the social life, including education.

A core assumption in education is that **learning is a social process**, rather than an individual one. Therefore, e-Learning fosters creation of learning environments where communication is easy and leads to some meaningful learning activities closely related to

*2000 Mathematics Subject Classification: 97U70, 97U80, 97B20, 97B40, 97C80.

Key words: Knowledge Society, Web 2.0, e-Infrastructure, e-Learning, e-Science, School 2.0, University 2.0, life-long learning, new media, teaching/learning strategies, information literacy.

The work on this paper has been partly sponsored by the FP7 SISTER Project.

the pre-defined educational goals. The emergence of the so called "*Web 2.0 revolution*" [23] catalyzes global transformation of the society [29]. Some new models of organizations emerged as well, such as School 2.0 [20] and University 2.0 [19, 32], etc. The paper analyses the impact of Web 2.0 and several related technologies on education and the global transformation of education.

2. The Web 2.0 Revolution. O'Reilly and his collaborators consider Web 2.0 as a synonym of a new generation web: "*The central principle behind the success of the giants born in the Web 1.0 era who have survived to lead the Web 2.0 era appears to be this, that they have embraced the power of the web to harness collective intelligence...*"[23]. Such companies are: Google, Yahoo, Amazon, eBay, Facebook, SecondLife, YouTube, etc. The 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, Facebook; Piczo); publishing one's own journals (Blogger, RSS, LiveJournal).

We can define the **School 2.0** as a *school that uses predominately Web 2.0 based educational applications and services in their educational activities.* Students can produce a new resource or edit existing ones for other students while they are learning themselves. Web 2.0 provides new opportunities for **sharing, collaboration and building online communities**. A lot of Web 2.0 school oriented portals providing access to web services and content for educational purposes in different school subjects exist, such as: Classroom 2.0 (`http://www.classroom20.com`), Schoolforge (`http://www.schoolforge.org.uk`), Edu 2.0 (`http://www.edu20.org/`), Lehrerforum (`www.lehrerforum.de`), etc. *eTwinning* (`http://www.etwinning.net`) is promoting school collaboration in Europe through the use of ICT. Currently a network of more than 120 000 schools involved in more than 4400 projects is supported by the *eTwinning* actions. The eTwinning 2.0 initiative tries to build a community of schools in Europe that collaborate, share information and resources, build communities of learners and teachers, etc [4]. The European Schoolnet (`http://www.eun.org`) is a not-for-profit consortium that provides a number of educational portals supporting teaching, learning and collaboration between the schools. It supports also a number of online communities in which teachers of common educational interest could form a **social network**, exchanging experiences and good practice and contributing to a common workspace, such as the eCLIL community among science teachers to share ideas and materials, exchange experiences and promote the use of English as a medium language [25].

The Web 2.0 technologies and tools provide **new avenues for cooperation between schools and universities** in the area of education, research and teacher training. On the way to a knowledge society in a dynamic ICT environment the universities should catalyse a process of **deep institutional change**. As Unsworth states, one of the major challenges facing the universities in the next decade is to **reinvent themselves as information organizations**. He emphasizes that the "*universities are, at their core, organizations that cultivate knowledge, seeking both to create knowledge and to preserve and convey knowledge, but they are remarkably inefficient and therefore ineffective in the way that they leverage their own information resources to advance that core activity*" [32]. The **model of University 2.0** is a framework for universities to adapt to the social computing phenomena and to the networked information economy [18, 19, 32]. The Web 2.0 virtual learning environments provide opportunities for students, teachers, profes-

sors, parents and other stakeholders to contribute to creating useful and 24/7 available educational resources. University 2.0 is a natural place, where schools and universities could establish solid bridges and **naturally integrate their activities**.

3. Other Technology Advances. The global education movement gave rise to another one, namely – **Open Educational Resources** (OER), which demonstrates great potential to overcome demographic, economic, and geographic educational boundaries and to promote life-long learning and personalised learning. For instance, **MIT OpenCourseWare** (`http://ocw.mit.edu`) is the most popular example of institutional OER model – they published about 1,800 courses which are made available to educators and learners worldwide at no cost. **OpenCourseWare Consortium** (`http://www.ocwconsortium.org/`) – a collaboration of hundreds of universities and associated organizations from around the world creating open educational content using a shared model.

A special case of OER is the **open textbook** [10]. A model of e-book based on the new technologies emerges: dynamic, interactive, regularly updated (including by users), localized, customized, remixed, etc, is being developed [14]. Open courses available on the Web can also be a **centre of communities of students and teachers.** These books and communities could be employed for **teacher professional development** in ways not possible or not easily attainable with static texts. OER and the open textbooks are very important instruments to approach the **educational gap** in the developing countries. Building **pan-European electronic libraries** is among the main priorities of the EC. A typical example of such libraries is Europeana (`http://www.europeana.eu`).

The **e-infrastructure** (cyber-infrastructure) is a **combination of hardware, software, services, personnel and organization**, which provides a wide range of services for the global research communities, such as [1]: high performance computation services; data, information and knowledge management services; observation, management and fabrication services; interfaces and visualization services; collaboration service. Such infrastructure could enable research communities and projects to rely on an effective application-specific, but interoperable, knowledge environments for research and education. New types of scientific organizations and supporting environments are emerging, e.g "*laboratories without walls*": **co-laboratory**, **grid community**, **e-science community**, and **virtual community**. E-infrastructure and virtual organizations are enabling new form of learning: **learning through interactive visualizations and simulations** [22]. There are many examples of implementation of e-infrastructure projects, such as: **Enabling Grids for E-sciencE** – EGEE (`http://www.eu-egee.org/`); **MATHEI** – a project announced by the European Mathematical Society; **nanoHUB.org** – created by the NSF-funded Network for Computational Nanotechnology – NCN (`http://nanohub.org`).

The e-infrastructures allow integration of research and learning across different levels of education – university, college, schools, professional, lifelong learning (`http://www.nsf.gov/`). Several measures and activities related to training university faculty, school teachers and students at all levels in the use of cyber-based tools (e.g., shared databases, internet portals, monitoring devices, visualization, data collection and analysis tools) to gather, depict, compare and/or reuse data to create **cyber-infrastructure-supported scientific community** facilitated by the "*marriage of research and education*" [26]. The cyber-infrastructure "*will extend beyond the walls of*

the classroom to include learner interaction data from a wide variety of information and communication technologies and media data streams. These include educational, performance, and entertainment technologies software (virtual laboratories, modeling tools, intelligent tutors, online assessments, and games), chat rooms, discussion boards, interactions with science museum exhibits, GPS-enabled cellular phones, and phone and grid conferences" [3]. For instance, in 2009 faculty at 76 universities used nanoHUB in 116 science, technology, engineering, and math classes, including all top 50 U.S. engineering schools and 88% of the top 33 physics and chemistry schools [26]. The nanoHUB is reaching students at all academic levels, and it has assumed a strong role in the education of minority and nontraditional students.

4. The Current Educational Reform. The current educational reform is driven by three major factors – **asynchronous space and time, responsive environments, and virtual reconstruction** [15]:

- *asynchronous space and time* – the ability of people, who are not synchronized in the same place at the same time, to communicate easily with each other in a variety of responsive ways. This means that the classical schools and universities would gradually loose their role of **instruments for synchronizing the learning activities** in the same place at the same time.
- *responsive environments* – customized to the learners' needs **interactive learning environments** which will help them better learn and communicate. "*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*" [15]. Downes analyses 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*" [7].
- *virtual reconstruction* – the ability to use interactive multimedia components to redesign and reconfigure the human experience of existing physical spaces without having to make physical, structural changes in buildings. The **virtual spaces could complement the physical spaces** when designing an effective, student centered, learning environment.

Technologies have made a remarkable progress since the early days of the ICT in education. The current learning 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. The students can work in a dynamic and interactive multimedia learning environment where aside from the tutor and the other students they can communicate and work with their virtual friends all over the world.

5. Virtual Learning Environments. Wilson defines a constructivist learning environment as "*a place where learners may work together and support each other as they use a variety of tools and information resources in their pursuit of learning goals and problem-solving activities*" [34]. A learning environment contains at least a learner and a place "*wherein the learner acts–using tools and devices, collecting and interpreting information, interacting perhaps with others, etc*".

When designing a Virtual Learning Environment (VLE) one could use different mental images (**metaphors**) about teaching and learning. Internet and Web gave rise of the

metaphor of *cyberspace*, i.e. an extension and a substitute for a physical environment. Dillenbourg emphasises 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*" [6]. 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*" [12]. Although there are many examples of pure VLEs, some authors argue that most of the existing VLEs do not only integrate a variety of software tools but also – all the physical tools that can be found in a classroom [6], such as:

- a variety of non-computerised 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.

We can argue that the e-Learning tends to be mostly related to designing and using VLEs. Very important role in effective use of VLEs play the **instructional designers** who should apply some appropriate learning theories when defining the learning activities.

6. Pedagogical Frameworks. Changes towards the information or knowledge society also lead to **new trends in learning**. According to Siemens these changes might induce the development of new theories of learning, such as *Connectivism*, and this may also lead to new forms of e-Learning [28]. Some of the changes observed by Siemens are:

- **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).

A future vision for VLEs is incorporated into the concept of *learning spaces,* which is build upon a learner centered educational model [24]. 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 spaces 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 (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 co-produced and shared;
- **Pleasant and emotional spaces**. ICT could make learning content more attractive (e.g. 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;
- **Knowledge management systems**: The strength of most organizations is based on their people, hence the need to share experience and knowledge amongst colleagues, within the organization, and even across organizations.
- The new feature is that the learners are considered not only as consumers of learning content but rather as **co-producers** of such content. This concept is incorporated into the Web 2.0 technologies.

In order to foster building such skills a more systemic approach to media education is needed. Dede describes the types of learning strengths, styles and preferences that the 21^{st} century students acquire in the new technology and social environment [5]:

- **Fluency in multiple media**, valuing each for the types of communication, activities, experiences, and expressions it empowers;
- **Learning based on collectively seeking, sieving, and synthesizing experiences**, rather than individually locating and absorbing information;
- Active **learning based on experience** (real and simulated) that includes frequent opportunities for reflection;
- **Expression through non-linear, associational webs of representations** rather than linear "stories";
- **Co-design of learning experiences** personalized to individual needs and preferences.

Web 2.0 technologies provide opportunities for people to develop skills, knowledge, ethical frameworks, and self-confidence through [11]:

- **Affiliations** — memberships, formal and informal, in online communities centered around various forms of media, such as Friendster, Facebook, message boards, metagaming, game clans, or MySpace);
- **Expressions** — producing new creative forms, such as digital sampling, skinning and modding, fan videomaking, fan fiction writing, zines, mash-ups);
- **Collaborative Problem-solving** — working together in teams, formal and informal to complete tasks and develop new knowledge (such as through Wikipedia, alternative reality gaming, spoiling);

• **Circulations** — Shaping the flow of media (such as podcasting, blogging).

7. Teacher Education in the Global Campus – Some Case Studies. Nowadays many universities are in a process of '*virtual reconstruction*' and go global. A **virtual university** (**virtual campus**) can be seen as "*a metaphor for the electronic, teaching, learning and research environment created by the convergence of several relatively new technologies including, but not restricted to, the Internet, World Wide Web, computer mediated communication*" [33]. The notion of "*campus*" reflects the American traditions in higher education. Turner states: "*As a kind of city in microcosm, it (the campus) has been shaped by the desire to create an ideal community, and has often been a vehicle for expressing the utopian social vision of the American imagination*" [30]. Although many universities are not "*campus universities*", all of them might afford building their virtual campus [18].

The teachers are among the main actors that are involved in process of *school re-engineering* and the corresponding educational change. Friedman has compiled a teacher oriented electronic book, which contains rich of expertise and experience papers of a number of leading-edge Web 2.0 in education practitioners [9]. He says: "*The web is, and always has been, an exciting place for education in terms of the possibilities it offers for research and collaboration. Now, it is even more exciting, with the appearance and development of new tools which have become collectively known as "Web 2.0"*.

A digital repository for teacher education is being developed under the Share.TEC Project (`http://sharetec.it.fmi.uni-sofia.bg/`). Share.TEC stands for "*Sharing Digital Resources in the Teaching Education Community*" (`http://www.share-tec.eu/`). The Share.TEC system will be an aggregation of resources. It provides access to the partners' own content and to other teacher education repositories. Share.TEC is developing an online platform which will help practitioners across Europe search for, learn about and exchange resources of various kinds, and will support the sharing of experience about the use of those resources. The system is primarily designed for teacher educators and for teachers engaged in pre-service education and continuous professional development. It will also cater for developers and publishers of digital resources for teacher education. Share.TEC is devoted to fostering a stronger digital culture in the teacher education field and to supporting the development of a Europe-wide perspective among those working in and with the teacher education community. The intended users of the system will be teacher educators, teachers engaged in self-guided learning, and developers and publishers of digital resources. Share.TEC will be adaptive to the specific needs of these users.

The TENCompetence project (`http://www.tencompetence.org/`) aims at supporting individuals, groups and organizations in Europe in lifelong competence development by establishing the most appropriate technical and organizational infrastructure, using open source standards-based, sustainable and innovative technology. The freely available infrastructure supports the creation and management of networks of individuals, teams and organizations in Europe who are actively involved in the various occupations and domains of knowledge. These '*learning networks*' will support the lifelong competency development of the participants from the basic levels of proficiency up to the highest levels of excellence. The network consists of learners, educational institutes, libraries, publishers, domain specific vendors, employers, associations, and all others who deliver services or products in the specific field. A pilot experiment for lifelong competence development in ICT-enhanced (soft) skills has been carried out [13]. It is based on the methodology

derived in this project and the training strategy developed under the project *Innovative Teacher – I*Teach* (`http://i-teach.fmi.uni-sofia.bg/`).

A virtual community model for school teachers and experts was developed under the I*Teach project. The project aimed at providing a means to support teachers in their daily work and professional development in building new knowledge and skills and to motivate and help them to collaborate, share and reuse educational resources. Among the main goals was the creation of a virtual community of teachers and experts, development of a methodology handbook, creating digital repositories and establishment of virtual training centers. Such centers have been created in five countries, including in Bulgaria [16].

An example of applying some innovative instructional strategy in a web based learning environment created in the frames of the project WebLabs, is given in [17, 27]. The WebLabs virtual environment provides the opportunity for *enhancing the scientist in the learner.* The students are involved in an international research project. They develop an understanding of mathematics as a science in which formulating hypotheses, carrying out experiments, solving open problems is its essence. The students are partners in a research process and can influence both the development of the computer environment and the design of the educational activities. They can communicate among themselves, with teachers and researchers both locally and globally. The teachers are seen as facilitators in a discovery process. 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. The existing e-infrastructure for e-science provides new opportunities for schools to get access to great number of virtual labs and **learn through interactive visualizations and simulations**.

The Sofia University internal project named *Elica* (`http://www.elica.net/`) has received a substantial international recognition among the mathematics educators. Some of the most important virtues of Elica are that an international virtual network of its users has been established [2]. Elica has been used for in-service teachers training for more than 6 years now and a virtual community of teachers using Elica in their educational practice has been established. Elica can be used as a development platform for virtual worlds implemented through intuitive and interactive virtual reality. Several courses at Sofia University are based on Elica and they are for students which will become teachers in mathematics and computer science. Being in touch with the system that is used to implement classroom software is an important factor, because several of the applications are already part of the IT textbooks for 6th and 7th grades. Nowadays Elica is used in several national and international projects.

8. Conclusions. The emergence of Schools 2.0 and the Universities 2.0 is a worldwide phenomenon. Due to the novelty of social computing, take-up in education and training is still in an experimental phase. Web 2.0 gives rise to new innovative ways of deploying social computing tools in **primary, secondary, vocational and higher education** [25]. The educators should work on a large scale of life-long learning activities for building new competency of teachers, students and all citizens of the information society. The technologies are ever changing and the new generations of Web are on the horizon – Web 3.0, Web 4.0, etc. They are related to increasing the intelligence

of the Web. A new trend is the integration of the Web technologies with the global e-infrastructure in the academic world. Having in mind the trend of integration of all existing forms of education, we might expect the ultimate result might be that **the whole world would become a Global Campus** in the next few decades [18].

REFERENCES

[1] D. Atkins et al. Revolutionizing Science and Engineering Through Cyberinfrastructure. Report of the National Science Foundation on Cyberinfrastructure, NSF, January 2003.

[2] P. Boytchev et al. IT for Innovative Educational Environments: Exploring, Authoring and Programming. Proc of ICL 2009 Conf., Sept. 23–25, 2009, Villach, Austria.

[3] CRA. Cyberinfrastructure for Education and Learning for the Future: A Vision and Research Agenda. Computing Research Association, 2005.

[4] C. Crawley, P. Gerhard, A. Gilleran, A. Joyce. eTwinning 2.0. Building the community for schools in Europe, Central Support Service for eTwinning (CSS), EC, 2010.

[5] C. Dede. Planning for "neomillennial" learning styles: Implications for investments in technology and faculty. In: Educating the net generation (Eds J. Oblinger, D. Oblinger) Boulder, CO: EDUCAUSE Publishers, 2005, 226–247.

[6] P. Dillenbourg. Virtual Learning Environments, EUN Conference 2000: "Learning in the New Millennium: Bringing New Educational Strategies for Schools". Workshop on Virtual Learning Environments, University of Geneva, 2000.

[7] S. Downes. Learning Networks in Practice. In: Emerging Technologies for Learning, V.2., BECTA, UK, 2007.

[8] J. Fernback, B. Thompson. Virtual Communities: Abort, Retry, Failure? International Communication Association, Albuquerque, New Mexico, 1995.

[9] T. Freedman (ed.) 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, 2006.

[10] J. Frydenberg, G. Matkin. Open Textbooks: Why? What? How? When?, University of California, Irvine, DLC, The William & Flora Hewlett Foundation, 2007.

[11] H. Jenkins, K. Clinton, R. Purushotma, A. J. Robinson, M. Weigel. Confronting the challenges of participatory culture: Media education for the 21st century. Chicago, IL: The MacArthur Foundation, 2006.

[12] Y. Kalay. Virtual learning environments. ITcon Vol. 9, Special Issue ICT Supported Learning in Architecture and Civil Engineering, 2004, 195–207.

[13] E. Kovatcheva, N. Nikolova, E. Stefanova. Collaborative creativity of learners and teachers – learning by e-communication. Proceedings of the 6th e-Learning Conference, Riga, Latvia, 25–27 August 2010.

[14] I. Koychev, R. Nikolov, D. Dicheva. SmartBook – the future e-book and educational hypermedia. National Conference Education in the Information Society, Plovdiv, 12–13 May 2009.

[15] R. McClintock. Power and Pedagogy: Transforming Education through Information Technology. Institute of Learning Technologies, New York, 1992.

[16] M. Miranowicz, A. Burewicz, G. Dodera, E. Stefanova, D. Ratcheva. Virtual Training Centers of the I*Teach Project – Continuous learning. Proceedings ot the 13th International Conference on Technology Support Learning & Training – Online Educa Berlin, 28–30 November 2007.

[17] Y. Mor, C. Hoyles, K. Kahn, R. Noss, G. Simpson. Thinking in Progress. Micromath Summer, 2004.
[18] R. Nikolov. The Global Campus. Avangard Print , 2009 (in Bulgarian).
[19] R. Nikolov. Towards University 2.0: A Space where Academic Education Meets Corporate Training. IPROF-09: ICT Professionalism: a Global Challenge, Arnhem, The Netherlands, February 12–15, 2009.
[20] R. Nikolov. Towards Web 2.0 Schools: Rethinking the Teachers Professional Development. In: Proceedings of IFIP-Conference on "Informatics, Mathematics and ICT: A golden triangle" (Eds D. Benzie, M. Iding), Boston, USA, June 27–29, 2007. ISBN-13: 978-0-615-14623-2.
[21] N. Nikolova, Kr. Stefanov, C. Todorova, E. Stefanova, M. Ilieva, H. Sligte, D. Hernández-Leo. TENCompetence tools and I*Teach methodology in action: development of an active web-based teachers' community. Proceeding of TENCompetence Workshop, 26–29 November 2009, Manchester, UK.
[22] NSF, Cyberinfrastructure Vision for 21st Century Discovery, National Science Foundation, Cyberinfrastructure Council, March 2007.
[23] T. O'Reilly. What Is Web 2.0: Design Patterns and Business Models for the Next Generation of Software, O'Reily Net, 2005.
[24] Y. Punie, M. Cabrera. The Future of ICT and Learning in the Knowledge Society. Report on a Joint DG JRC-DG EAC Workshop held in Seville, 20–21 October 2005, EC, DG JRC-IPTS, EUR 22218 EN, 2006.
[25] C. Redecker. Review of Learning 2.0 Practices: Study on the Impact of Web 2.0 Innovations on Education and Training in Europe, IPTS, JRC, EC, 2009.
[26] M. C. Roco, C. A. Mirkin, M. C. Hersam. Nanotechnology Research Directions for Societal Needs in 2020, Retrospective and Outlook. NSF, WTEC report, September 2010, Springer, Berlin and Boston, 2010, 610 p.
[27] E. Sendova, I. Nikolova, G. Gachev, L. Moneva. Weblabs: A Virtual laboratory for Collaborative e-learning. In: EduTech: Computer-Aided Design Meets Computer Aided Learning (Eds C. D. Kloos, A. Pardo) Kluwer, 2004, 215–221
[28] G. Siemens. Connectivism: A Learning Theory for the Digital Age. *International Journal of Instructional Technology and Distance Learning*, **2** (2005), No 1.
[29] D. Tapscott, A. Williams. Macrowikinomics. Rebooting Business and the World. Penguin Group (USA) Inc, 2010.
[30] P. Turner. Campus: An American Planning Tradition. MIT Press, 1995.
[31] UNESCO. Report on Trends and Developments in Higher Education in Europe: 1998–2003, European Centre for Higher Education, Paris, 2003.
[32] J. Unsworth. University 2.0, In: The Tower and the Cloud: Higher Education in the Age of Cloud Computing (Ed. R. Katz) 2008, pp. 227–237. Educause.
[33] G. Van Dusen. The Virtual Campus: Technology and Reform in Higher Education. ASHE-ERIC Higher Educ. Report 25, N. 5. George Washington University, 1997.
[34] B. Wilson. Metaphors for Instruction: Why we Talk about Learning Environments. *Educational Technology*, **35** (1995), No 5, 25–30.

Roumen Vassilev Nikolov
70, Cherni Vrah Blvd
1407 Sofia, Bulgaria
e-mail: nroumen@abv.bg

УЕБ 2.0 И ГЛОБАЛНАТА ТРАНСФОРМАЦИЯ НА ОБРАЗОВАНИЕТО

Румен В. Николов

Статията анализира необходимостта от институционални промени в училищата и университетите с цел да се адаптират към съвременните изисквания на обществото на знанието. Паралелно се анализират феноменът на електронното обучение, глобалната образователна реформа и необходимостта от разработването и прилагането на нови педагогически модели. В статията е поставен акцент върху Уеб 2.0 технологиите и електронните инфраструктури, както и върху тяхното влияние върху образованието и научните изследвания в училищата и университетите. Професионална квалификация на учителите, която да е проектирана така, че да отговаря на новите предизвикателства, се разглежда като ключов фактор за успешното навлизане на новите технологии в училище. Важно е да се отбележи необходимостта от разработка на стратегия за обучение на учителите през целия живот, която да отчита съвременните научни постижения в технологично-обогатеното обучение и новите теории за ученето. Препоръчва се изграждането на социални умения и компетенции, които са подходящи за работа в една Уеб 2.0 базирана учебна среда и с глобалния социален софтуер, да се включи в учебните планове и програми както на учениците, така и в курсовете за подготовка на учители.