



ENTERPRISE 3.0 IN ENGINEERING EDUCATION *ENTERPRISE 3.0 INŽENIERU IZGLĪTĪBĀ*

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Abstract. *Enterprise 3.0 offers potential solutions for the quality, maintenance and sustainable development of services. The synergy between Enterprise 3.0 and engineering education advances the development of innovative products, processes and services in the European economy. Aim of the research is to analyze student engineers' use of Enterprise 3.0 within engineering education. The meaning of the key concepts of Enterprise 3.0 and Enterprise 3.0 curriculum are studied. Moreover, the study demonstrates how the key concept is related to the idea of engineering education. The explorative research has been used. The sample involves 28 participants of the Sixth Baltic Summer School „Technical Informatics and Information Technology” at Kaunas Technical University, Lithuania, August 13-28, 2010. The empirical results reveal that the student engineers are able to adapt new technologies and their benefits easily. Directions of further studies are elaborated.*

Uzņēmība 3.0 piedāvā iespējamus risinājumus pakalpojumu kvalitātes un uzturēšanas ilgtspējīga attīstībā. Sinerģija starp Enterprise 3.0 un inženieru izglītību katalizē inovatīvu produktu, procesu un pakalpojumu attīstību Eiropas ekonomikā. Pētījuma mērķis ir analizēt topošo inženieru Enterprise 3.0 lietošanu inženieru izglītībā. Galveno jēdzienu, proti, Enterprise 3.0 un Uzņēmības 3.0 programma, nozīme pēta. Pētījums atklāj, kā pamatkonceptijas ir saistīti ar inženierzinātņu izglītību. Empīriskais pētījums veikts Sestajā Baltijas vasaras skolā “Tehniskā Informātika un Informācijas Tehnoloģijas” Kauņas Tehniskā universitātē, Lietuvā, 2010. gada 13.-28. augustā. Izlase ietver 28 dalībniekus. Empīriskie rezultāti liecina, ka studenti spēj pielāgoties jaunajām tehnoloģijām un to ieguvumiem. Tālāko pētījumu virzieni ir izstrādāti.

Keywords: *Enterprise 3.0 – Uzņēmība 3.0; Engineering Education – inženieru izglītība, Enterprise 3.0 curriculum – Uzņēmības 3.0 programma*

Introduction

The contemporary situation in the Baltic region, namely, the lack of working places due to structural problems, a high unemployment rate, the migration of highly qualified young people and the low rate of self-employees [4], demands on innovation as an engine of the economic development with a strong impact on sustainable development in the European Union. The development of innovative products, processes and services in the European economy is advanced by the synergy between Enterprise 3.0 and engineering education.

Aim of the research is to analyze student engineers' use of Enterprise 3.0 within engineering education.

The remaining part of this paper is structured as follows: Materials and methods are revealed in the next part of the contribution. Section 1 introduces Enterprise 3.0. Integration of Enterprise 3.0 into engineering education is described in Section 2. The associated results of an empirical study will be presented in Section 3. Finally, some concluding remarks are provided followed by a short outlook on interesting topics for further work.

Materials and methods

The analysis of student engineers' use of Enterprise 3.0 within engineering education on the pedagogical discourse involves a process of analyzing the meaning of the key concepts "Enterprise 3.0" and „Enterprise 3.0 curriculum". Moreover, the study demonstrates how the key concepts are related to the idea of "engineering education". The study presents how the steps of the process are related: defining Enterprise 3.0 → determining Enterprise 3.0 curriculum in engineering education → empirical study within a multicultural environment. The methodological foundation of the present research is formed by the System-Constructivist Theory based on Parsons's system theory [15] on any activity as a system, Luhmann's theory [9] on communication as a system, the theory of symbolic interactionism [12] and the theory of subjectivism [8]. The System-Constructivist Theory emphasizes that human being's point of view depends on the subjective aspect [10]: everyone has his/her own system of external and internal perspectives that is a complex open system [2], and experience plays the central role in a knowledge construction process [10]. Therein, the subjective aspect of human being's point of view is applicable to the present research to analyze student engineers' use of Enterprise 3.0 within engineering education.

Results and Discussion

1. Defining Enterprise 3.0

Enterprise 3.0 is defined to be an ideal organization for the 21st century to form new business functions of collaboration with the focus on information sharing within the enterprise and the eco-system partners [13].

“Organization” and “agency” are used synonymously in many publications. However, the distinctive use of these terms is emphasized by Barker [3]. Organization is a social arrangement which pursues collective goals, controls its own performance, and has a boundary separating it from its environment [19], thereby influencing or limiting the choices and opportunities that individuals possess [3] whereas agency refers to the capacity of individuals to act independently and to make their own free choices [3]. Hence, Enterprise 3.0 is an agency based on the practice of curriculum [5].

Moreover, the paradigm shift from socialization within Web 2.0 to peer contribution within Web 3.0 reveals the elements of Enterprise 3.0 determined as online networks.

Online networks as a form of peer contribution today bring a dimension to the Web that goes beyond simple links between pages; they add links between people, between communities [21] and between organizations. In such a network, direct links will typically point to our closest friends and colleagues, indirect links lead to the friends of a friend, and etc.

A network on the Web is typically the result of employing some software that is intended to focus on building an online community and, consequently, organization for a specific purpose [21]. Social networks connect people with common interests and may be as simple as a blog, or as complex as Facebook or MySpace for mostly private applications, as LinkedIn or Xing for professional applications, or as Twitter for both. The primary impact that the current Web developments are having in this area are that connecting people, communities and organizations constantly becomes easier, and it is not difficult anymore to maintain a professional or personal network of buddies worldwide. Yet another impact is that a social network may open up novel sources of revenue, in particular through advertising. Finally, Vossen [21] underlines that technology enables functionality, which as a “byproduct” leads to data collections, and users have a new tendency to socialize over the Web, by exploiting that functionality and the technology.

2. Enterprise 3.0 in Engineering Education

In education business students are traditionally concerned with business applications of Web 2.0 techniques and technologies, namely, corporate blogs, wikis, feeds and podcasts [21]. In turn, engineering students are associated with the infrastructure and functionality dimensions of Web 3.0. However, all the Web 3.0 dimensions, namely, the infrastructure dimension, the functionality dimension, the data dimension, and the social (or socialization) dimension as depicted in Figure 1, contribute to engineering students' use of Enterprise 3.0.

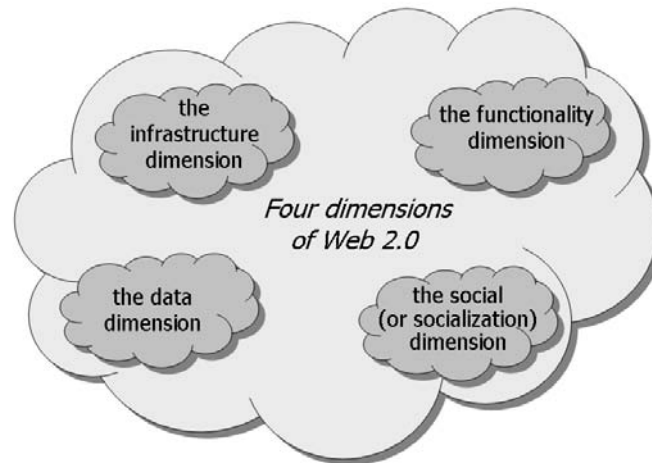


Fig.1. Four dimensions of Web 3.0

Enterprise 3.0 in engineering education focuses on a central, organizing stance regarded as curriculum [18]. The Enterprise 3.0 curriculum in engineering education comprises its aim, objectives, content and procedural aspect. Moreover, the curriculum centres on the possibilities for the co-construction and co-production of innovation, rather than on innovation as simply educator transmitted or simply engineering student created [17]. Hence, curriculum is centred on the process design [16].

Thus, the pedagogical aim of the Enterprise 3.0 curriculum in engineering education is to foster students' enterprise capability and to promote students' capability to cope with their own problems in all spheres of life in a knowledgeable and enterprising way while studying in an engineering educational institution [14]. The main objective in use of Enterprise 3.0 in engineering education is to actively involve the student engineers as prospective employees in the life of Enterprise 3.0 [18] by providing innovative opportunities and organizing student engineers' cognitive activity. The content of the Enterprise 3.0 curriculum focuses on analysis of online networks of Enterprise 3.0 technologies. A integration of Enterprise 3.0 into the central process of curriculum, namely, teaching and learning, [7] in engineering education is provided by peer-learning [23]. Use of Enterprise 3.0 is implemented gradually, namely, from teaching in Phase 1 to learning in Phase 3 through peer-learning in Phase 2 as shown in Figure 2 by Zaščerinska and Ahrens [23].

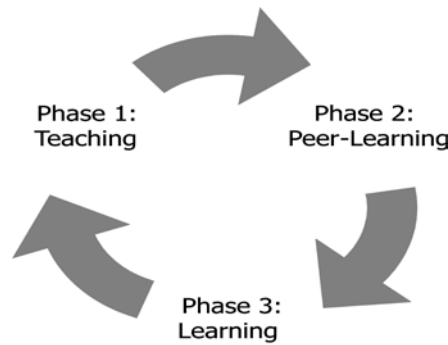


Fig.2. Phases of use of Enterprise 3.0 in engineering education

Phase 1 of the implementation of Enterprise 3.0 is aimed at a safe environment for all the students considering the essence of constructive social interaction and its organizational regulation. The present phase of use of Enterprise 3.0 is organized in a frontal way involving the students to participate.

Phase 2 of the implementation of Enterprise 3.0 is designed for the students' analysis of an open professional problem situation and their search for a solution. The present phase of use of Enterprise 3.0 involves the students to act in peers. A variety of teaching/learning techniques and/or activities with use of Enterprise 3.0 is provided by role plays, simulations, dialogues, prepared talks, discussions, and communication games and information-gap activities [22].

Phase 3 of the implementation of Enterprise 3.0 emphasizes the students' self-regulation with use of assessment of the process and self-evaluation of the results. The students present their self-evaluation by the end of each class.

Thus, student engineers' use of Enterprise 3.0 is centred on peer-learning to promote sustainable incorporation of Enterprise 3.0 into engineering education.

4. Empirical Research

4.1. Research Methodology

This study is oriented towards the revealing of effectiveness of the Enterprise 3.0 curriculum to improve the learners' use of Enterprise 3.0. Its topicality is determined by ever-increasing flow of information in which an important role is laid to Enterprise 3.0 as a means of getting information and gaining experience.

An explorative research aimed at developing hypotheses, which can be tested for generality in following studies [11] has been used in the research. The study consisted of the following stages: exploration of the context of use of Enterprise 3.0 through thorough analysis of the documents, analysis of the students' feedback regarding their needs in use of Enterprise 3.0, data processing, analysis and data interpretation, analysis of the results and elaboration of conclusions and directions of further studies.

Student engineers' needs serve as criteria of use of Enterprise 3.0 in engineering education. Need is defined by the reasons for which the student is learning, which will vary from study purposes such as following a course in Enterprise 3.0 to work purposes such as participating in business and/or working in an enterprise that are the starting points which determine the content to be taught [6].

Analysis of the students' feedback regarding their needs in Enterprise 3.0 was based on the following questionnaire: Question 1: Do you know the concept of Enterprise 3.0? Question 2: Do you use Enterprise 3.0 for your individual purposes? Question 3: Do you use Enterprise 3.0 for your organizational purposes? Question 4: Do you use Enterprise 3.0 for your professional purposes? Question 5: Do you participate in activities for your professional development, namely, education, in-service training and/or learning, in use of Enterprise 3.0?

The evaluation scale of five levels for each question is given where “1” means “disagree” and low level of experience in use of Enterprise 3.0 technologies and “5” points out “agree” and high level of use of Enterprise 3.0 technologies.

It should be mentioned that the emphasis of the System-Constructivist Theory on the subjective aspect of human being’s point of view and experience that plays the central role in a knowledge construction process does not allow analyzing students’ needs in Enterprise 3.0 objectively: human beings do not always realize their experience and their wants in use of Enterprise 3.0.

4.2 Respondents of the Research

The present empirical study conducted during the implementation of the Enterprise 3.0 curriculum in the Web 2.0 module within Sixth Baltic Summer School *Technical Informatics and Information Technology* at Kaunas Technical University, Kaunas, Lithuania, August 13-28, 2010 involves the sample of 28 participants.

All 28 participants of Sixth Baltic Summer School *Technical Informatics and Information Technology* have got Bachelor or Master Degree in different fields of Computer Sciences and working experience in different fields. The International Summer School offers special courses to support the internationalization of education and the cooperation among the universities of the Baltic Sea Region. The aims of Baltic Summer Schools *Technical Informatics and Information Technology* are determined as preparation for international Master and Ph.D. programmes in Germany, further specialization in computer science and information technology and learning in a simulated environment. Baltic Summer School *Technical Informatics and Information Technology* does not contain a special module on Enterprise 3.0. The Summer School *Technical Informatics and Information Technology* contains a special module on Web 2.0.

The Web 2.0 module examines the advantages and problems of this technology, namely, architecture and management, protocol design, and programming, which makes new social communication forms possible. The Web 2.0 module does not reveal the concept of Enterprise 3.0. However, the Web 2.0 module comprises Enterprise 3.0 technologies, namely, online networks.

The 28 participants of Sixth Baltic Summer School *Technical Informatics and Information Technology* are with different cultural backgrounds and with diverse educational approaches from different countries, namely, Latvia, Lithuania, Estonia, Russia, Great Britain, China, India, Nigeria, Romania and Mexico. Whereas cultural similarity aids mutual understanding between people [20], the students’ different cultural and educational backgrounds contribute to successful learning and become an instrument of bringing the students together more closely under certain conditions, namely, appropriate materials, teaching/learning methods and forms, motivation and friendly positioning of the educator [1]. The group of 28 participants of the Sixth Baltic Summer School *Technical Informatics and Information Technology* is multicultural.

4.3 Findings of the Research

Between the pre- and post-survey of the participants’ use of Enterprise 3.0 the Enterprise 3.0 curriculum was implemented in the Web 2.0 module within [the](#) Sixth Baltic Summer School *Technical Informatics and Information Technology*.

After having implemented the Enterprise 3.0 curriculum, the results of two surveys of the participants’ experience in use of Enterprise 3.0 within the Sixth Baltic Summer School 2010 demonstrate the positive changes in comparison with the pre-survey:

- the level of the participants' experience in terms of knowledge of the concept of Enterprise 3.0 has been enriched,
- the level of the participants' experience in terms of use of Enterprise 3.0 for individual needs, for organizational and professional needs increased and
- the level of the participants' experience in terms of participation in activities for professional development, namely, education, in-service training and/or learning, in use of Enterprise 3.0 has been improved.

The *Mean* results of the descriptive statistics highlighted in Table 1 demonstrate that the level of the students' use of Enterprise 3.0 has increased in the post-survey (3,28) in comparison with the pre-survey (1,68).

Table 1.

Mean analysis of the pre- and post-surveys carried out with the participants of the Baltic Summer School 2010

Question	Pre-survey	Post-survey
1	1,86	3,25
2	1,75	3,44
3	1,54	3,33
4	1,57	3,16
5	1,68	3,21
Total	1,68	3,28

The comparison of the *Standard Deviation* (Std. Deviation) results as shown in Table 2 reveals that the scores of the post-survey are spread wider than the scores in the pre-survey.

Table 2.

Standard Deviation analysis of the pre- and post-surveys carried out with the participants of the Baltic Summer School 2010

Question	Pre-survey	Post-survey
1	1,85	2,35
2	1,14	2,40
3	1,99	2,39
4	1,57	2,19
5	1,96	2,31
mean	1,70	2,33

Hence, the results of *Mean* and *Standard Deviation* within the surveys of the students' feedback regarding their needs in Enterprise 3.0 reveal that most of answers are concentrated around Level 2 and 3. Thus, there is a possibility to increase the engineering students' use of Enterprise 3.0 within Web technologies.

Conclusions

The findings of the research allow drawing the conclusions that the Enterprise 3.0 curriculum is effective to contribute to the students' use of Enterprise 3.0 in engineering education. Hence, the Enterprise 3.0 curriculum for the development of students' use of Enterprise 3.0 influences and determines the students' success or failure for acquiring tertiary engineering education and profession as illustrated in Figure 3.

Thus, it might be stressed that the Enterprise 3.0 curriculum is efficient if it provides student's learning outcomes:

- if the development of students' experience in use of Enterprise 3.0 is supported by the Enterprise 3.0 curriculum centred on peer-learning, students better attain learning outcomes, and
- if students' needs are met and a support system is created that would secure their learning outcomes, students demonstrate better results.

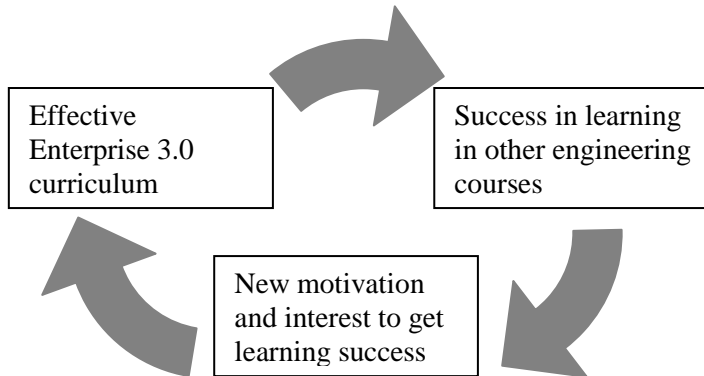


Fig.3. Successful use of the Enterprise 3.0 curriculum for the development of engineering students' use of Enterprise 3.0

The present research has *limitations*. Use of Enterprise 3.0 in the Sixth Baltic Summer School was studied paying attention to the students' feedback regarding their needs. Another limitation is the empirical study conducted by involving the master students of one tertiary institution. Therein, the results of the study cannot be representative for the whole area. As well as the empirical study outlines the opportunities of the development of students' use of Enterprise 3.0. Nevertheless, the results of the research, namely, the Enterprise 3.0 curriculum and the explorative research, may be used as a basis of the development of students' use of Enterprise 3.0 at master level of other tertiary institutions. Moreover, if the results of other Baltic Summer Schools had been available for analysis, different results could have been attained. There is a possibility to continue the study.

Enterprise 3.0 demonstrated the technology of online networks to assemble and manage large communities with a common interest in peer contribution, where organisations and enterprises have made use of the potential of Web 3.0 with single solutions such as online networks. However, Enterprise 4.0 will be derived from the full application of Web 4.0 concepts such as ambient intelligence, WebOS or Web operating system, artificial intelligence, rather than Web 3.0 point solutions. This remains as an open point for the future as depicted in Figure 4.

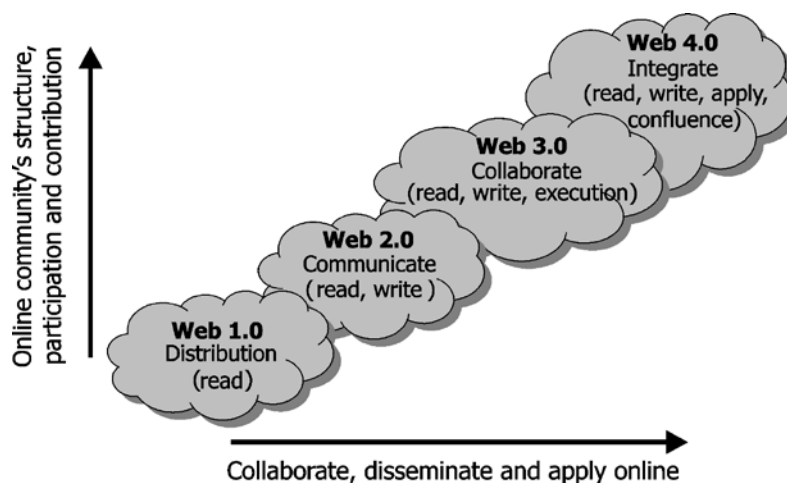


Fig.4. Web 3.0 and beyond

It should be mentioned that the concept of a Web operating system or WebOS is distinct from Internet operating systems. Web operating system or WebOS is independent of the traditional individual computer operating system.

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