ENTERPRISE 2.0 IN ENGINEERING AND BUSINESS EDUCATION: ENGINEERING AND BUSINESS STUDENTS' VIEW

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Abstract. Contemporary engineers and entrepreneurs need to become more cognizant and responsive to the emerging needs of the market for engineering, enterprise and technology services. Enterprise 2.0 which penetrates our society more thoroughly with the availability of broadband services has the potential to contribute decisively to the sustainable development of engineering and business education. Aim of the following paper is to analyze student engineers' and entrepreneurs' view on Enterprise 2.0 of Web 2.0 technologies within engineering and business education. The meaning of the key concept of *Enterprise 2.0* is studied. Moreover, the study demonstrates how the key concept is related to the idea of *engineering and business education.* Finally, the study presents how the steps of the process are related: determining *Enterprise 2.0* → revealing Enterprise 2.0 within engineering and business education → empirical study within a multicultural environment.
The present empirical research was conducted during the implementation of Bachelor's programmes at the Faculty of Engineering and at the Faculty of Business of Wismar University, University of Technology, Business and Design, Germany and during the implementation of Fifth Baltic Summer School *Technical Informatics and Information Technology* at the Institute of Computer Science of the Tartu University, August 7-22, 2009, Tartu, Estonia. The results of the empirical study reveal that the student engineers' and entrepreneurs' view on use of Enterprise 2.0 for individual, organizational and professional purposes is heterogeneous. However as shown by the Fifth Baltic Summer School, students are able to adapt new technologies and their benefits easily, which leads to new ways of socializing.
The findings of the research allow drawing the conclusions that the student engineers' and entrepreneurs' view on Enterprise 2.0 in engineering and business education is a condition for successful use of Enterprise 2.0 in acquiring engineer's and entrepreneur's profession.

Keywords: *Enterprise 2.0 for individual, organizational and professional purposes, Engineering and Business Education*

1. Introduction

The primary target for software, namely, service (Vossen, 2009, p. 38), is enterprise. Enterprises benefit from Web 2.0 where the increased data exchange within the system is no longer a limiting parameter with the current developments in the infrastructure. All dimensions of Web 2.0, namely, the infrastructure dimension, the functionality dimension, the data dimension, and the social (or socialization) dimension

are on their path into the enterprise (Vossen, 2009, p. 33, 38). Typical Enterprise 2.0 of Web 2.0 techniques and technologies include "social software", namely, Skype, the eBay seller evaluation, the Amazon recommendation service, or Wikipedia, etc., and online social networks, namely, a blog, or Facebook or MySpace for mostly private applications, LinkedIn or Xing for professional applications, or as Twitter for both (Vossen, 2009, p. 37) and have found widespread acceptance in the community.

Aim of the following paper is to analyze student engineers' and student entrepreneurs' view on needs in Enterprise 2.0 technologies within engineering and business education on the pedagogical discourse. The meaning of the key concepts of *Enterprise 2.0* and *needs analysis* is studied. Moreover, the study demonstrates how the key concepts are related to the idea of *education* and shows a potential model for development, indicating how the steps of the process are related following a logical chain: determining *enterprise* → revealing *Enterprise 2.0* in education→ defining *needs analysis* → carrying out an empirical study within a multicultural environment.

The methodological foundation of the present research on the student engineers' and student entrepreneurs' view on needs in Enterprise 2.0 within engineering and business education is formed by the System-Constructivist Theory based on Parson's system theory (Parson, 1976, pp. 9-30) where any activity is a system, Luhmann's theory (Luhmann, 1988, pp. 1-14) which emphasizes communication as a system, the theory of symbolic interactionalism (Mead, 1973; Goffman, 2008) and the theory of subjectivism (Groeben, 1986). The application of this approach to learning introduced by Reich (Reich, 2005) emphasizes that human being's point of view depends on the subjective aspect (Maslo, 2007, p. 43): everyone has his/her own system of external and internal perspectives (Figure 1) that is a complex open system (Rudzinska, 2008, p. 366), and experience plays the central role in a construction process (Maslo, 2007, p. 39). Therein, the subjective aspect of human being's point of view is applicable to the present research on the students' needs in Enterprise 2.0 within engineering and business education.

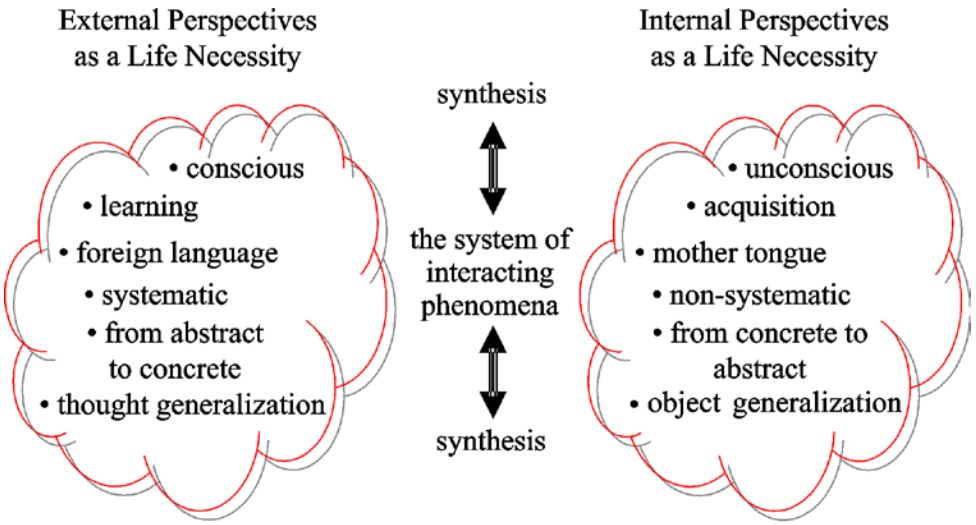

Figure 1. Developing the System of External and Internal Perspectives

The remaining part of this paper is organized as follows: Section 2 introduces enterprise. Enterprise 2.0 in education is studied in Section 3. The associated results of an empirical study will be presented in Section 4. Finally, some concluding remarks are provided in Section 5, followed by a short outlook on interesting topics for further work.

2. Defining Enterprise

Oganisjana and Koke (Oganisjana, Koke, 2008, p. 224) point out that "entrepreneurship" and "enterprise" are used synonymously in many publications. However, the distinctive use of these terms is emphasized by Kearney (Kearney, 1999, p. 36).

- Entrepreneurship mainly concerns business and commerce: entrepreneurship defined as an individual's ability to turn ideas into action includes creativity, innovation and risk taking, as well as the ability to plan and manage projects in order to achieve objectives (Commission of the European Communities, 2006, p. 4). This supports everyone in day-to-day life at home and in society, makes employees more aware of the context of their work and better able to seize opportunities, and

provides a foundation for entrepreneurs establishing a social or commercial activity (Commission of the European Communities, 2006, p. 4).

- Enterprise defined as an individual's complex capability to identify, generate and realize new socially valuable opportunities in the personal, professional, cultural, economic and other contexts of the social life (Oganisjana, Koke, 2008, p. 225), is considered in a broader social context than within business framework only, namely, to run a club, to make a film, to run a household or to run a good classroom or to help oneself and others. Moreover, enterprise is fostered to work in favour but not to the damage to the society (Oganisjana, Koke, 2008, p. 225).

The inter-connections between enterprise and entrepreneurship reveal that the term *enterprise* involves *entrepreneurship* as highlighted in Figure 2. Thus, every student including students in engineering and business education is involved with enterprise.

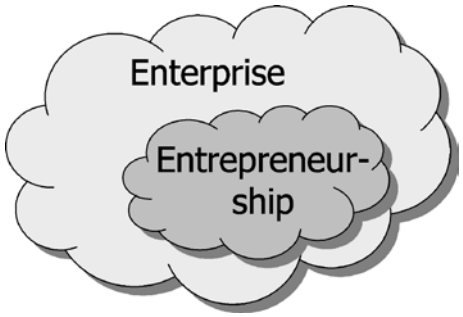

Figure 2: The relationships between enterprise and entrepreneurship

3. Enterprise 2.0 in Engineering and Business Education

The paradigm shift from the entrepreneur's personality (Oganisjana, Koke, 2008, p. 221-222) to the enterprising process employs a broad usage of Web 2.0 techniques and tools within an enterprise, paired with an increased exploitation of services offered over the Web and with leaving more room for the individual and its preferences, that has led to the term *Enterprise 2.0* (Vossen, 2009, p. 38). In other words, enterprises as well as software vendors are exploiting it by integrating Web 2.0 features into their software, processes, and work environments (Vossen, 2009, p. 38).

Traditionally, business students are concerned with business applications of Web 2.0 techniques and technologies, namely, corporate blogs, wikis, feeds and podcasts (Vossen, 2009, p. 38). In turn, engineering students are associated with the infrastructure and functionality dimensions of Web 2.0. However, the employed approach of the present paper, namely, Web 2.0 on the path into the enterprise (Vossen, 2009, p. 38) in a broader social context than within business framework only, reveals all the Web 2.0 dimensions, namely, the infrastructure dimension, the functionality dimension, the data dimension, and the social (or socialization) dimension, to be contributing to engineering and business students' enterprise.

The change in specialist entering the service area, namely, not working permanently at a large-scale enterprise but accepting project-related orders of large-scale enterprises by free engineers' and entrepreneurs' office (Bassus, Wolfgramm, 2009, p. 38) emphasizes the main pedagogical task that is not only about educating economically versed people able to work business miracles, but as well about promoting students' self-confidence and capability to cope with their own problems in all spheres of life in a knowledgeable and enterprising way, fostering students' enterprise capability instead of entrepreneurship only while studying in different educational institutions (Oganisjana, Koke, 2008, p. 225).

Integration of Enterprise 2.0 into the processes and environments of engineering and business education has the potential to contribute decisively to the needs of student engineers and student entrepreneurs to become more cognizant and more responsive to the emerging needs of the market for engineering, enterprise and technology services. The search for the integration of Enterprise 2.0 of Web 2.0 techniques and technologies into engineering and business education emphasizes that the software programmes following the traditional stimulus-response model based on behaviourism, lead to the computers' misuse (Trageton, 2010, p. 18). Hence, a proper integration of Enterprise 2.0 into engineering and business education is provided by needs analysis. However, 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

construction process does not allow analyzing the students' needs objectively: human beings do not always realize their experience and their wants (Maslo, 2007, p. 38).
In accordance with the research methodology, namely, developing the system of the external and internal perspectives, needs analysis is revealed to be of three levels, namely, individual needs, organizational needs and professional needs. Regular analysis of students' needs becomes a means of development of students' use of Enterprise 2.0 (Lūka, 2008, p. 7). Thus, needs analysis has the potential to bridge the gap between the student engineers' and entrepreneurs' needs in Enterprise 2.0 and in use of Enterprise 2.0 (Oganisjana, Koke, 2008, p. 225).

4. Empirical Results

This study is oriented towards the revealing of the student engineers' and entrepreneurs' view on the use of Enterprise 2.0 for individual, organizational and professional purposes in engineering and business education.
The present empirical study involves four independent samples, namely,

- 22 participants of Fifth Baltic Summer School *Technical Informatics and Information Technology* at the Institute of Computer Science of the Tartu University, August 7-22, 2009, Tartu, Estonia,
- 40 bachelor students at the Department of Electrical Engineering and Computer Science of the Faculty of Engineering of Wismar University, University of Technology, Business and Design, Germany,
- 22 bachelor students in Business Law at the Faculty of Business of Wismar University, University of Technology, Business and Design, Germany and
- 110 bachelor students in Business Management at the Faculty of Business of Wismar University, University of Technology, Business and Design, Germany.

All 22 participants of Fifth 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 the Baltic Summer Schools *Technical Informatics and Information Technology* are determined as preparation for international Master and Ph.D. programs in Germany, further specialization in computer science and information technology and learning in a simulated environment.
The Summer School *Technical Informatics and Information Technology* contains a special module on Web 2.0 where Enterprise 2.0 is part. The module on Web 2.0 examines the advantages and problems of this technology, namely, architecture and management, protocol design, and programming, which makes new social communication forms possible.
The 22 participants of Fifth Baltic Summer School *Technical Informatics and Information Technology* at University of Tartu Institute of Computer Science are with different cultural and upbringing backgrounds and with diverse educational approaches from different countries, namely, Latvia, Lithuania, Estonia, Russia, Great Britain, China, India, Nigeria, Romanian and Mexico. Whereas cultural similarity aids mutual understanding between people (A. Leontiev quoted by Robbins, 2007, p. 55), 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 (Abasheva, 2010, p. 431).
Then, 40 students at the Department of Electrical Engineering and Computer Science at the Faculty of Engineering of Wismar University, University of Technology, Business and Design were taken into consideration at the beginning of the seventh semester in the fourth year of their bachelor studies. The students have not got any or few work experience. The seventh semester of the Bachelor's program for Electrical Engineering and Computer Science at the Faculty of Engineering of Wismar University does not contain a special module on Web 2.0.
Finally, 22 bachelor students in Business Law and 110 bachelor students in Business Management at the Faculty of Business of Wismar University, University of Technology, Business and Design, Germany were taken into consideration at the beginning of the second semester in the first year of their bachelor studies. The bachelor students have not got any or few work experience. The second semester of the Bachelor's program in Business Law and Management at the Faculty of Business of Wismar University does not contain a special module on Web 2.0

An explorative research has been used in the research (Tashakkori, Teddlie, 2003; Mayring, Huber and Gurtler, 2004). The study consisted of the following stages: exploration of the contexts in use of Web 2.0 through thorough analysis of the documents, analysis of the students' feedback regarding their needs, data processing, analysis and data interpretation (Kogler, 2007) and analysis of the results and elaboration of conclusions and hypothesis for further studies.

The view of student engineers' and student entrepreneurs' as prospective specialists on needs in Web 2.0 within engineering and business education is particularly important. Their view on needs in Web 2.0 within engineering and business education is considered through needs analysis. Needs of three levels, namely, individual needs, organizational needs and professional needs, are analyzed. Moreover, needs analysis serves as a basis for designing the following questionnaire (Surikova, 2007, p. 389):

- Question 1: Do you know the word *Web 2.0*?
- Question 2: Do you know the basic idea of Web 2.0?
- Question 3: Have you already used Web 2.0, namely, Facebook, Twitter, Wikipedia, etc?
- Question 4: Do you think Web 2.0 requires a lot of profound knowledge, namely, math, physics, etc?
- Question 5: Do you think Web 2.0 is useful for your individual needs?
- Question 6: Do you think Web 2.0 is useful for your organizational use?
- Question 7: Do you think Web 2.0 is useful for your professional use?

The evaluation scale of five levels for each question is given where "1" means "disagree" and low level of experience in use of Enterprise 2.0 technologies and "5" points out "agree" and high level of use of Enterprise 2.0 technologies.

The analysis of the surveys, as depicted in Figures 3-6, carried out with four independent samples, namely, 22 participants of Fifth Baltic Summer School, 40 student engineers, 22 bachelor students in Business Law and 110 bachelor students in Business Management, shows that the students' view on the use of Enterprise 2.0 for individual, organizational and professional purposes is heterogeneous as well as the student engineers and student entrepreneurs don't know the possibilities offered by Web 2.0 properly.

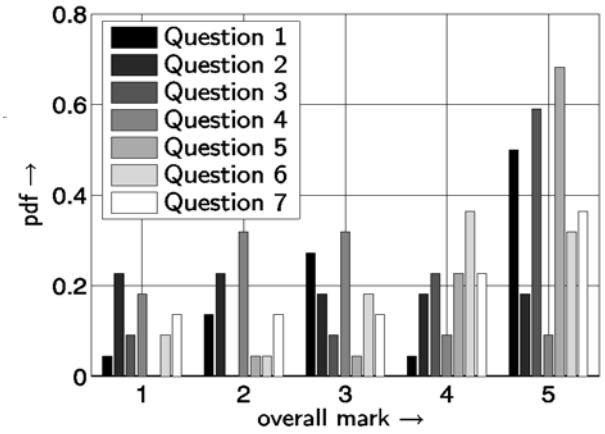

Figure 3: PDF (probability density function) of the BaSoTi participants' evaluation on August 7, 2009

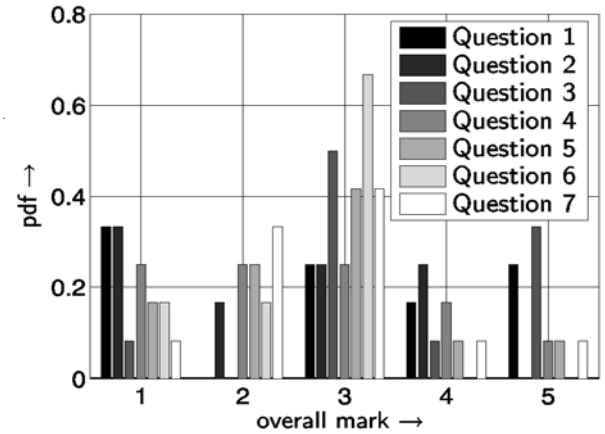

Figure 4: PDF (probability density function) of the university student engineers' evaluation in September

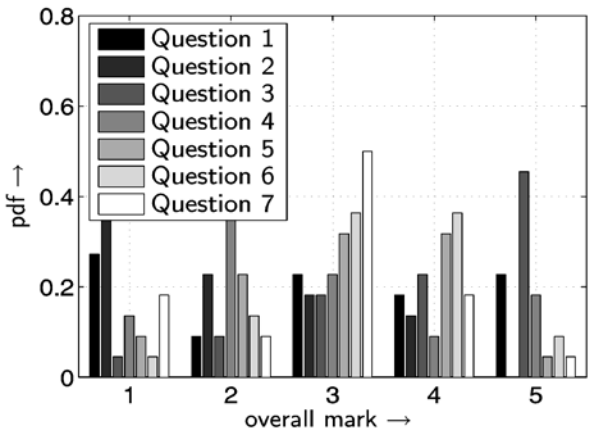

Figure 5: PDF (probability density function) of the university Business Law Bachelor students' evaluation in April 2010

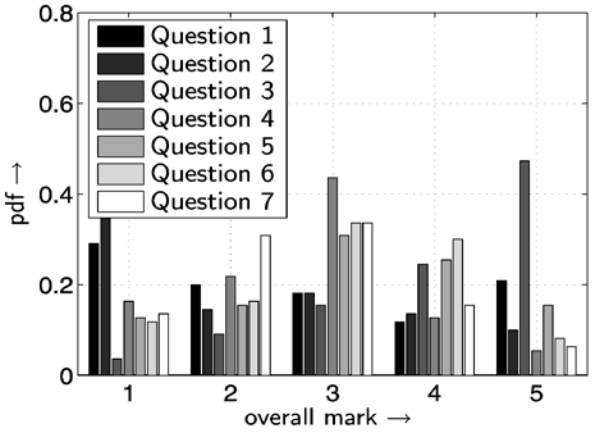

Figure 6: PDF (probability density function) of the university Business Management Bachelor students' evaluation in April 2010

However, with the appropriate courses as shown by the BASOTI students, they are able to absorb the possibilities of the new technology easily.

Between Survey 1 and 2 of the participants' experience in use of Web 2.0 within the Baltic Summer School *Technical Informatics and Information Technology* teaching/learning activity involved courses in Technical Informatics and Information Technology (German and English), preconference tutorials for introduction into advanced research topics, attendance of conference *Advanced Topics in Telecommunication*, tutorials and practical tasks, language training for talk and presentation (optional in English or German), leisure activities and social contacts as well as practical work at IT Company.

Then, the analysis of the second survey (Figure 7) carried out within the Baltic Summer School *Technical Informatics and Information Technology* on August 11, 2009 reveals that the participants' experience in use of Web 2.0 has become homogeneous, and the participants have put the emphasis on use of Web 2.0 for professional needs.

After having implemented a variety of methods and forms of teaching/learning activity (Zaščerinska, 2009) the result summary of two surveys of the participants' experience within the Baltic Summer School 2009 demonstrates the positive changes in comparison with Survey 1: the level of the participants' experience in terms of use of Web 2.0 has been enriched; the level of the participants' experience in terms of knowledge of basic idea of Web 2.0 has been improved; the level of the participants' experience in terms of use of Web 2.0 for individual needs decreased, thereby developing the system of the external and internal perspectives; the level of the participants' experience in terms of use of Web 2.0 for organizational and professional needs increased, thereby developing the system of external and internal perspectives (Figure 1).

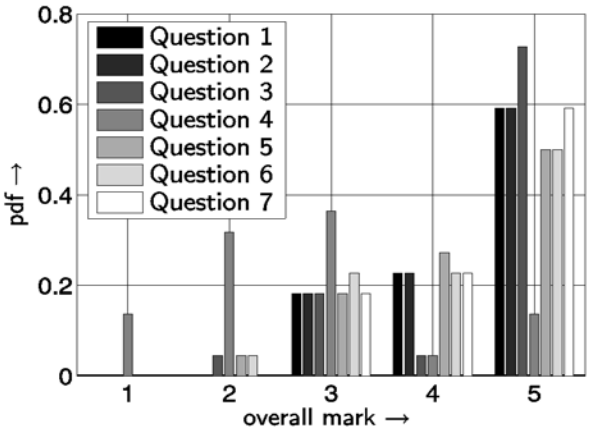

Figure 7: PDF (probability density function) of the second BaSoTi participants' evaluation on August 11, 2009

Thus, the results' comparison of Survey 1 and Survey 2 of the participants' experience in use of Web 2.0 emphasizes the decrease of the participants' number who have obtained the low and critical level of experience and the increase of the participants' number who have achieved the average and optimal level of experience revealed by the levels of the participants' experience in use of Web 2.0.

5. Conclusions for Education

The findings of the research allow drawing the conclusions that the student engineers' and entrepreneurs' view on Enterprise 2.0 in engineering and business education is a condition for successful use of Enterprise 2.0 in acquiring engineer's and entrepreneur's profession. The results of the empirical study within a multicultural environment reveal that the student engineers' and entrepreneurs' view on use of Enterprise 2.0 for individual, organizational and professional purposes is heterogeneous. However as shown by the Fifth Baltic Summer School, students are able to adapt new technologies and their benefits easily, which leads to new ways of socializing.

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 construction process does not allow analyzing student engineers' and student entrepreneurs' needs in Enterprise 2.0 objectively: human beings do not always realize their experience and their wants in Enterprise 2.0. The recommendation here is the role of educators in engineering and business education at tertiary level as mentors for student engineer's and student entrepreneur's self-discovery and self-realization; to motivate student engineers and student entrepreneurs, to stimulate their interests, to help them to develop their own structure and style, as well as to help them to evaluate their performance and be able to apply these findings (Maslo, 2007, p. 45) to improve their futher use of Enterprise 2.0.

The research results could be particularly useful for the educators in engineering and business education at tertiary level who enable new specialists to act in a multicultural environment. The paradigm shift from focusing on macro-cultures to micro-cultures (family culture, school culture, class culture, professional culture, gender culture, culture of interest groups, political groups/parties, generation) leads to a new perspective: people behave being influenced by identification with different groups, not only one group (Dirba, 2007, p. 102-103). Thus, all groups/classes are understood to be multicultural (Dirba, 2007, p. 103).

The present research has *limitations*. Use of Web 2.0 was studied paying attention to the students' expressions regarding use of Web 2.0 in the Baltic Summer School, but it was studied in isolation from the work of other educators and their contribution. Another limitation is the length of the research. The results of the seventh and second semesters were analyzed but the full length of the Bachelor programmes in engineering and business education is eight semesters. If the results of the other semesters had been available for analysis, different results could have been attained. There is a possibility to continue the study.

The following hypothesis for further studies is put forth: in order to develop the students' view on Enterprise 2.0 in education it is necessary to promote engineering and business students' use of Enterprise

2.0 for organizational and professional purposes, as well as to create a favourable learning environment which supports learners' needs and provides successful use of Enterprise 2.0 in multicultural environment.

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