Implementing Blended Learning for 1000 Mechanical Engineering Students

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Abstract:

The module Techniques of Programming *of the RWTH Aachen University is one of five case studies within the EU funded project Blend-XL – Finding a Balance in Blended Learning with eXtra Large Students Groups. During the project the module changed from a face-to-face module into a blended learning one. Therefore a blended learning concept has been developed which includes a special virtual learning environment. With the help of the blended learning concept the main problem areas of this module, the different previous knowledge of the students and the motivation of them, have been faced. The first research cycle of the case study has been implemented. This paper describes the corresponding evaluation results and the outlook to the second cycle.*

1 The Project Blend-XL

Teaching large student groups with more than 100 students is especially in the first year of study a common phenomenon. In the core modules of the study the large group is often taught in big lecture theatres. This leads to a lack of communication between the teacher and the students, which is often found de-motivating. As a result, the exam results have a lower success rate and the attrition rate is higher than in small-scale education [1].

The idea behind the project *Blend-XL – Finding a Balance in Blended Learning with eXtra Large Student Groups* is that the effective use of ICT can make the large-scale education more motivating and more personal. Designing pedagogical models for learning situations with blended learning - a mix of face-to-face and online activities - is the main focus of the project. The project started in October 2005 and is funded for three years by the Socrates Minerva Programme of the EU.

The output of the project will be five blended courses, an educational design model for blended learning situations, scenarios and cases from educational practice, a toolkit for blended learning, a digital handbook for teachers and a virtual centre of expertise on blended learning. All the outputs are focused on large student groups. In the project five European partners are involved, the RWTH Aachen University in Germany, the Delft University of Technology in the Netherlands, the Academy of Humanities and Economics in Lodz in Poland, the University of Zilina in Slowakei and the University of Maribor in Slowenia. In the project the action research methodology is used [2]. The case studies will perform two cycles during the project, so that the experiences of the first cycle can directly improve the second cycle and the development of the pedagogical model is based on many experiences. In the following the first cycle of the case study *Techniques of Programming* of the RWTH Aachen University is described.

2 Case Study Aachen *Techniques of Programming*

2.1 Framework

The course *Computer Science in Mechanical Engineering* is a course for students in mechanical engineering in their first and second semester. It starts with the module *Techniques of Programming* (3 ECTS) in the first semester. In the second semester a lecture (3 ECTS), a practical class (1.5 ECTS) and a *Project Work* (3 ECTS) are following and are taking place in parallel. The module *Techniques of Programming* is the basis for the module *Project Work*. Both modules are mandatory in order to be allowed to take part in the written exam. About 1000 students attend the course [3].
Before the project started the module *Techniques of Programming* has been a face-to-face module in which the first semester students learn the basics of structured programming with the aid of the programming language C++. After an introduction into the working environment and the necessary tools, e. g. editing tools, the following questions are tackled: What constitutes a computer program, what datatypes are there, what are loops and IF control structures, what are function calls?
The students have got small theoretical inputs and gained practical experience by completing a range of tasks from simple exercises on a wide range of subjects to more complex problems later on. The students worked with a paper handout which includes the slides of the theoretical inputs and the exercises. The module is taking place in a computer pool, 160 computers are situated in four rooms for the students to work with. Linux is used as the operating system and all of the computers have internet access. To support the students with their work there are two student tutors in each room and a faculty tutor who oversees the entire computer pool.

2.2 Problem Areas

The main problem areas of the module *Techniques of Programming* are:

- Different previous knowledge: The participating students have different levels of previous knowledge. Some of them are already able to write a complex computer program, some of them have no experience at all. Therefore the module Techniques of Programming is boring for the first group and overstrains the second group.
- Motivation: The module is mandatory. The students have to attend each module unit. But they only have to attend and not to successfully end tasks. This and the above mentioned problem of different levels of previous knowledge can lead to unmotivated students.

Therefore with the beginning of the project Blend-XL a blended learning concept has been developed in order to face the above mentioned problems.

2.3 Blended Learning Concept

The content and the structure of the module should not be changed, because the content is relevant for the module *Project Work* in the second semester and the structure is well tried in the last years. Because of the different level of previous knowledge of the students the decision was made that the theoretical inputs would be replaced with a virtual learning environment (VLE) and the exercises would be extended in number and in skill levels. Like this the students can work through the theory in their own way. Those who already know a lot can do it fast and the others have the possibility to read parts e. g. twice. The first group also

has the possibility to do more exercises on a more difficult skill level than the second group. The VLE would also include multiple choice tests for each chapter. Like this the students can check, if they understand the main aspects of the chapter and can reread special parts if necessary.
The used VLE has been developed from a student group with the focus on the special demands of the module. For this software different software development tools like PHP, mySQL, Macromedia Flash, AJAX and MediaWiki have been used [4].
As you can see in Figure 2-1 the VLE includes a menu with the chapters and the corresponding exercises and tests. One has the possibility to implement graphics, flash animations and videos.

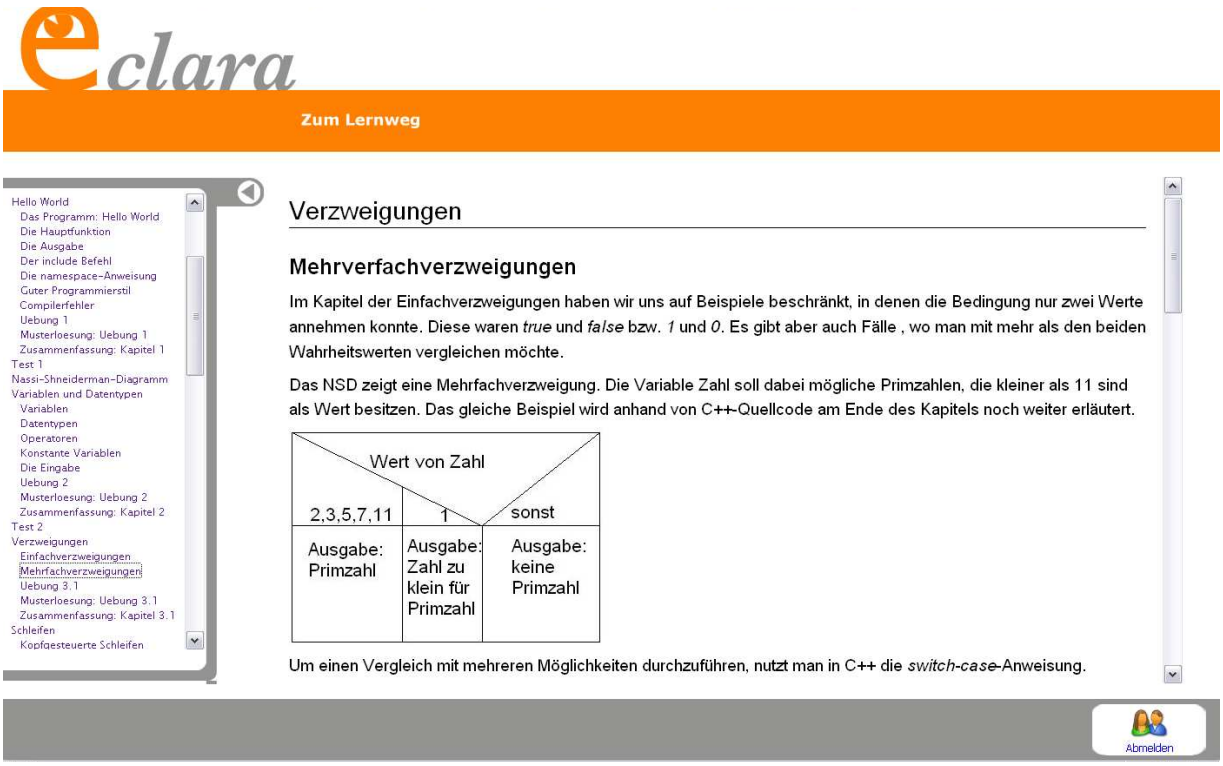

Figure 2-1: Screenshot of the used VLE *eClara*

Beside of this the already existing course website including organisational information, a download area and a message board has been used [3].

2.4 Implementation

The existing content of the module has been worked over textual and graphical. As a result the complete theory of the course is now available in small chapters in the VLE. The exercises have been extended and divided into those, which all students should solve and those, which only the faster students could solve. The content, the tests and the exercises have been quality checked in two rounds in order to detect write errors, correctness and solvability.
The whole student group involved in the case study was 480 students, which has been divided in three groups of 160 students, which are arranged one after the other in the semester as usual for this module. 120 of 160 students of the first group have had a normal face-to-face course. The rest of the group has been taught with the new blended learning concept. The students worked themselves through the theory with the help of the new VLE. The two coaching tutors were there to answer questions. Subsequent to the theory chapters the students solved the corresponding exercises themselves. Again the tutors were available to help and to answer

questions. After the main part of the students has solved an exercise, the corresponding solution has been presented in detail. In this presentation the focus lies on the main questions and problems of the students during solving the exercise. The first 40 students mainly liked the blended learning approach. Therefore the second and the third group have been taught completely with the blended learning concept.

2.5 Evaluation

The evaluation has been undertaken with the help of different methods:

- "observing" the students behavior during the module,
- asking for direct feedback of the students via face-to-face or e-mail,
- discussions during regular meetings with the involved teachers,
- a teacher questionnaire and a cross-case questionnaire, which have been developed in the project Blend-XL.

The students set about the task in different ways: Working through one theory chapter before starting with the exercises or the test, starting with the test in order to see, which part of the chapter they have to read, starting with the exercises and reading the theory parts, if they were not able to solve it, or starting with the exercise and asking the tutors when they had problems in solving the task. This shows what different ways of learning the students have and that the use of a VLE gives the possibility to consider many of them.
In order to improve the VLE the students were asked to give feedback, what they liked or disliked at the VLE. Like this some writing errors in the textual parts have been filtered out. Beside of this the only feedback was, that most of them like working with the VLE. From this we learnt that getting improvement for our VLE could only be reached by a special questionnaire, because in such a large group nobody feels really responsible for giving feedback.
In the cross-case questionnaire 216 of 360 students took part, of which 88% were male. Most of the participants were between 18 and 23 years old. In the questionnaire the following areas are treated: General questions, preparatory advice and course components, online materials and resources, teacher and peer support, group work (if provided), study time, the online learning environment as well as the programme as a whole. About 44% of the students say that it is important to have the possibility of time-and-place independent work and study. The working with the VLE assess 47.1% of the students as a positive experience, 41.4% are not sure and only 11.5% assess it as a negative experience. This might go hand in hand with the assess of the information and advice they received before the course started in terms of course description, explanation concerning what blended learning is, rationale for the way the blend was put together as well as the role and usage of blended learning tools. Here the students rate on a five point Likert scale from *not at all* to *very* mainly between *very* and *fairly*, which means that it is even nowadays very important to explain the use and handling of VLEs. The teachers were rated *good* up to *excellent* concerning their availability, explanations and dealing with questions. Some students mentioned that they would like to have more different exercises in order to be more motivated. Others would like to have more detailed explanations of the theory. This shows that especially in large groups the students really need the possibilities of a VLE, which means that one is able to offer various materials and content on different skill levels.
The teachers have different impressions. Those who were responsible for the content of the VLE have a much higher workload than usually for this module. The others have had nearly the same workload as before. During the course the teachers were able to answer more individual questions than in the normal face-to-face module. They feel more than a facilitator

of learning than a provider of content. This may correspond with the good feedback for the teachers in the cross-case questionnaire.

3 Outlook

The evaluation shows that using a blended learning concept is a feasible way to handle different previous knowledge and a lack of motivation of the students. With the help of VLEs especially in large groups different ways of learning can be considered and like this the motivation increased. Nowadays the students are used to get information via the computer. Therefore the acceptance of VLEs is high. But nevertheless a good instruction and personal contact to tutors are important.
Finishing the first cycle starts the planning phase for the second research cycle. There the focus will be on the different skill levels. Some students mentioned that they like to have more explanations. This will be considered by more detailed textual descriptions, more animations and small video sequences. Beside of this more exercises will be developed, so that the students have the possibility to select from more and more difficult ones. The next cycle will take place in spring 2008.

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