E-BUSINESS APPLICATIONS IN ENGINEERING EDUCATION

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Abstract: Contemporary engineers need to become more cognizant and more responsive to the emerging needs of the market for engineering and technology services. Engineering education has the potential to contribute decisively to the sustainable development of e-business applications or enterprise 2.0, which penetrate our society more thoroughly with the availability of broadband services. However, the success of e-business applications in engineering education requires needs analysis to be considered. Aim of the following paper is to analyze the student engineers' needs in e-business applications of Web 2.0 technologies within engineering education on the pedagogical discourse. The meaning of the key concepts of e-business applications, engineering education and needs analysis is studied. The study shows a potential model for development, indicating how the steps of the process are related following a logical chain: determining e-business applications → revealing e-business applications in engineering education → defining needs analysis → empirical study within a multicultural environment. The results reveal that needs analysis of e-business applications in engineering education contributes to the incorporation of business-driven topics in the curriculum of engineering science.

1 INTRODUCTION

The primary target for software as a service is businesses (Vossen, 2009) considered as an overall attribute necessary for innovation-friendly societies to transform social capital into economic growth (European Union, 2008). New business ideas such as the payment service offered by RevolutionMoney, the mail service offered by eSnailer, the flight service offered by Virgin Charter, or the personalized TV service from Current.com are classical examples and have found widespread acceptance in the community (Vossen, 2009). E-business applications 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. Aim of the following paper is to analyze the student engineers' needs in e-business applications of Web 2.0 technologies within engineering education on the pedagogical discourse. The meaning of the key concepts of e-business applications and needs analysis is studied. Moreover, the study demonstrates how the key concepts are related to the idea of engineering education

and shows a potential model for development, indicating how the steps of the process are related following a logical chain: determining e-business applications → revealing e-business applications in engineering education → defining needs analysis → empirical study within a multicultural environment. The remaining part of this paper is organized as follows: The introductory state-of-the-art demonstrates the authors' position on the topic of the research. Section 3 introduces e-business applications. E-business applications in engineering education are studied in section 4. The associated results of an empirical study are presented in section 5. Finally, some concluding remarks are provided in section 6 followed by a short outlook on interesting topics for further work.

2 STATE-OF-THE-ART

The modern issues of global developmental trends emphasize "a prime importance in sustainable development that is to meet the needs of the present without compromising the ability of future generations to

meet their own needs" (Zimmermann, 2003). Thus, sustainable personality, and, consequently, e-business application user, is "a person who sees relationships and inter-relationships between nature, society and the economy" (Rohweder, 2007). In other words, this is a person who is able to develop the system of external and internal perspectives, and in turn the system of external and internal perspectives becomes a main condition for the sustainable e-business application user to develop.

For instance, the concern of the European Union, namely, to become "the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion" (European Commission, 2004), demonstrates the significance of developing the system of external and internal perspectives for the development of humans, institutions, society and mankind. Thus, the life necessity to develop the system of two perspectives, namely, external and internal, determines the research methodology of e-business applications in engineering education, as highlighted in Figure 1.

However, in real life sustainable e-business application user is often realized from one of the perspectives: from the internal perspective accentuating cognition (Vossen, 2009) and from the external perspective accentuating social interaction and finding a balance between the external and internal perspectives (Surikova, 2007).

The methodological foundation of the present research on use of e-business applications of Web 2.0 in engineering education is formed by the System-Constructivist Theory based on Parson's system theory where any activity is considered as a system, Luhmann's theory which emphasizes communication as a system, the theory of symbolic interactionalism and the theory of subjectivism. The System-Constructivist Theory introduced by (Luhman, 1988, pp. 1–14) and (Parson, 1976) emphasizes that human being's point of view depends on the subjective aspect: everyone has his/her own system of external and internal perspectives (Figure 1) that is a complex open system (Rudzinska, 2008) and experience plays the central role in a construction process (Maslo, 2007).

3 E-BUSINESS APPLICATIONS

The paradigm change, namely, the move towards collaborative business - from person to people and from systems to service (Jones, 2008), puts the emphasis on the use of e-business applications of Web 2.0 technologies. Typical e-business applications of Web 2.0

techniques and technologies include corporate blogs, wikis, feeds and podcasts (Vossen, 2009).

Blogs are seen by Vossen (Vossen, 2009) as a common way to stay in touch with customers, to inform about new products and to receive immediate feedback; they can also be used internally in order to discuss specific topics among the staff of an enterprise, in particular if people are geographically distributed. Blogs allow a moderated interaction between participants, be it customers or colleagues, and a simple and efficient distribution of announcements, experiences, opinions, reports, or evaluations. However, bloggers need to keep in mind that blogs are typically crawled by search engines, so that company internals written into a blog might reach the outside world and be presented as search results. Also, a blog is useless without regular updates, a reasonable number of readers, continuous moderation, and good content. It is also a good idea for a company to treat independent bloggers just like regular journalists, since they might have a considerable readership.

In order to stay up-to-date with a company blog, but also with other information an enterprise might publish, there are essentially two approaches: pull and push. The active or pull way is to read the information at my own liberty and pace; in the passive or push approach, the information will be delivered to me automatically. Indeed, blog entries and other sources can be subscribed via feeds that are based on protocols such as RSS or Atom (Johnson, 2006), and they can be read using a feed reader such as Bloglines, Google Reader, Newsgator, or NewsAlloy (or simply in the browser). A podcast is determined by Vossen (Vossen, 2009) as a particular form of feed consisting of audio or video material. Wikis allow collaborative work on a common set of documents by many authors, and have been discovered as a new way of performing knowledge management in a learning organization. If staff members can be motivated to participate in the development of a wiki, this can be considered as a good example of making implicit knowledge explicit, thereby attacking the core problem of knowledge management.

A social network can also act as a means of connecting employees of distinct expertise across departments and company branches and help them build profiles in an easy way, and it can do so in a much cheaper and more flexible way than traditional knowledge management systems. Once a profile has been set up and published within the network, others can search for people with particular knowledge or expertise and connect to them. If the social network is to be run outside an enterprise, providers like Ning allow an easy setup of a self-regulated and self-managed
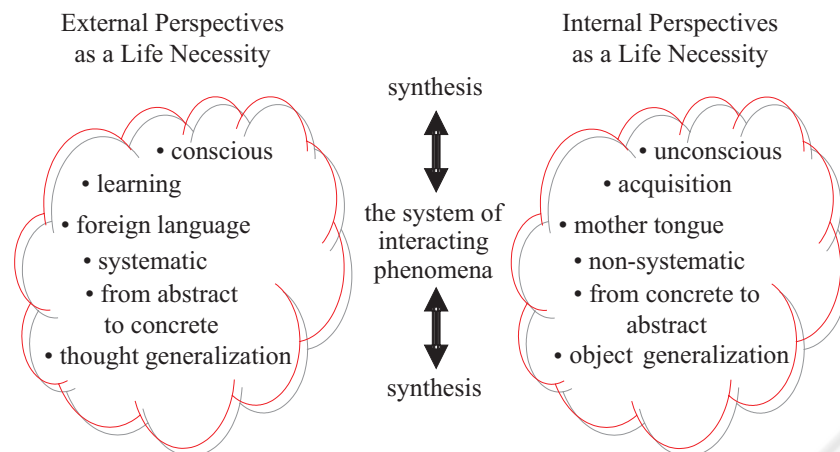
Figure 1: Developing the system of external and internal perspectives as a life necessity.

community. Vossen (Vossen, 2009) summarizes that 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, has led to the term "enterprise 2.0." 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. Hence, e-business applications of Web 2.0 technologies, namely, corporate blogs, wikis, feeds and podcasts, are seen as an integral part of engineering education.

4 E-BUSINESS APPLICATIONS IN ENGINEERING EDUCATION

The change in engineer 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' office (Bassus and Wolfgramm, 2009) reveals the significance of e-business applications of Web 2.0 technologies to be integrated into the processes and environments of engineering education.

A proper integration of e-business applications into engineering 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 student engineer needs objectively: human beings do not always realize their experience and their wants (Maslo, 2007).

In accordance with the research methodology, namely, developing the system of the external and in-

ternal perspectives, needs analysis is revealed to be of three levels, namely, individual, organizational and professional needs, in engineering education. Moreover, needs analysis includes four domains, namely, student's needs, wants, lacks and expectations, to analyze (Karapetjana, 2008). Thus, needs analysis has the potential to contribute decisively to the sustainable incorporation of e-business applications of Web 2.0 technologies or enterprise 2.0 into engineering education.

5 EMPIRICAL RESULTS

The target population of the present empirical study involves 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 and 40 students at the Department of Electrical Engineering and Computer Science of the Faculty of Engineering of Wismar University, University of Technology, Business and Design. 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 co-operation 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 Tech-

nology contains a special module on Web 2.0 where e-business applications are an integral part.

Finally, 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 where e-business applications are an integral part.

Analysis of the use of Web 2.0 is based on needs analysis as a basis for designing (Surikova, 2007) the following questionnaire:

- 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 e-business applications of Web 2.0 technologies and "5" points out "agree" and high level of use of Web 2.0. The participants' use of Web 2.0 was evaluated by the participants themselves on the first day of the Baltic Summer School, namely, August 7, 2009, and by the student engineers themselves at the beginning of the seventh semester in the fourth year of bachelor studies, namely, September 2009.

The analysis of the survey (Figure 2) reveals the following: the use of Web 2.0 by the Baltic Summer School (BaSoTi) participants is heterogeneous and the participants consider Web 2.0 to be most useful for their individual needs. The analysis of the survey (Figure 3) in September 2009 emphasizes that the university students' use of Web 2.0 is heterogeneous as well as the students don't know the possibilities offered by Web 2.0 properly. Then, the comparison of the survey results of the BaSoTi participants and the university students reveals the following:
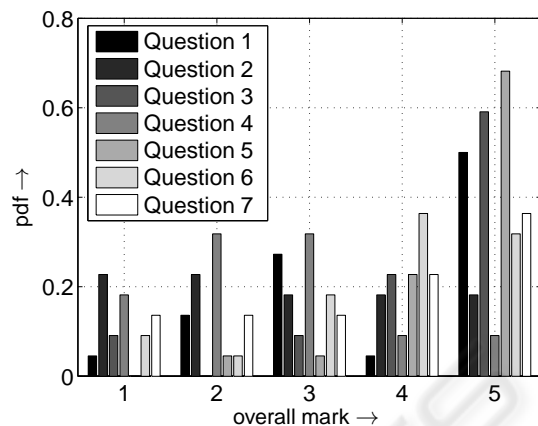

Figure 2: PDF (probability density function) of the BaSoTi participants' evaluation on August 7th, 2009.
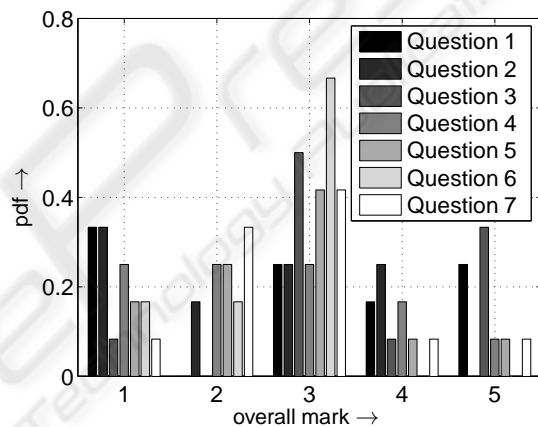

Figure 3: PDF (probability density function) of the university students' evaluation in September 2009.

- Question 1: The word Web 2.0 to a wider extent is known by the BaSoTi participants thereby developing the internal perspective that can be explained by a higher level of their education, namely, obtained Bachelor or Master Degree in different fields of Computer Sciences.

- Question 2: The basic idea of Web 2.0 to a higher degree is obtained by the BaSoTi participants as well thereby developing the internal perspective, that can be also revealed by a higher level of their education, namely, obtained Bachelor or Master Degree in different fields of Computer Sciences, and their participation in international projects, for example, Baltic Summer School Technical Informatics and Information Technology.

- Question 3: A wider experience in use of Web 2.0, namely, Facebook, Twitter, Wikipedia, is stressed by the BaSoTi participants that can be meant by the fact that the BaSoTi participants mostly come from the Baltic states where English is an interna-

tional means of communication whereas the university students use German that is already an international language thereby finding a balance between the external and internal perspectives.

- Question 4: Both groups, namely, the BaSoTi participants and the university students, consider that Web 2.0 does not require a lot of profound knowledge in math and physics, thereby developing the internal perspective that emphasizes the role of both groups as users and not as Web 2.0 designers.

- Question 5: The use of Web 2.0 for the individual needs is emphasized by the BaSoTi participants thereby developing the internal perspective that can be meant by the educational peculiarities, namely, the use of Web 2.0 in educational systems of the Baltic States.

- Question 6: The use of Web 2.0 for the organizational purposes is considered by the BaSoTi as well as university students, thereby finding the balance between the external and internal perspectives explained by the increased use of Web 2.0 in the educational system.

- Question 7: The use of Web 2.0 for the professional use is outlined by the BaSoTi participants thereby developing the system of the external and internal perspectives that can be also revealed by a higher level of their education, namely, obtained Bachelor or Master Degree in different fields of Computer Sciences, and their participation in international projects, for example, Baltic Summer School Technical Informatics and Information Technology.

Hence, the use of Web 2.0 and, consequently, e-business applications by the BaSoTi participants is provided by the knowledge the participants obtained in Bachelor or Master studies in different fields of Computer Sciences and by their working experience in different fields thereby putting the emphasis on developing the internal perspective while the use of Web 2.0 by the university students is regarded as finding the balance between the external and internal perspectives.

Due to the educational differences, namely, Web 2.0 module volume and content, between the Baltic Summer Schools Technical Informatics and Information Technology and the Bachelor's program for Electrical Engineering and Computer Science at the Faculty of Engineering of Wismar University in the seventh semester, Survey 2 of use of e-business applications of Web 2.0 technologies by only the Baltic Summer School participants was carried out on August 11, 2009.
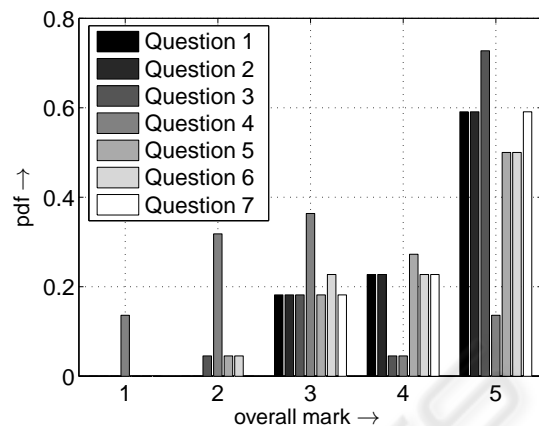
Between Survey 1 and 2 of the participants'

Figure 4: PDF (probability density function) of the second BaSoTi participants' evaluation on August 11th, 2009.

experience in use of e-business applications 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, practical work at IT Company. Then, the analysis of the second survey (Figure 4) reveals that the participants' experience in use of e-business applications has become homogeneous and the participants have put the emphasis on use of Web 2.0 where e-business applications are an integral part 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 and 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 the external and internal perspectives. Thus, the results' comparison of Survey 1 and Survey 2 of the participants' experience in use of e-business applications 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 significance in difference between the levels of the participants' experience in use of e-business applications.

6 CONCLUSIONS

The results reveal that needs analysis of e-business applications in engineering education contributes to the incorporation of business-driven topics in the curriculum of engineering science, thereby developing the system of the external and internal perspectives.

The recommendation here is the role of teachers as mentors for participants' self-discovery and self-realization; to motivate participants, 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 to improve (Maslo, 2007) their further use of e-business applications in engineering education.

Further research on needs analysis of e-business applications in engineering education is considered to include needs analysis, the questionnaire development, carrying out empirical studies and statistical analysis.

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