e-Learning as a solution for transition from high school to university:Challenges and possible solutions

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Abstract: This paper is about the role of e-learning environments to support first year students of computer science. Our goal is to make their transition easier from high school to university learning as well as to introduce our students self-regulated learning step by step. Our results are based on our qualitative study with our students. We analyzed the interviews we carried out with them to identify challenges in the first semester program. In this paper we discussed some possible solutions with support of our e-learning environment we have already established. We know that we need to adapt our system to meet these challenges. We conclude our paper with our future work.

Key words: E-Learning, learners' requirements, higher education, self-regulated learning.

INTRODUCTION

Seen as a supporting electronic technology e-learning is well-established at several universities for several reasons: to support the lecturers to prepare their courses in a multimodal way, to support students to get all relevant information of a course asynchronously, to provide additional support to students by answering their questions and helping them in their assignments, to name a few. Additional features of creating time schedules, discussion groups and forums among participants, messaging mechanisms, grading and feedback possibilities, etc. make the teaching and learning easier to all stakeholders involved. Nevertheless the most e-learning systems do not provide enough support for learning from students' individual point of view and see learners as "deindividualized and demoted noncritical homogenous users" [6, p.273]. In this paper we show that the opposite is the case, especially when considering first semester students of higher education.

If it comes to introduce self-regulated learning, it is not only about the material provided for the students [6] or using ICT to improve assessment processes [8], it is about processes like scheduling, planning, and managing the learning activities, or assessment of one's knowledge and preparation for exams, etc. These are the factors for what we show in this paper evidence from our field study. Considering learning as an active, self-regulated, constructive, and situated process [4] [1] e-learning systems need to support learners in management and organization of learning activities, especially when the study requirements are unfamiliar, high (at least higher than expected), and not much individualized. One of the main goals of our paper is to show how to accompany "novice" learners in the first semester of a computer science university study to "advanced beginners" [3]. Our focus is on e-learning support to self-regulated learning.

Since there are several definitions of e-learning, we want to clarify that we refer to the following definition: "… all forms of electronic supported learning and teaching, which are procedural in character and aim to effect the construction of knowledge with reference to individual experience, practice and knowledge of the learner. Information and communication systems, whether networked or not, serve as specific media (specific in the sense elaborated previously) to implement the learning process." [6, p.274]. Self-regulation is based on "students' self-generated thoughts and behaviors that are systematically oriented toward the attainment of their learning goals" [5, p.59]. This also means that students contribute actively to their learning goals and procedure.

The main research question we deal with in this paper is: How can we apply e-learning mechanisms and systems to help students to transit from familiar learning structures and habits at high school to autonomous self-organized learning at a university? This is followed by other questions like: How can we support a newcomer at a university at all? What do we need to consider in a first year computer science (CS)

study program? How can a newcomer survive the very demanding, different, unusual first year program at a university? How can this be done when the first year is an orientation year with strict requirements, i.e., passing all courses of the first semester is the precondition for the eligibility of the continuation of the study at the university? What mechanisms are good to lower the pressure students have with regard to competition and expected success in the first semester? How can we improve the cooperation and sharing among the first semester students even the competition and pressure for success are very present?

First, we will present our setting to contextualize our study and then the methodology we applied. Then we will try to answer the most of the questions raised above by analyzing the situation of novice learners in the first semester of our computer science curriculum from learners' points of view, structured as challenges and possible solutions in terms of e-learning, before concluding the paper.

THE SETTING

At our university we offer five different CS curricula: media informatics and visual computing, medical informatics, software and information engineering, computer engineering, and business informatics. All studies have a very similar first semester program. Only computer engineering and business informatics are slightly different. In this paper we refer to the first three studies we listed above. The first semester contains six different courses of total 30 ECTS:

- Algebra and discrete mathematics (VO, 4 ECTS + UE, 5 ECTS)
- Modeling – formal modeling (VU, 3 ECTS), data modeling (VU, 3 ECTS)
- Programming – foundation of program construction (VU, 2,9 ECTS), program construction in practice (UE, 5,9 ECTS)
- Fundamentals of computer engineering (VU, 6 ECTS)
- *Introductory conversation* (UE, 0,2 ECTS) – STEG (Studieneingangsgespräch) – This is a 20 min conversation with the students, one by one. One professor ideally from the same area as the student wants to study (see the different five bachelor studies we offer at our university above). One assistant professor or ideally one student representative are present in this conversation. The precondition for this conversation is a letter of motivation submitted by the student beforehand. The goal is to talk about the circumstances and requirements our studies have and either the students' choice is the right one. Students are marked as "participated" or "not participated". Participation is a strong precondition for the CS study at our faculty.

When we consider all courses of the first year program, 64% of male newcomers of the winter term 2012 succeeded the first semester program and 50% of female newcomers of the same term [7, p.25]. These students have different backgrounds: 35% of all students finished a secondary high school, 6% commercial high school, 28% polytechnic, and 31% others [7, p.6].

At our university we use an e-learning environment based on Moodle, called TUWEL (TUW E-Learning, tuwel.tuwien.ac.at). The most courses we offer at our faculty in CS are organized in TUWEL. Time schedules, documents we provide for our students, work assignments, marking, etc. are the main components we use for the administration and management of our courses. We also use the community functionality and communication channels that Moodle facilitates. Unfortunately, how we use TUWEL cannot be seen enough to call its application blended learning. It is still necessary that our students are present in all courses. TUWEL only offers additional support for the communication between the lecturers and students by being a document management system and a limited organizer at the same time.

METHODOLOGY

After studying the related research how to design a computer science (CS) curriculum, after introducing a very well discussed new curriculum in CS at our university in the winter term 2011, and after evaluating its success in terms of statistics, we carried out qualitative open interviews with four of the students from the first year to find out the reasons for these results. We believe that quantitative data needs to be explained with qualitative evidence. This is an essential condition for understanding the context, for sense making of the observed phenomena and most importantly to improve the situation or solve problems. Our open interviews were conducted for 1-1:30 hours, recorded, and transcribed. We coded the transcriptions and summarized the most important and common findings in this paper. We are aware of the limited number of the interviews at this point of time. We keep going with our inquiry in the next semester as well. Still, we want to start to think about challenges we face now in our first semester program and possible solutions to our problems. That is why we started to analyze our material and want to present our findings so far in this paper.

RESULTS

The students we interviewed could show us different aspects, because they are very different in character, in their approach how to study at a university, and in their perception of learning in general and in particular in the first semester of CS. Their success of the first semester was different. They expect different services and structures when they started at the university. They have different backgrounds. One is female; three are male, which actually shows the ratio of female students in our CS studies. One started in the summer term, three started regularly in the winter term. Starting in winter term is different in possibilities and modes of attending the courses than starting in the summer term, even if the same courses are offered in both terms. Their habits and approach to study are also different: One is very keen on being on time, organized, and having success by driving his work forward. Two are more reflecting on the content offered and ways of teaching in the first year by questioning everything. The forth one gets easily lost and depressed if he misses something. He tries to catch up, but it is not easy for him to be on track.

In the following we will systematically describe our findings based on our qualitative open interviews with these students.

First semester at a university is special for the newcomers. Students in the first semester usually do not know the ways how to deal with different subjects organized in different courses. They do not know their fellow students. They need time to build trust and a relation with other colleagues. They do not really know what a university require from them, even they are given all information about the courses and examination modes. They simply do not have the experience yet. Some of them underestimate the work load, some overestimate constantly. Some are shy and need more time to contact the others or initiate cooperation with their fellow students. Some have a very good background, fulfill the most prerequisites because they had the according high schools, some don't. These differences end up in *heterogeneity of the students in their knowledge and experiences and furthermore their expectations* from a university study especially in the first semester.

Challenge of the difference in learning in high school and at a university: Students differentiate strongly between their high school and the university by comparing their experiences in learning so far within the new learn environment. Not only the content taught is compared but also the ways of teaching, the classroom situations, and the structure of the learn environment. They see there several differences: The high school was more structured and predefined than the university. The contents in high school were more practical and less formal than the content taught at the university. Though, one student says that he can really use part of the knowledge he acquired at the high

school for this study. Not everything is new to him. This helps him to use his time resources in an optimized way, e.g., he spends more time for contents he is not familiar with than the ones he can easily refresh and catch up.

Solution: An e-learning environment can be used to create the familiar learning structure and organization for the newcomers, at least in the first semester. With functions of customization it might even provide possibilities for individual time management, task arrangement, priority setting, creating of to-do items by optimizing the individual output planned. Automatically created but customized reminders can help to keep track of appointments and to-dos.

Challenge of the tempo and structure of introductory courses: The tempo and structure of an introductory course like introduction to programming have an important impact on the acceptance and success by newcomers, especially they are not familiar with the basics of the subject at all. If the contents are well-introduced, i.e., by firstly defining the elements on a formal level and then by giving examples to make the understanding and seeing its use in a context possible, students do not have a bad first confrontation with the subject. They feel confident and do their best to keep their motivation and involvement. Otherwise it becomes a burden and it takes them usually long to overcome this barrier in their study.

The students perceive books and scripts for the lectures as very important and helpful. Students need to know from the beginning that they can count on the documentation of a lecture, if they miss it or could not follow the content. In some courses, like program construction in practice, they need to attend the lectures because the scripts alone are not enough to understand the programming as a skill or different concepts that programming is based upon, like recursion. One student thinks that he has to learn how to think recursive in order to be able to understand the test questions. They do not write their code from scratch, they interpret codes written by others. This makes the whole test very unpleasant for them. They feel unsecure and think they need more examples to practice, what is unfortunately not provided. On the other hand, attending to a lecture does not mean listening to the lecture. Some students sit in the lecture hall and do something else on their computers.

Additionally there are differences among the first year courses with regard to teaching methods, expected knowledge and skills, density of attending the lectures and tests, frequency of assignments, etc. This inhomogeneity confuses some of the students. Despite the fact that the first semester students theoretically know that it is a university and not a high school anymore and they perceive being autonomous as a student important, some are mentally not ready to jump into a completely self-organized and self-managed study life. The main problems of being behind the schedule, missing lectures' key points, setting the priorities for learning or attending lectures wrongly, miscalculating the time that is necessary for preparation for a lecture, etc., are some examples of this fact.

Solution: The structure of an introductory course can be prepared in a more school-like version in the e-learning environment, at least for the courses of the first semester. The right manageable portions of content, which is temporally well-distributed and content wise well-described by using additional exercises and quiz-like assessment possibilities for students, would help to ease the transition from high school to university for some of our students. It is important that students start thinking of their higher education learning habits successively. That is why this support needs to be provided carefully.

On the other hand, newcomers cannot estimate the time they will need for learning for different contents in a course. They need help which can be provided by means of e-learning tools. They can be used to portion the content so that they are learnable. They can help to better schedule the semester and guide the students through the semester. In mathematics, e.g., even the lecturer does not have enough

time to present all content of the course. He hurries in the lectures and tries to present as much as possible. Students are busy making notes – unfortunately partly without understanding any word.

Challenge of having no time for social life: The program in the first semester is very demanding. If one wants to finish it on time, there is no spare time to do anything else. All students had the same situation. One of the students says that he did not even manage to meet his friends during the term because he simply did not have time for this. In total he managed to meet some of them only 2-3 times within 4 months during the term. Before he started to study he was regularly in a fitness studio where he had touch with his friends. He claims that he would not have managed to succeed the first semester if he would not only focus on his study.

Solution: e-Learning has indirectly a positive impact on social life of students by helping to arrange the individual learning temporally and content-wise in a more flexible way, which can lead to spare time. Students can use the time left to spend with their friends. We have to stress out that our students want to meet their friends face-to-face and not only in the social network environments.

Challenge of complexity caused by the density of the lectures and responsibilities: What first semester program requires from the students is "too much" – all interviewed students agree. One student is exhausted and plans to do less in the second semester. He means that he cannot continue working this way. He thinks that the first semester is doable as planned and required but it is too much in a very short period of time. The complexity is caused by the density of the lectures and duties the students have, like exams, examples they have to deliver regularly, presence in practical parts of the lectures, other assignments, etc.

Solution: Using an e-learning system to guide the students in the first semester and support their self-regulation in learning is crucial. Helping them to set their priorities by providing them enough information to make their decisions, to assess their knowledge during the learning phase to make them aware of their knowledge they gained – which is also very important to motivate them – or whether it would be enough to pass an exam are some examples how we imagine to use our e-learning environment in this respect.

Challenge of learning alone: One of the most important differences of university learning to high school learning is learning alone and learning at home – mostly self-regulated. Students need to learn how to learn alone, i.e., how to structure the learning process, how to prioritize the learning content to make sure that the most important content is already dealt with, how to check whether one has learned enough for a test, how to assess one's knowledge on a certain subject, etc. The freedom students have at the university to decide themselves what to do at what time can be the source of failure, as one of interviewed students pointed out. Some students try to build groups with other newcomers and try to arrange learning sessions depending on the assignments in different courses. Some try to optimize their time and avoid additional effort that occurs in case of cooperation and coordination with other fellow students and prefer rather being alone in the learn process.

Some content cannot be learned alone, this is a common understanding among our students. Proofs in Mathematics, e.g., are too complicated and not appreciated by the most of the novice students. Especially because they do not understand the importance of such abstract thinking in their study. Actually, it is also not easy for them to follow. They have to learn at home additionally, by using other relevant Internet resources. One student claims that it is not possible to learn such abstract content alone at home, even if an e-learning environment supports them. It is crucial that the lecturer explains the rationale behind the proofs step by step. This calls definitely for blended learning.

Solution: On the one hand, there could be a transition time in the first semester for the students: at the beginning of the semester more pre-defined structured ways of learning by attending the lectures or e-learning assignments (more blended learning), at the end more flexibility in learning modes and ways defined rather by the student and by the system. The first phase offers an orientation for university education; the second phase shows that universities offer a space for self-management and self-organization of the learning process. E-Learning modules can still offer support for structuring, scheduling, guidance, additional information, and connecting to other students, tutors, or lecturers.

Challenge of distribution of (correct) information about the courses and results in the first semester: Due to heterogeneity of newcomers regarding their background knowledge and skills based on the type of high school they have attended, there is a need to know what are the prerequisites for the courses of the first semester program. Students would very much appreciate if they would be informed at the beginning of a course about these expectations. This information needs to be kept also present, to remind them during the term about the dependencies between different subjects, in order to catch up if necessary.

For some lectures the information available for the students is ambivalent, like in case of fundamentals of computer engineering. Students do not know certain practical information about the course, like how long the tests in practical part of the course will take, or how many students managed to pass the previous tests, etc. If the data available is not correct or students are not really informed about the real circumstances they cannot organize themselves correctly to fulfill the requirements of these courses. They cannot plan enough time to be prepared for the tests or regular examples they have to deliver for the practical part of the course or they underestimate the complexity of the content they have to learn to pass single tests.

Besides the lecturers, who must provide information about the lectures directly in the course preferably at the beginning of a course, student representatives have an important role for the awareness especially in the first semester. They inform the students about several aspects of studying at our university: They help them to orient in their study program, provide data about the study conditions and show some statistics about the success of students in different semesters. The data about how many students managed to finish the first semester as planned, and how many percentage is still trying to finish it in the second year have been perceived as very important for our newcomers. After introducing the new curriculum only 5-10% of the newcomers were capable to finish the first semester on time. On the other hand there is always gossip about the numbers, about struggles of passing a particular test, or what happened in certain previous exams, etc. Gossip is distributed faster than the correct data about the real facts and it is very difficult to avoid or correct wrong information which is already distributed among our students.

Solution: An integrated e-learning platform can help to inform the students regularly about the results of the exams based on the real data captured in the university examination system. Such a system can also provide and keep alive all important information about the courses, prerequisites, content-wise dependencies among or within courses, etc. Questions (stated by students) and answers (normally given by the instructors or lecturers) can also increase the quality of the data provided centrally.

CONCLUSIONS

In this paper, we presented our research on how to support our first semester students in computer science to make their transition easier from high school to university learning. Our results are based on our qualitative study with our students. We tried to analyze the interviews we carried out so far to identify challenges in the first

semester and possible solutions given if the e-learning environment we have already established is adapted to meet these challenges. Our goal was to introduce self-regulated learning to our students step by step.

This work shows only the start of our future research and implementation. After qualitative data collection and analysis with additional students – as said before, we are only at the beginning of our investigations – we plan to implement the 360-degree evaluation framework in higher education [2] with following steps: identification and selection of collectives of stakeholders, evaluation of stakeholders' knowledge by assigning different subsets of criteria to each collective, definition of items which are actual questions of the survey that are grouped into criteria, instrument testing to understand the questions, implementation of the online survey, aggregation process, and the analysis and interpretation. On the other hand we are working on a European Evaluation Framework in Computing Education and Training 2020 (EEFCET-2020) in the scope of the ETN project called FETCH (Future Education and Training in Computing: How to support learning at anytime anywhere)[1].

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