Google Apps for Education – a powerful solution for global scientific classrooms

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Abstract

This article provides a description of possibilities provided by Google APPS for University and K-12 education. The theoretical section is written in accordance with mathematical models of learning. The practical section provide the practical guidelines for application for Google Apps for Metasystems Learning Design through concept mapping techniques and self, peer and group assessment. Advantages and disadvantages of Google Apps for Education are discussed regard to new strategy of science, math and technology competence development. The opportunities for competence knowledge based structure are provided.

Keywords: globalisation, electronic textbook, global scientific classroom

Introduction

Globalization adds new values to global educational system. The implications of globalisation for knowledge, education and learning are: the focus on abstract concepts; the use of holistic understanding; the enhancement on student's ability to manipulate symbols; the enhancement the ability of learners to access, assess, adopt, and apply knowledge, to think independently, to exercise appropriate judgment and to collaborate with others to make sense of new situations. In the Globalisated Age the research and development is a critical component that blurs the distinction between mental and physical labor. The globalisation encourages students to work in teams and to use virtual teams around the world. The academic institutions become less rigid and more flexible in their attempt to meet the varied needs of learners and the global economy. In the education and learning are used a wide range of synchronous and asynchronous activities, which break the boundaries of space and time (Kalantzis&Cope, 2006; Cogburn, 2011).

There are new learning design approached and methodologies for Globalisated Age (Cooper, 1993; Gustafson&Branch, 1997; Hakkinen, 2002; Donovan&Bransford, 2005; Edyburn et al, 2005; Eun et al, 2008; Glahn, 2009; Carr-Chellman, 2011). Metasystems learning design is one of them (Railean, 2010). The metasystem learning design idea is based on metasystems methodology (Hall, 1987). Through fostering globalisation, the scientific management is replaced by knowledge management (Koulopoulos, 2000). The knowledge management processes constitute the base for cybernetic modeling of informatizated didactic process.

Google Apps represent a suite of free email and collaborative tools for K-12, University Education, or large school districts, university consortiums, and state governments to create high-level legal agreements which allow child institutions to quickly and easily deploy Google Apps for Education.

2. Cybernetic Learning Models for Globalisated Education System

In Google Apps can be incorporated many cybernetic models of learning, for example: Social Learning Model (Bordogna&Albano, 2001), Statistical Learning Theory (Guergachi&Patry, 2002), Neo-Vygotskian sociocultural perspective (Zbiek& Conner, 2006) and others.

According to Social Learning Model the cognitive impact (CI) acting on an individual is the overall result of those interactions with his/her environment, capable of modifying his/her knowledge, and the self-elaboration of such influence. He/she can also become a source of CI to other individuals by persuading and supporting. The persuasiveness, $P_{ji} \geq 0$, describes the degree to which the ith individual can persuade the jth individual. Also, the support, S_{ij}, describe the degree to which the ith individual support the statement of the jth individual during, e.g., a discussion. The knowledge of the jth individual $\sigma_j(t)$, at time t, is defined as a dynamic variable such as $-1 \leq \sigma_j(t) \leq 1$, where $\sigma_j(t) = 1$ corresponds to optimum knowledge. In the autors point of view, the CI due to all multimedia information accessible to the jth individual ($CI^{MM}(j,t)$), is given by:

[1] $$CI^{MM}(j,t) = A(j)Q(t)(1-\sigma_j(t))$$

where $0 \leq A(j) \leq 1$ is the ability of the individual to search and locate the information in the Internet, its capacity of understand such information, to perform critical analysis and to establish relationships among correlated topics. On the other hand, CI due to social interaction through discussions ($CI^{SI}(j,t)$ is assumed to be:

[2] $$CI^{SI}(j,t) = \sum_{i=1,\ i\neq j}^{N}[P_{ij}(t)(1-\sigma_i(t)\sigma_j(t)) - S_{ij}(t)(1+\sigma_i(t)\sigma_j(t))]$$

where the first(second) terms accounts for mutual persuasiveness (support), and N is the number of individuals. S_{ij} and P_{ij} depend on the strength of psychological coupling, affinity of social and educational status, rhetorical abilities, personal skills, etc. The knowledge is considered a dynamical variable which changes as follows:

[3] $$\sigma_j(t+\Delta t) = \sigma_j(t) \pm \Delta\sigma$$

where Δt represent an interval of time, $\sigma_j(t)$ - a discrete variable and $\Delta\sigma$ - a quantum of knowledge. For this consideration $\sigma_j(t)$ may improve (or become worse) with a certain probability. Both processes have their own noise.

Guergachi and Patry (2002) describes the concept of system model identification. In the author point of view a system *S* whose state space x is a finite dimensional one can be represented by a mathematical model of the general form:

[4] $$\dot{x} = f(x,\ t,\ p)$$

where f is a mathematical function which is generally nonlinear, x is the system state vector, p is the parameter vector and t is the time. A fundamental problem in system modeling is the determination of the values of model parameters $p = \{p_1, p_2, ..., p_k\}$ such that the corresponding response of the model equation approximates as closely as possible the actual response of the physical system.

One main idea that is widely adopted for Globalisated Educational System is the concept of *zones of proximal development* (Vygotsky, 1978). Lesh& Lehrer(2003) note that student's level of understanding can be influenced by a variety of factors such as: guidance provided by an adult or peer, conceptual tools that may be available either by luck or because of interventions from an adult or approaches limited by sociocultural norms and standards that have been developed by relevant communities—such as students and teachers in classrooms. In the author point of view, the notion of a zone of proximal development needs to be expanded from a *1*-dimensional interval to an *N*-dimensional region in which a variety of paths lead to any given construct.

On the other hand, the globalisated learning system is both real and virtual. This implies a need for *Neo-Vygotskian sociocultural perspective.* Zbiek and Conner (2006) comments, that learning is a discursive activity that involves social and material resources. Mathematical modeling on learning is a non-linear process that involves elements of both a treated-as-real world and a mathematics world. The modeling process involves movement among elements such as the real-world situation, solution, a mathematical entity, and a mathematical solution. This can be done by enhancing motivation through real simulations or activities that prove the real world insight.

3. Competence based Knowledge Structure and Google Apps

According to Heller et al, 2006 the competence based knowledge structure can be represented by the knowledge of the learner in a certain domain, which is characterized by a set of assessment problems (denoted by Q). The knowledge state of an individual is identified with the set of problems the person is capable of solving. There are various possible learning paths for moving from the native knowledge state (that is an empty set Θ) to the knowledge of full mastery (set Q). Each knowledge state (except Q) has at least one immediate successor that contains the same problems, except one (set Q).

A knowledge structure in which learning is taken step by step is called *well graded*. But, what is step-by-step learning: auditive learning, visual learning, haptic learning, learning through the intellect, learning through all senses or holistic learning? Can be one student deeply involved in learning, if design of the competence based knowledge structure is based on classroom activities in learner centred environment?

In our point of view, the answer of these questions is competence based knowledge structure. The competence based knowledge structure can be developed according to EQF standards, if learning will be designed according to *Learning Metasystems Design* (LMD) approach. Metasystems approach represents an alternative paradigm to systems approach dominant in the educational technology and instructional design. The LMD is based on core integrative principles of philosophy, pedagogy, cybernetics, psychology, and knowledge management.

The competence based knowledge structure, named *savoir –vivre*, integrate *savoir-dire or savoir* (which represents „theoretical and verbal knowledge"(Minder, 2003), *savoir-faire* (which represent „learner's own strategies, methods, procedures, and techniques" (*ibidem*)) and *savoir-être* (which represents „wishes, affectivity, emotions and motivations" (*ibidem*)). Such a structure represent the main learning outcomes, which can be defined, using EQF terminology, as proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development.

The competence based knowledge structure is dynamic and flexible. The dynamicity and flexibility signifies that the structure is strictly individual and can be formed only after each individual has been deeply included in learning process. The strategy of LMD is based on the following principles: the principle of self–regulation, the principle of personalization, the principle of clarity, the principle of dynamicity and flexibility, the principle of feedback diversity and the principle of ergonomics.

Google Apps http://www.google.com/apps/intl/en/edu/ is a powerful tool to develop knowledge and social skills. It is designed for Higher Education, K-12 and large school districts. Google Apps include free email and collaborative tools, which permit to connect campus through emails, messaging, phone and video calls from a single interface. The students and the staff can share ideas, collaborate and work together. They use email, chat, voice and video calls. The activities can be planned and managed efficiently, using Google Docs and Google Calendar. The schools can publish school event calendars, plan meetings and share course schedules. Google Apps permit to connect tablets and other mobile device.

4. Google Apps for study Science, Technology, and Math

Basic Competence in Science, Technology and Math is one of EQF eight key competences. It's requiring the ability to develop and apply mathematical thinking in order to solve a range of problems in everyday situations, the ability to use mathematical modes of thought (logical and spatial thinking) and presentation (formulas, models, constructs, graphs, charts). The competence in science require the ability and willingness to use the body of knowledge and methodology employed to explain the natural world, in order to identify questions and to draw evidence-based conclusions. Competence in technology is viewed as the application of that knowledge and methodology in response to perceived human wants or needs. Competence in science and technology involves an understanding of the changes caused by human activity and responsibility as an individual citizen.

Basic competence in Science, Technology and Math is expected to be developed before the phase of the K-12 will end. So, Google Apps, designed for K-12, provide emails and tools for collaboration and working anytime and anywhere. Fast, easy collaboration is what makes Google Apps unique. This means that K-12 students can edit one document together in real - time, without attachments. Also, the students can work together in assessment projects. Self, peer and group assessment is the most used strategies for learning. As was noted by Roberts (2006) with reference to Schunk (2000) "developing self assessment strategies helps students gain control over their learning …[and] allows them to focus more effort in studying those areas where they need more time". Peer assessment refers to the process of having the learners critically reflect upon, and perhaps suggest grades for, the learning of their peers. It is important for the instructors to provide clear and concise guidelines, and for the instructor to maintain the ultimate responsibility for the final grades. Group assessment is a general term, which covers the meaning from assessment of groups as a whole, to the assessment of individuals within a group and the group members assisting other group members' contributions to the group.

Our idea is to develop a Global Scientific Collaborative Classrooms. The idea is to establish a new approach, consisting in a total redesign of the introductory University's mathematics, chemistry, physics and biology courses using collaborative learning environment. The proposed idea aims at the production of a new generation of personalised e-textbooks with stimulators, intelligent analyses of students' answers and virtual laboratories with generators of semantic based items. A real way to make this idea a reality is to join the technology of virtual learning environment and the methodology of electronic textbooks, based on LMD. There are a few uncertainties that need to be addressed. The uses of true / false and multiple-choice tests are unwelcome.

The role of global collaborative learning scientific classrooms in studding Science, Technology and Math is based on the application of a method of instructions in which students with various performance levels and culture of learning work together in small groups, towards a common goal. Proponents of collaborative learning claim that an active exchange of ideas within small groups not only increases interest among the participants but also promotes critical thinking. To archive the collaborative learning environment will be used dynamic and flexible instructional strategy.

Shared gives students an opportunity to engage in discussion, take responsibility for their own learning, and thus become critical thinkers. As result, the students became deeply involved in personal acquisition of knowledge and the learning is more efficient.

The proposed aim could be realised through the following project objectives: 1) To elaborate a new approach of learning technology of electronic textbooks based LMD; 2) To promote learning outcomes based on student – centred approach through global scientific classrooms; 3) To create a world network that will permit cooperation and collaboration with lecturers and students taking involved in natural science courses at both lyceum and university levels; 4) To provide a platform for career development, innovation and further graduated study applied in a new Europe of knowledge.

The K-12 students involved in the scientific collaborative networks are more motivated to learn science, math and technology. Instead, the scientific collaborative classrooms increase understanding in order to study the mathematics, chemistry, physics and biology. One of the main examples is "concept mapping techniques" (Railean, 2006) with affordance to represent the competence structure and to provide the level of understanding the main concepts in deeply learning.

5. Toward Metasystems Learning Design for Google Apps

Google Apps can be viewed as promoter of Learning Management Systems like Moodle is. In the case of University Learning we used Moodle for teaching the course "Methodology of Educational Software Development". During the course was observed that students need new collaborative tool for self, peer and group assessment. Moodle with traditional computer based assessment items designed to apply it in solving scientific problems no longer meet the requirements. The students need more personalised learning environments and new methods of assessment (figure 1).

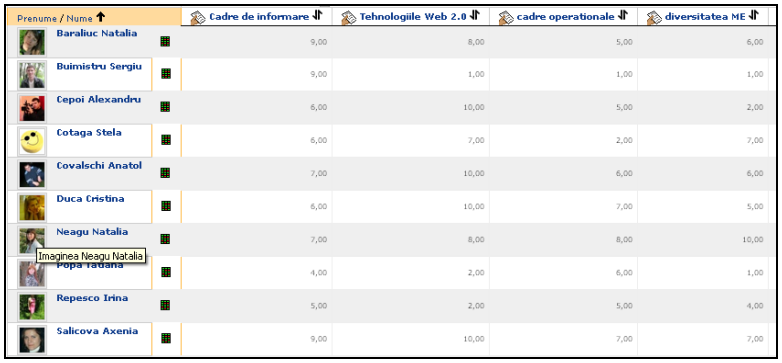

Figure 1. **The personalised learning environment**

Students need to develop competence based knowledge structure in collaborative environment and, also, to design and conduct own or group research as well as to analyse and interpret data gained from real learning objects. That is why the global environment needs for dynamic and flexible metasystems learning design.

Khan (2007) reports about well-designed, learner-centered, affordable, easily accessible, efficient, and effective flexible learning systems to meet learners' needs. They expect on-demand, anytime/anywhere high-quality learning environments with good support services. In other words, they want increased flexibility in learning—they want to have more say in what they learn, when they learn, and where and how they learn. They may choose a mix of traditional and new learning approaches and technology; they may want to study at their chosen time and location and at their

own pace. As one of the Internet tools, Google Apps distributes resources and information, making it the tool of choice for those interested in delivering instruction. Google Apps is the tool that supports flexible, collaborative, but not dynamic learning.

6. Conclusion

The concepts tested using Google Apps tools are often done in an incomplete fashion and are very sensitive to the wording used by the developers. In addition, although the use of web-based instruction appears to be quite promising, there are some dangers in using Google Apps as a testing tool. Steps should be taken to ensure the flexibility and dynamicity in learning, the student's anonymity and the reliability of information transfer. Google Apps need to be developed as powerful tool for analysing students' answers like essay, mathematic formula or stereoscopy of the chemical formula.

The other trends seem to be testing the performance taking into account the individual differences via performance, such as cognitive style, experience and culture of learning. These can be done by the way of optimization verbal and nonverbal learner – computer communications through knowledge graph. The other way is to analyse as much as possible the learning variables such as complexity, difficulty, abstraction etc.

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