E-Learning Systems in the Bergen Region, Norway: An Overview

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ABSTRACT
In this paper we describe how e-learning systems in the Bergen region of Norway have developed, from early learning environments such as "Gudmundstad" and "Reidar" systems in the nineties towards to "It's learning" and "The Dynamic Presentation Generator" (DPG) systems of today. At the beginning of this decade a new learning system was developed as a continuation of its for-runners. This system, "It's learning", has been a great success with the foundation of the company "It Solutions". It's learning" is now used in many universities and colleges in our country and abroad. A new learning system, the "Dynamic Presentation Generator" (DPG) system, is now being developed at the University of Bergen. The most important aspect of this system is the decoupling of content from the formatting. This means in an educational context that the system offers reuse of content and presentation patterns for developing continually online courses.

1. INTRODUCTION
E-learning has become an important part of our educational life. Web-based learning systems have developed in many different fields to support the learners in the learning process. Previous learning methods were restricted to access and assimilation of knowledge. A web-based system is a valuable support for face-to-face communication. The art of designing good e-learning systems is difficult and is a great challenge for the human mind. The way this is done is also dependent on the culture in each country.

Traditional classroom learning is mostly based on *behaviourism* learning theories where the learner is the object of assessment. The teacher initiates the learning process and the learner responds. The other learning approach, *constructivism*, focuses on the learner's abilities to develop her own mental models and learning concepts [11]. This approach has more and more become accepted to be the most relevant method to promote learning, even at the university level.

Traditional lecture-based learning is not so attractive for students of today. This type of teaching is less effective and usually creates more passive students. By introducing web-based teaching systems one is able to create more constructive learning paradigms. The students will be more active in the learning process and more able to construct their own mental models of the learning objects.

User-friendliness is a critical factor in e-learning systems. Different commercial e-learning systems appear to contain much of the same functionality. It is often the intuitiveness of a system's user-interface that decides whether or not it is accepted and taken into use by the end-user. It is also important that the system offers a flexible learning platform that can easily be adapted to different learning situations and types of courses.

An important aspect with e-learning systems of today is that they are adapted to recent technologies such as mobile devices. Mobile systems are already an important part of our lives and the mobile e-learning approach will also be equally important as part of the web-based learning

paradigm of the future. Use of portable web devices are already an important part of the ICT learning paradigm. New learning modes will be introduced by using devices such as the mobile telephone, the PAD and GPS. All of these technologies have a great potential to be used in practical education.

About ten years ago e-learning systems like "Gudmundstad" and "Reidar" were developed and used in distance education. These systems also had impact on how e-learning systems of today are constructed. A new system, DPG, is based on new software technologies like XML, Java and design patterns. Use of these technologies makes the system more flexible and adapted to different kind of learning situations.

2. PRIOR E-LEARNING SYSTEMS

2. 1. The "Gudmundstad" Project
About ten years ago web-based learning systems were constructed and used that had great impact on the development of e-learning systems of today. The "*Gudmundstad*" project [5,7], for instance, was started in 1994 in the region of Bergen, Norway and was a quite successful e-learning project of its time. In figure 1 we see that the technological infrastructure of the system is used as a metaphor for learning. The project ended in 2002.

The project provided very useful insights into the development and growth of an e-learning system and a learning network that started from fairly local initiatives to regional, national and even international ones.

"Gudmundstad" has been used quite much in practical education. One project in the "Gudmundstad" learning environment was a project about

Figure 1. The "Gudmundstad" learning metaphor

"*Norse mythology*" where the students studied the beliefs of the Vikings. The "Gudmundstad" project has been described in the book "The Learning Highway" that was published in New York and Toronto in 1997 [7]. This book was the winner of the New York Public Library's Books for the Teen Age Award of 1997.

2.2. A Distributed Test System

One very important application of the "Gudmundstad" learning system was a distributed test system that was used in different school subjects [6]. The system was developed in C on the Solaris/Unix platform using CGI (Common Gateway Interface) programming for interaction between the Web server and an external program. The system demonstrates quite well at that time how to use the web to distribute resources between schools in the Bergen region, Norway. When logging into the test system, the user was either classified as a '*teacher*' or a '*student*'. Every test was given an *identification* number and the necessary information, like title, access lists, author, etc. was contained in a special *file*. When a teacher corrected a test, she could comment on individual questions, together with the total assessment. The result of the test was saved in a file. The student could then later on download the corrected test to see the result of the evaluation.

2.3. The "Reidar" System

In 1997 the "Gudmundstad" project was followed up with another e-learning system, developed on the Windows platform. This system was called "*Reidar*" [8]. The "Reidar" system was very much used in both the curriculum and in distance education at Bergen University College. The most important use of the system was as part of a collaborating project between the four university colleges of the western part of Norway. One very important application of the "Reidar" system was in English teaching at Bergen University College.

Students were using different kinds of Java programs that were developed, for instance, a program that supported the students in the learning of the *phonetics* of English. Students who were taking a one-year course in English learn how the alphabet of English phonetics was working. The students learn, for instance, how to relate *sound* and *symbol* of the English phonemes by using a *virtual keyboard* of the phonetic symbols that was developed in Java. The students learn how to *transcribe* English words by clicking on the phonetic symbols as shown in figure 2. Use of such an approach to English teaching was quite unique at that time.

3. SYSTEMS OF TODAY

3.1. It's Learning System

"It's learning" is a new e-learning system (http://www.itsolutions.no) that has been developed in Bergen, recently. It has had a great success in the Scandinavian market, with more than 450.000 users. The "it's learning" platform is designed for schools and universities. The origin of the "it's learning" system was a student project at Bergen University College in 1999. "It's learning" is a tool for supporting and enhancing different learning activities, new teaching methods and also providing easy access to knowledge.
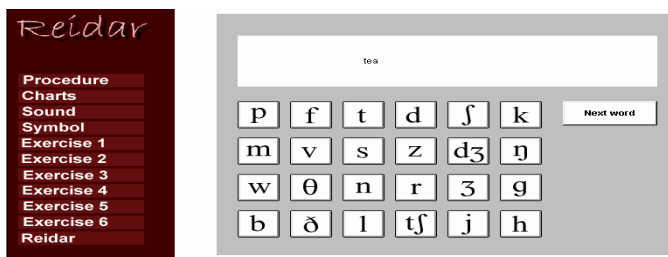
"It's learning" has a variety of built-in tools for communication and cooperation such as internal messaging system, e-mail, chat, SMS notifications, discussion forums, etc.. This offers a lot of possibilities for the instructor of a course. However, much of the tools are not necessary to design a course. They may appear as noise in a given learning situation. The problem is that the system gives the user too many possibilities. An ordinary user does not need all these options. Another problem is that the graphical layout and navigation are not consistent. This makes it difficult for the users to have a global overview and control the learning objects.

3.2. The DPG System

A problem with most of the e-learning systems of today is that the formatting is tightly coupled with the content. Decoupling of the two aspects are not always trivial. Cutting and pasting between existing and new pages is not always a good option, and usually the teacher will not have the necessary knowledge to program such a task. A simple web-based system that could take a new content and create a new representation based on the formatting and the functionality of the existing web pages could overcome such a problem.

By generating net-based presentations (for example online courses) based on presentation patterns one could solve such a problem. A *presentation pattern* specifies the pertinent aspects of a presentation: page rendering, the navigation and the requirements for the content it can display, so that a presentation can be generated by supplying the right kind of data. This strategy decouples the content from the formatting, and both the content and the presentation pattern can be reused.

Such a system is the Dynamic Presentation Generator (DPG). In this system the learning content is specified in XML and its structure is dictated by a Course pattern. The teacher needs only supply the contents of the learning material in order to create an online course. The system takes care of the rest; dynamically generating the web pages for the course and making them accessible to the users.

## 4. TECHNICAL DESCRIPTION OF DPG

4.1. The Workflow Model

The workflow model of the DPG system is shown in Figure 3. It comprises of two phases:

- The static phase, and
- The dynamic phase

In the static phase, the Repository Administration Tool (RAT) validates the data in XML files against the content structure specified in the presentation pattern. Only validated data is stored in a XML database. RAT is also used to retrieve the data from the database for updating purposes.

The core of the dynamic phase is the Dynamic Publishing Engine (DPE). Given the content tree and the corresponding presentation pattern, the

Figure 2. A virtual keyboard of the English alphabet

Figure 3. The workflow model of the DPG system
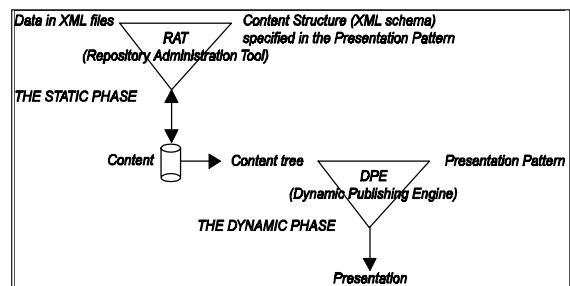
DPE renders the web pages that comprise the presentation. The DPE dynamically generates a web page in response to a browser request. The content tree is created from the content in the XML database at the start of the web application. Data for a browser request is retrieved from the content tree. Formatting of a web page is done according to the presentation pattern specification. The most obvious advantage of this workflow model is that different content and presentation patterns can be mixed and matched to create different presentations, as long as the content conforms to the presentation pattern.

4.2. Use of the DPG system

The DPG system has been used since 2003 to create online Java programming courses at the Department of Informatics, University of Bergen [3] and since 2004 at Bergen University College in a regular course in programming technology. The experience has shown that there are several advantages of using presentation patterns to create online courses. For instance, an initial investment in defining a suitable navigation structure and visually appealing layout can be capitalized on in later courses, as these aspects of a presentation are captured in the presentation pattern.

One high-priority task is to create new presentation patterns. Typical examples of new patterns would be for slide shows, for interactive presentation of a lecture or for "webifying" articles and books. The main challenge will be achieving this goal through reuse of web-based presentation components. The aim is not just to create dynamic HTML pages, but also to develop functionality that exploits the content in new ways. In terms of cost and effort, the threshold to deploy this system is low compared to other such systems.

5. DISCUSSION

There are a number of benefits by establishing a learning platform that separates the content from the presentation. In the future one may have a databank of learning contents and presentations patterns that teachers can use for creating online courses. A number of methodologies, technologies and tools exist today for organizing content for web-based presentations. Design and development of data intensive web applications is an area of active research [2,4]. These and other research teams are attacking the problem by defining the structure, navigation and layout of a web presentation using various data modeling formalisms. At the moment these approaches are still in the research domain, but may give valuable result in the future.

Most of the commercial e-learning systems of today have a lot of facilities, but are often missing a well-defined underlying pedagogical structure. This means that the major challenge for an e-learning system is the development of its pedagogical structure – not its technical functionality. To construct better e-learning systems one therefore needs to study more in detail how humans learn.

6. CONCLUSION

The application of e-learning technologies complements and enriches more conventional modes of education and training. E-learning systems as "Gudmundstad" and the "Reidar" of the nineties contain most of the key functionality of an e-learning system of today. However, the problem was a very tight coupling between contents and formatting.

The DPG system promotes reuse of both the content (i.e. learning material) and presentation patterns (leaning structure) for developing new courses. By using the DPG system non-programmers can easily use the system to create online courses once the presentation pattern has been defined. This approach is valuable in many online learning situations, where a full-blown e-learning system would be an overkill. Such a problem is contained in the "Its learning" system and other commercial systems of today and may disturb the learning situation, both from a user and a course administration perspective.

In the future we believe that interactive web-based e-learning best can be achieved by using different types of intelligent agents supporting the users in the learning process [1,9]. By introducing user profile agents, representing the learning profile of the users, we may be able to get the best-adapted learning material for each student. In the future we plan to combine a collaborative multi-agent system [10,12,13] with a presentation pattern regime, such as for instance DPG. In this way we should be able to construct a more flexible and user-adapted pedagogic learning platform.

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