Constructing Blended Learning and E-Learning Material for Higher Education

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Abstract

In recent years E-Learning has become an established field to support or substitute traditional forms of teaching and learning. In the paper we sketch different E-Learning scenarios in higher education and as main area we focus on content production.

There are different ways of producing content for an E-Learning environment. We have evaluated different approaches, e.g. producing content from scratch or the rapid E-Learning approach where content is produced by using existing material.

For all aspects and approaches we give examples from lectures that must be visited by undergraduate computer science students.

1. Introduction

In the last about 15 years E-Learning has become an established field to support or substitute traditional forms of teaching and learning [17, 19, 21, 18, 4, 7, 11, 14]. This holds for (higher) education as well as for continuation of employees' education in companies. The presented matter is called content. An important variant of E-Learning is Blended Learning, a combination of online and traditional learning [2, 22, 24].

There are some problems in producing content and establishing E-Learning within an organisation.

The first one is the way of content production. Traditionally, content is developed from scratch. Thus new pedagogical elements can be considered and complete courses can be restructured. But this procedure is very time consuming and expensive. For obvious reasons existing course material like lecture notes, overhead transparencies, exercise sheets, manuals for laboratory tutorials etc. can be used as starting basis to develop E-Learning content. This approach is called rapid E-Learning [1, 5].

Another challenge in producing E-Learning content is the coordination of many different skills [13]: For creating a concept pedagogical and didactics skills are necessary, for attractive appearance knowledge in media design and graphics is needed, for implementation programming or at least technical skills are essential and last but not least the content from the field of interest must be considered.

Also very important is the motivation of the lecturers as well as the learners for the new technology. The latter group must be given reasons to use and learn with the new medium, for the former one the question "Why should I produce content?" must be answered satisfactorily. Moreover, in different cultures there are different cultures of learning which have to be considered as well.

The remainder of the paper is organised as follows: Section 2 describes different scenarios where E-Learning resp. Blended Learning can be used in higher education. Section 3 lists different types of content, followed by different ways of content production in section 4. The following section shows some examples of using E-Learning in the bachelor studies of Applied Computer Science. The contribution ends with a summary and an outlook.

2. Scenarios in Higher Education

This chapter describes different scenarios of using E-Learning in higher education. We have identified the following forms of appearance.

The first one is Closing Knowledge Gaps. Unfortunately, not all starters of a bachelor study have the same state of knowledge. Reasons are different emphasis of different grammar schools (in Germany Gymnasien), the opening of universities for employed persons without A-level degree or a time lag between school and university studies. These groups have to close the knowledge gap before the first semester starts. In this area E-Learning units can be used because these groups are very heterogeneous and so they can determine the rate they are going on.

Another form is Blended Learning within lectures. A lecture can be supported by a Blended Learning concept. Here we distinguish two different forms: Supporting the lecture means that some topics for repeating or deepening are realised as E-Learning components, the use of them is optional. In contrast, integration means that there are E-Learning components being an integrated part of the lecture, their use is mandatory.

Substitution of lectures is the third form. Within this approach a complete classroom lecture is replaced by an E-Learning lecture. Here we can further distinguish whether the whole lecture is done completely online without any additional support or if the process is supported by tutorials or discussions.

If any lecture is organised like described ahead and therefore the whole course of studies is organized in E-Learning modules we call it Virtual (Course of) Studies or Virtual University.

3. Types of Content

This chapter gives a list of different content types that can be used to enrich or to substitute classical classroom lectures:

- Simple Content: Pictures, short audio tapes or videos are used to enhance a lecture and to illustrate a single aspect
- Wikis can be used for e.g. producing glossaries [3, 16]
- Podcasts can be used to present some new topic or to deepen the knowledge about an already known topic [8, 20]
- Using communication platforms like chat rooms, blogs, etc. can improve the communication between learners or between learners and lecturers [15]
- "Normal" PowerPoint presentations can be moved to interactive presentations by using animations or embedding simple content like described ahead
- Some more elaborated aspects of a lecture can be supported by a visualisation or animation
- Following the Blended Learning paradigm lectures can be video recorded and published over the internet or the universities intranet
- Online self-tests, ideally with explained solutions, can be used either during a lecture to measure the comprehension of the students or as self-tests for controlling the success of reworking
- In some lectures business simulation games can be used to simulate complex real world scenarios [10, 23]
- Finally, complete units or lectures can be designed as E-Learning components

4. Ways of Content Production

This section briefly describes different approaches of content production being depicted in figure 1 [4].
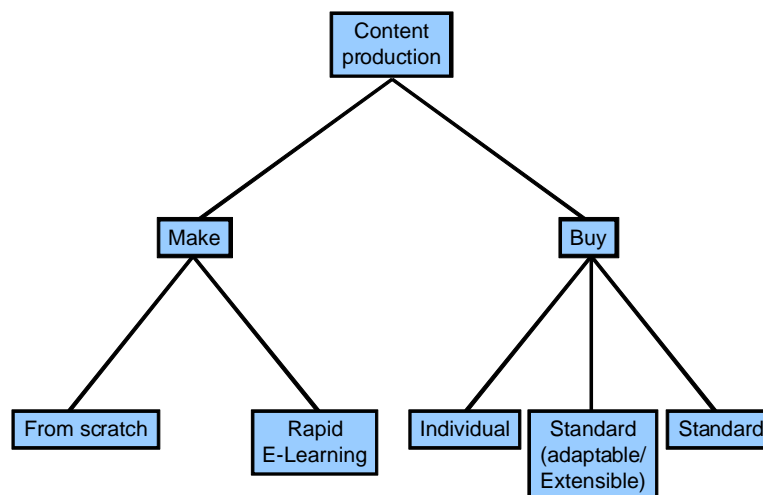

Figure 1: E-Learning Content Production

On the first level we can distinguish between making it on our own or buying a solution. In the category of buying three different variants can be distinguished:

- Standard modules from a provider which have to be used in the way they are offered
- Standard modules which can adapted or extended either by the vendor or by the user
- Individual modules being conceived and developed based on the user's requirements

Self-made modules on the other hand can be distinguished into:

- Modules created from scratch, i.e. all existing material is thrown away and new content is produced by using some authoring tool [6, 12]
- Modules created by the rapid E-Learning paradigm: Take existing material and use this, e.g. make a video of a lecture.

In [9] we suggest a hybrid way of producing content: Existing material should be used or updated and only where necessary new E-Learning content is developed.

5. Examples

This section shows some examples of E-Learning resp. Blended Learning approaches in the bachelor studies of Applied Computer Science.

One bottleneck in the course of studies is the mathematics module. So we have produced small videos of different aspects enriched by small self-tests about each topic. These videos are widely used by starters before and during the first semester.

Besides the technical knowledge in computer science also soft skills are an important topic within the course of studies. One of these soft skill units is project management where we use a business simulation game where the real life scenario of a software development project is simulated.

One of the central lectures during the first year is called algorithms and data structures. Here we have to teach important algorithms. Traditionally, the dynamic aspect is taught by "draw and wish" technique with choke on the blackboard. The first progress was the advent of overhead projectors where the algorithms were demonstrated by the lecturer. The next step is an animation in PowerPoint. All these approaches have the limitation that only one or a small number of fixed examples can be

demonstrated. Moreover, in every case the learning style is passive, the lecturer does and explains, the student listens and consumes.

By applying the HyCEC methodology [9] we have developed a platform for learning algorithms being organised as follows: We broke down the lecture into small topics, one algorithm or a family of algorithms corresponds to one topic. For every topic there exists a set of a few PowerPoint slides with the lecturer's voice explaining. As core there is an interactive component where the learner can execute the algorithm step by step, vary parameters, etc. Finally, there exists a self-test where the student can verify his learning progress. Here we can see the hybridism of the approach: While the small video is produced following the Blended Learning paradigm, the animation is created new from scratch. The self-test is new but uses existing material.
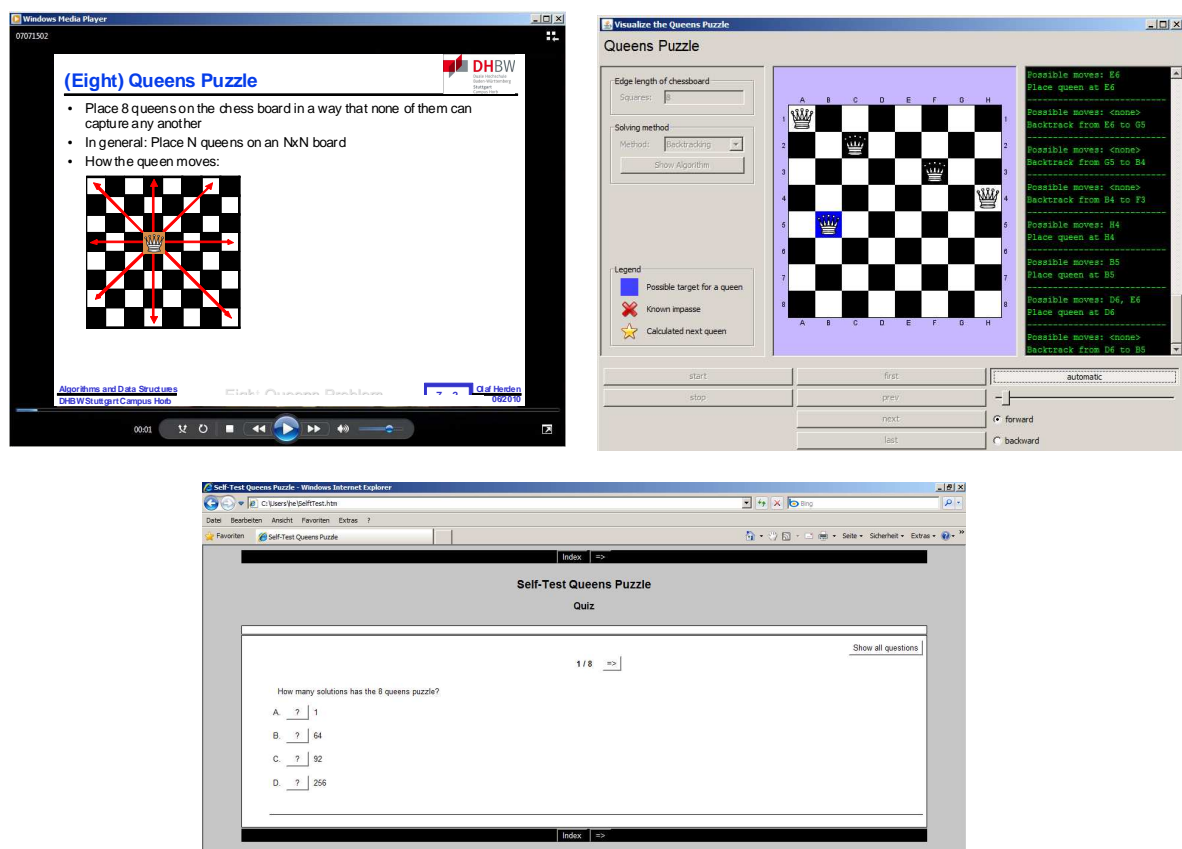

Figure 2: Platform for Learning Algorithms and Data Structures

Figure 2 demonstrates the components by the example of the Queens Puzzle where eight queens have to be placed on a chess board in a way that none of them can capture any other. In the top left corner we can see a screenshot of the short video, right of it the interactive animation. The bottom of the figure shows some self-test questions to the topic.

6. Summary and Outlook

This contribution handles different ways of constructing E-Learning resp. Blended Learning materials for higher education. After an introduction and motivation by describing the problems of content production, we describe different scenarios where E-Learning resp. Blended Learning can be used in higher education. We give an overview of different types of content, before classifying and explaining different ways of content production. With our learning portal for the lecture algorithms and data structures we give an example for using E-Learning in our course of studies.

In the future we want to conclude our research and experience in the field of E-Learning where the following aspects should be handled:

- Completing and improving the existing platform
- Moving the concept of the platform with its central ideas to other lectures
- Extending our framework for visualisation with some wizards because at the moment it can only be used by people with programming experience
- Evaluating other methods and tools and improving other lectures by using E-Learning

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