Different E-learning Paradigms - a Survey

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Abstract

At the beginning of this decade a new Learning Management System (LMS) was developed at Bergen University College as a continuation of its for-runners. This system has been a great commercial success with the foundation of a company. Their e-learning system, "its' learning", is now being used in many universities, high schools and primary schools in our country and abroad.

New e-learning paradigms are now introduced at our university. The "Dynamic Presentation Generator" (DPG) and Dynamic Content Manager (DCM) systems are two such systems. One very important aspect of the DPG system is the decoupling of content from the formatting. This means for instance that in an educational context the system offers reuse of content and presentation patterns for developing continually online courses. The system uses the concept of a presentation pattern as a mechanism to capture the key aspects of a web presentation: layout, navigation and data structure.

In the DMC project these ideas are further developed. One focuses on removing the tight association between learning material to specific courses. In this system one defines a conceptual atomic unit of knowledge and builds up courses by the organization of these knowledge elements from the repository. The system allows the educator to create an arbitrary collection of knowledge elements, tag them with meta-information as a single unit and link the unit with previously saved and similar aggregations. The DCM system uses the ideas of Concept Maps to model the relationships between the knowledge elements that can be created by the instructor or the educator.

1. Introduction

E-learning has become an important part of our educational life. Different web-based Learning Management Systems (LMS) [6] have been developed to support the learner 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 as well as a way of transmitting the learning material to enhance the students' own studies. 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 learning culture in each country. The key issues are to facilitate new learning modalities for the younger generations. This is like a self-learning process where previous goals undergo continuously changes. Traditional classroom learning was former mostly based on *behaviouristic* learning theories where the learner is the object of assessment [20]. The teacher has the necessary knowledge, initiates the learning process and 'transmits' her knowledge to the learners. Another learning approach, *constructivism*, focuses on the learner's abilities to develop her own mental models and learning concepts. This approach has become more and more accepted to be the most relevant method to promote learning, even at the university level.

In the last years we have also seen a shift towards socio-cultural learning theories where learning is seen as integrated in social, historical and institutional practices [8]. Learning emerges as a mixture between theoretical knowledge, practice and discussions among students and supervisors. Focus here is not only on the 'single learner', but on the learner's activities in a community of practice [23]. The socio-cultural learning paradigm is a part of the constructivism in the spirit of Vygotsky [22].

2. The E-learning process

Using only traditional lecture-based learning is not enough for the students of today. This type of teaching can be ineffective and often creates more passive students in the learning process. By introducing web-based teaching systems one is able to create more constructive learning scenarios. The students may then be more active and more able to construct their own mental models of the learning objects, rather than doing only pure knowledge acquisition [1,17]. But there are problems with web-based teaching too. If the website is too overloaded with applications this may introduce noise in the learning process.

LMS has become a central agent for fulfilling these goals of optimal flexibility process, and LMS is an obvious tool for administration of students in e-learning courses, delivering learning material, as well as an arena for communication, problem solving and providing a common workplace for teachers and students.
Online learning is a major force giving optimal flexibility due to the *time* and *place* of the learner's study activities, and with the latest technological development there are vast opportunities for both synchronous and asynchronous cooperation, both between students and teacher and between students. These new communication tools facilitate dialogue and collaboration between the participants, even with the use of low-technological and low-cost computer tools [18].

Computers are well suited to deliver learning materials in different forms, checking what activities the students has undertaken, testing through quizzes and multiple-choice-tests the amount of 'acquired knowledge' the students possess. But the main findings from many studies indicate that without careful planning and painstaking efforts towards creating a learning environment enhancing student activity, promoting and rewarding collaboration and experience-sharing, the LMS carries out an *instrumental* form of teaching and learning. In accordance with Biggs [1], good pedagogical design requires consistency between *curriculum*, *teaching methods*, *environments* and *assessment*.

3. Paradigms of E-learning systems

3.1 Prior Systems

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 [9,10]. The "Gudmundstad" and "Reidar" learning environment at that time in Norway [11,12] had all the key facilities of a modern e-learning system. However, one major problem was that all the educational aspects of the system were hard-coded. Hence, important aspects of an e-learning system, such as its flexibility, reuse of learning content and presentation of learning material were missing. It was then difficult to construct flexible modes of learning because the use of the system has to follow a certain predetermined pattern. The systems that we now are developing in Norway are more flexible and founded on better learning principles.

3.2 it's learning System

"it's learning" is an e-learning system that has been developed in Bergen, Norway (http://www.itsolutions.no). It has been a great success in the Scandinavia market. 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 message system, e-mail, chat, SMS notifications, discussion forums, etc. This offers a lot of possibilities for the instructor of a course. However, on the other hand much of the tools are not necessary to use in a course by an ordinary user. The tools may appear as noise that disturbs the user in a given learning situation. One 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 of the learning objects [7].
"it's learning" is also a tool for course administrators and course leaders. The system provides a range of automatically generated reports that provide an overview of a group and individuals progress within the learning cycle. The problem is that the reports do not have a consistent design.

3.3 The DPG and DCM System

The Dynamic Presentation Manager (DPG) system [4] offers a more flexible learning platform that can easily be adapted to different learning situations and different types of courses. This is a very important aspect in practical education since it offers reuse of both presentation patterns and learning content.

A new project has now been started at Bergen University College. The Dynamic Content Manager (DCM) Project focuses on removing the tight association of the learning material to specific courses. It defines a conceptual atomic unit of knowledge and builds up courses by an organization of these knowledge elements from the repository. In the following sections we will describe the new paradigms, the DPG and DCM, more thoroughly, and how they are related to a modern e-learning platform or paradigm.

4. DPG

4.1 Decoupling from formatting

Consider a scenario where a teacher who is satisfied with the web pages that comprise a presentation on the net, would like to *replicate* the web pages with new content. In the worst case, the teacher has to start from scratch and re-implement the web pages with the new content. 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 the new content and create a new representation based on the formatting and the functionality of the existing web pages could overcome this 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. This decoupling means that the same content can be used to create other types of representations based on different presentation patterns, and the same presentation pattern can be applied to different contents to create the same type of presentation, as long as the content conforms to the patterns. In order to simplify setting up new on-line courses one wants solutions that do not require particular programming skills. The main objective of the teacher is to develop and presents good learning material.

4.2 Use of the DPG system

The learning content of the DPG system is specified in XML, and its structure is dictated by the course pattern. The teacher needs only support the content of the learning material in order to create an online course. The system takes care of the rest; dynamically generating the web pages of the course and making them accessible to the users.

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. From a course administration point of view, no programming experience is needed to prepare and update the content, and web-based tools are available for content generation and maintenance. In terms of cost and effort, the threshold to deploy this system is low compared to other such systems.

If the administration tool modifies the content, a publishing engine automatically updates the presentation. 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. The administration tool will also be extended to streamline the process for online course development, for example, by providing better support for content generation and customization based on presentation patterns.

5. The DCM System

Most of today's e-learning systems are based on the *constructionist* pedagogical theory. As such, they focus on enhancing the interaction of the student and instructor via the availability of various resources and activities. The educator avails various resources to the learner during the running period of the courses she is giving. There is mostly little support for the educator while creating the learning materials and because most systems do not have an easy-to-use navigation mechanism of existing resources, much effort is duplicated. The separation of learning content from specific courses and provision of visual navigation and arbitrary aggregation of the existing learning material helps the educator reuse existing resources and lets her focus on enhancing the quality of the knowledge unit in the repository.

5.1 Organization of Knowledge

The DCM system tries to remove the very tight coupling of learning material to specific courses. It defines a conceptual atomic unit of knowledge and builds up courses by organization of these knowledge units from the repository. This gives the ability to create knowledge elements at a finer granularity level which can be re-used across various courses. Resources like lecture notes, presentations, attachment files, questions etc… are attributed to the knowledge elements and hence can be imported while using existing knowledge elements. The DCM is designed with the functionality of knowledge elements, courses and resources versioning and history tracking so that changes made to the underlying knowledge elements is carefully tracked. This ensures that a specific course or some aggregation of the knowledge elements the educator has created, can appear unchanged as far as she is concerned while giving her a chance to follow the various revisions made on it.

A great emphasis is given on the design of the system and hence provisions are made for the seamless addition of external functionalities. The concept of dynamic presentation patterns is put into use in the DCM project. This gives the system the feature of being highly customizable in that the presentation of courses, resources and navigation, can all be enhanced according to the configuration set by the site administrators. The instructor is also be given the freedom to define the appearance of the courses she is giving and can use already used presentation patterns as well as define her own.

5.2 Concept Map

Concept Map is a graphical tool for organizing and representing knowledge [16]. We here define a concept as a perceived regularity in events or objects, designated by a label. When dealing with a huge collection of learning material in the repository, the level of its use greatly depends on its naturalness of its presentation and ease of navigation.

There is a lot of research going on world wide how to best model an arbitrary aggregation of small knowledge elements. The DCM system uses the ideas of Concept Maps to model the arbitrary relationship that can be created by the educators by their selection of the knowledge elements from the repository. The DCM provides the educator with a graphical navigation of the knowledge repository. Such a visual presentation gives the educator a feeling of the resources of the repository and enables her to create her own universe of collection of knowledge elements. The interconnection between the various knowledge elements, defined by many educators, can be used for data mining purposes and for creating better structuring of the knowledge repository as a whole. In a specific course the motivation of using Concept Map is to model the dependencies in the learning process. A sample Concept Map is shown in figure 1 on the next page.

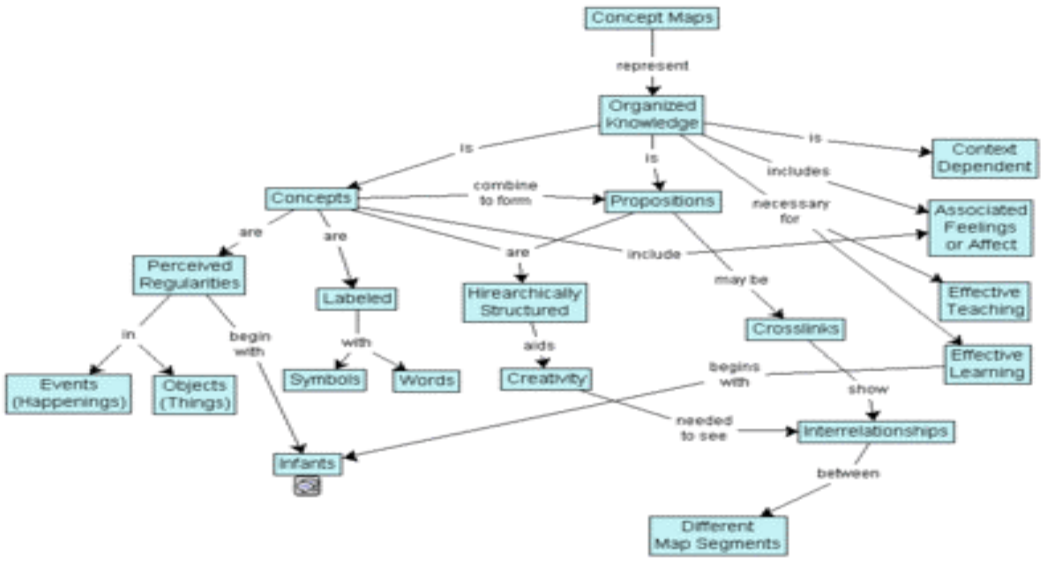

Figure 1. A sample concept map created using IHMC CmapTools.

5.3 Student Modelling

The DCM system also supports student modelling. Questions are related to the knowledge elements. Some question types have been supported with an extensible framework so that more types can be added as the project undergoes further iterations. The system defines a very simple model of the learner and puts her in some category with respect to a specific course she is taking. Currently the educator is responsible for updating the category of the learner, based on assessment. The DCM has a practice module where the learner goes through questions that have been associated to the knowledge elements of the course she is taking. The learner's category is taken into consideration and as a default optional filtering mechanism while providing the learner with practical questions.

6. Discussion and Conclusion

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 repository of learning content and presentation 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. The design and development of data intensive web applications is an area of active research [3]. These and other research teams are attacking the problem by defining the structure, navigation and layout of a web presentation using various data modelling formalisms. At the moment these approaches are still in the research domain, but may give valuable results in the future.

6.1 Impact for World-Wide Education

In many ways the DCM project may help to fulfill UNESCO's and World Bank's aim of giving access to education for students in developing and emerging countries [5]. It gives an ICT tool which is flexible with a user-friendly interface to be compatible with the main software on the market. It supports the student's work with the learning content in different ways, due to different teaching methods, learning goals, individual cognitive preferences and other conditions that influence the learning process. Being an independent platform, DCM can contribute to develop educational systems for developing and emerging countries to empower their inhabitants by getting access to better educational tools. Talking about

education as a tool for democracy, the word literacy is an important concept. In this situation we speak about ICT literacy [18] which is defined as giving the students knowledge, skills and attitudes which they need to handle the influences of ICT in their lives.

6.2 Concluding Remarks

We have introduced two new paradigms for e-learning systems which offer more flexible learning platforms that can be adapted to different learning situations. The DPG system promotes reuse of both content (i.e. learning material) and presentation patterns (learning structure) for developing online courses. By using the DPG system non-programmers can easily use the system to create online courses, once the presentation pattern has been defined. The approach is valuable in many online learning situations where a full-blown e-learning system will be an overkill. Such a problem is contained in most of the commercial systems of today and may disturb the learning situation, both from a user and a course administration perspective.

In the DCM project we want to establish an e-learning platform that separates the learning platform from the different courses. This will enhance more adaptive learning where the students may solve problems which are more suited to their knowledge level. We believe that this will also introduce more flexibility in the learning process where the students can assimilate the learning content in many different ways. This is implemented by using different Concept Maps for the syllabus. Such a platform will also contribute to reuse and share of the learning material.

By introducing software agents [19] in the systems we may be able to construct even more intelligent e-learning systems. User profile agents may collaborate with other agents to get the best learning material for the students [13,20]. The DCM platform is very much suited to handle agent based learning that makes the system more flexible and adapted to different kinds of users and their knowledge level. We are currently working on these aspects to include them into the DCM system.

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