

AN APPROACH TO DESIGNING PREDEFINED MODELS OF PEDAGOGICAL SCENARIOS FOR E-LEARNING

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Abstract: Our research relates to the problem of design and evaluation of hypermedia pedagogical environments. We aim to offer teachers with limited computer knowledge the opportunity to create their own pedagogical web sites, by proposing them dynamically generated models to choose from. This is what the netUniversité web portal was designed for. We will discuss here the mechanisms behind the automatic course generation, giving an insight into the design of predefined models of pedagogical scenarios. These scenarios are represented in IMS Learning Design formalism, which ensures the interoperability of the application. We will present here some of the challenges we had to face while designing the predefined pedagogical models and the adopted approach, with its advantages and limitations.

Keywords: educational hypermedia, IMS Learning Design specification, designing learning scenarios, project-based learning.

1. INTRODUCTION

Our research is situated in the field of web-based learning, more precisely the design and evaluation of educational hypermedia. The subject is a part of a larger project carried out by a research team at HEUDIASYC laboratory, called CEPIAH (Conception et Evaluation des Produits Interactifs pour l'Apprentissage Humain – Design and Evaluation of Interactive Products for Human Learning) – see (Trigano and Giacomini, 2004a; Trigano and Giacomini, 2004b; Giacomini and Trigano, 2004). The goal of this system is to help teachers that want to build an educational web site to design and evaluate their work. It is composed of three modules: "Design Support", "Evaluation Support" and "Predefined Models". The first two modules have already been realized, while the third

one is currently under development. It is made up of a web portal, called netUniversité, which was conceived as a support for the teachers with no web design knowledge. The idea is to dynamically generate educational web site models, having as start point an interactive questionnaire. The portal also provides facilities for course editing and management.

In this context, the idea was to design predefined pedagogical scenarios for e-learning. This involves two research directions: first a study concerning the main learning theories and the way they influence instructional design and secondly a study concerning IMS Learning Design standard that netUniversité is based on, especially levels B and C.

Thus the main objective was to propose teachers a set of learning scenarios with true pedagogical value, since the trend is to move the focus from the technological part to the actual learning part in e-learning. Another objective was to ensure the interoperability between applications, opening the possibility of free circulation of courses. Therefore the choice to support IMS Learning Design, a specification that values pedagogical principles, focuses on instructional content and supports personalized learning experiences (Hummel *et al.*, 2004; Koper and Olivier, 2004).

This paper will first give a short overview of the underlying netUniversité platform, focusing on the dynamic course generation principle; next, the basic design procedures for IMS LD templates will be presented, followed by some concrete examples. Finally we will draw the conclusions, presenting the value of the work, its limitations, as well as the research perspectives opened by this project.

2. NETUNIVERSITÉ PLATFORM

2.1. General Presentation

The netUniversité web portal allows for the automatic generation of educational web sites, as well as providing facilities for editing and management. The application is structured in three parts that provide the above functionalities: course generator, course editor and course navigator, as shown in Fig. 1.

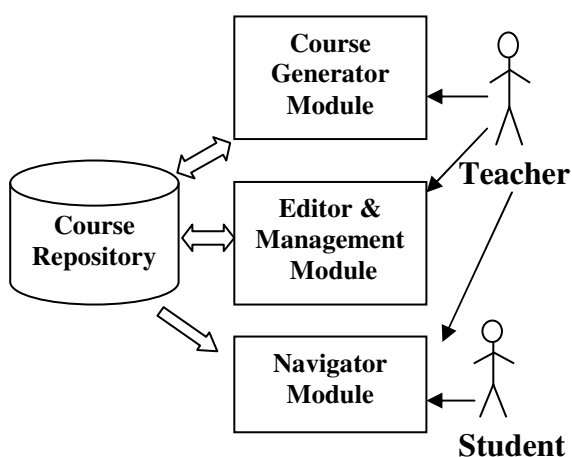


Fig. 1. netUniversité – general structure

The general idea is that each course is saved as two XML files, one for the pedagogical content (respecting the IMS Learning Design standard) and the other for the GUI aspects. The information contained in the two XML files is then used to dynamically generate the HTML page that will be presented to the user.

The idea behind the generator is that courses can be automatically generated starting from some elementary pedagogical scenarios ("bricks"). These predefined models are stored on disk and combined according to the teacher's preferences at generation time. Thus the automatic generation is based on the teacher's answers to two questionnaires, one concerning the pedagogical concepts and the other related to the GUI, as shown in Fig. 2.

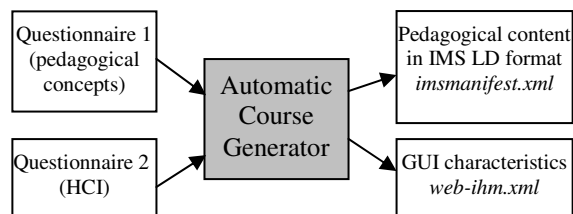


Fig. 2. Course generator (general presentation)

The design and aggregation of the elementary pedagogical models comprised several stages. The first phase was dedicated to a thorough research study concerning IMS Learning Design standard on the one hand and the learning theories and instruction principles on the other. The second phase consisted in conceiving the narratives of the course scenarios based on the pedagogical findings. The next phase was the translation of these models in a more formal way, using UML modelling. Next, the course templates were translated in IMS Learning Design and the resulted files were tested using the netUniversité platform. The last phase consisted in conceiving the interactive questionnaire and modelling the knowledge base so as to provide the final course templates, as a combination of the predefined primary models (according to the criteria specified in the questionnaire answers).

The answers related to the graphical interface have a one-to-one correspondence with the GUI characteristics generated in the *web-ihm.xml* file. However, the processing of the answers to the pedagogical questionnaire is much more difficult, since it involves selecting and combining several elementary pedagogical bricks to create the final *imsmanifest.xml*. In order to handle the complexity of the rules and conditions necessary for the automatic generation, we have designed a system based on JESS (Java Expert System Shell). Thus the answers to the two questionnaires represent initial facts in the corresponding knowledge base and the JESS inference machine is used to generate the web site structure in XML format.

2.2 Positioning of netUniversité within the Context

IMS LD is a complex and expressive specification therefore requiring a substantial supporting framework of components and services, as suggested

by the Valkenburg Reference Architecture (Koper and Tattersall, 2005). Although IMS LD is at its very beginnings, some specialized software already exists. We can thus find several existing editors, such as RELOAD, Perot LD Editor, Komposer (as tree-based editors) and MOT+, Eduplone LearningSequence, elive LD-Suite (as high-level editors). As far as the runtime tools are concerned, the CopperCore engine should be mentioned, together with the RELOAD Player which is based on it. In this context, netUniversité offers a global tool, integrating most of the needed tools:

- course generator based on a questionnaire (creation from templates)
- editor for all 3 levels (one very close to specifications, pretty low-level and one more high-level with a graphical interface; the editor is pretty close to RELOAD conception, offering also a tree view with drag and drop facilities)
- player for all 3 levels (presenting content in HTML form appropriate for display in any web browser)
- administrative tool (allowing for enrolling students and/or teachers to courses)
- materials editor (an integrated HTML editor)

Among the functionalities that are out of the scope of netUniversité are included: a constraints editor, the possibility to create UOLs starting from scratch, a way of editing the presentation of LDs, a material repository, advanced testing support (debugging, validity checking, simulations).

To sum up, netUniversité is one of the first platforms to support all three levels of IMS LD and the first one to integrate full functionality in a single product, freely available online.

3. DESIGNING PEDAGOGICAL SCENARIOS

As already stated, netUniversité web portal is based on the IMS LD standard, a specification released in February 2003 and inspired by EML (Educational Modelling Language). The IMS Learning Design Version 1.0 final specifications ("Learning Design Information Model", "IMS Learning Design Best Practice and Implementation Guide" and "IMS Learning Design XML Binding") are freely available at <http://imsglobal.org>.

IMS LD is used to describe learning scenarios that can be presented online and shared between systems and learners. The choice of IMS LD was based on the richness and expressivity of the specification, which meets all the necessary requirements (completeness, pedagogical flexibility, personalization, formalization, reproducibility, interoperability, compatibility and reusability). IMS LD describes how the learning proceeds through the analogy with a

theatrical play, involving a series of acts, roles (learner or staff) and activities, supported by different environments (services and learning objects). IMS LD has three levels of implementation. Most of the pedagogical scenarios proposed are based on levels B and C of the specification, which add greater control and complexity through the use of properties, conditions and notifications respectively.

Consequently, designing the pedagogical templates is a complex task, involving five phases: analysis, design, development, implementation and evaluation (Morrison and Kemp, 2004). The focus of this article is on the first two phases. The analysis phase concerns defining a specific educational problem, clarifying the subject of learning, the learner profiles, the most adequate learning strategies and a way of evaluating the learning results. This phase concludes with a narrative which in the design phase will be translated into a more formal UML diagram. In the last stage the learning flow is coded into XML, thus resulting the filled-out templates - the XML instance documents without the resources, which will be subsequently added in the development phase. It's in this phase only that the teacher is involved in case of the netUniversité platform - the analysis and design phase are hidden from the teacher, who is offered a course template that must only be filled in with instructional content in order to become usable. The teacher should also extend the model provided in order to contain the desired number of chapters; he/she is also offered the possibility to modify the built-in scenario by adding/deleting activities, properties and conditions. This is done easily by means of the integrated editors (and especially the graphical one which provides a very simple and intuitive manner of working with activities at level A). The idea is that it is always easier to modify a template than to build one from scratch. The most important thing to add are the resources, which can take the form of an uploaded file, an in-line content (an HTML embedded editor is offered in this respect), a QTI type test (multiple choice questions, fill in the blanks, open questions etc).

We will now illustrate the process of designing IMS LD course templates by means of a simple example, the "Individual Project Based Learning" model. The idea is that the learners are presented with a real-world problem that they have to solve, which is supposed to facilitate the learning process, according to Merrill (1999). Indeed, when engaged in solving an authentic, real world and if possible personal problem, the students are more motivated to learn. As Jonassen (1999) put it, "The problem drives the learning. Students learn domain content in order to solve the problem, rather than solving the problem as an application of learning". The role of the tutors is highly important in project-based learning, since on the one hand they should provide interesting, ill-defined problems to solve and on the other hand they should continuously monitor the learning process,

offering constant feedback and assistance whenever required. They should also encourage students to reflect on their work, to analyze their progress and achievements. Schank's learning by doing model also emphasizes the fact that students practice their skills and also seek and use relevant content knowledge by trying to achieve their goal (Schank, 1999).

The learning activity flow is summarized in the UML activity diagram found in the Appendix. The basic ideas are:

- the teacher formulates the project assignment
- the student defines and clarifies the task that lies ahead, identifies learning issues and goals
- an initial design plan is consequently elaborated
- the necessary resources are identified, with the help of the teacher
- a preliminary report is sent by the student
- the teacher provides the necessary feedback
- the project is evolved in successive iteration, each of which containing several phases: acquiring the needed information, resources and expertise, developing the project, assessing the current version of the project. Each iteration is ended with a report sent to the teacher.
- the teacher provides feedback after each iteration
- after the final iteration, the student finalizes the solution and hands in the final version of the project for assessment
- the teacher evaluates the projects and provides a grade
- the student submits its reflections on the learning process, evaluating the learning gains
- the teacher provides the final feedback, assessing the whole learning process

A few notes should be made regarding the IMS LD translation. Obviously, there are two roles in the Unit of Learning, the student role (learner) and the assistant role (staff). Both the learning-activities and the support-activities are grouped into activity-structures, grouping which helps the handling of visibility/accessibility issues, together with the properties and conditions (e.g. whole activity-structures are made visible as the result of a change in a property value). Moreover, since no synchronization points are needed (each student works individually), the grouping of all learning-activities into one complex activity-structure offers the possibility to include it in a single act. Thus there is only one play, containing one act, since there is no need for synchronization between students. Consequently each student can work in his own rhythm, independent from the other students. However, there is a need for parallel working with the teacher; therefore the act contains two role-parts,

one corresponding to the student and the other to the assistant. The properties are mainly used to manage the visibility of student activities (locpers-properties) but also to retain the email addresses of all the users involved (gloppers-property) or to handle the project submission deadline (loc-property).

4. CONCLUSIONS

4.1. Achievements

In the context of a dynamic domain as e-learning, with rapid growth and continuous change, *netUniversité* web portal appears as a free and easy to use solution for educational hypermedia generation, being among the first platforms to support the IMS Learning Design specification. Furthermore, the design of course templates using IMS LD is at its very beginnings, especially when it comes to levels B and C of the specification. Apart from its novelty, the *netUniversité* approach also has a sound pedagogical component, reflected in the richness and variety of the learning theories is supports.

4.1. Perspectives

In order to provide a finer degree of granularity, an extension of the pedagogical questionnaire could be proposed – thus there can be offered two questionnaires, one regarding the structure of the entire course and one getting into the details of each lesson or chapter.

Another valuable research direction would be to provide more support for *adaptive scenarios*, a crucial step for the individualisation of the teaching process.

From the point of view of the whole *netUniversité* platform, but with influence on the template design decisions, *extending the functionality* is an aspect to be taken into consideration as future work.

Finally, an alternative approach could be used for the conception of the course templates instead of creation by analysing theoretical pedagogical approaches and best practices. This approach, namely *extracting patterns from LDs*, was suggested by Brouns (2004). The opportunity of replacing the traditional approach should be analysed as more and more IMS LD models will become available in the near future.

APPENDIX

Fig. 3 presents the learning flow of the project based learning scenario, by means of an UML activity diagram.

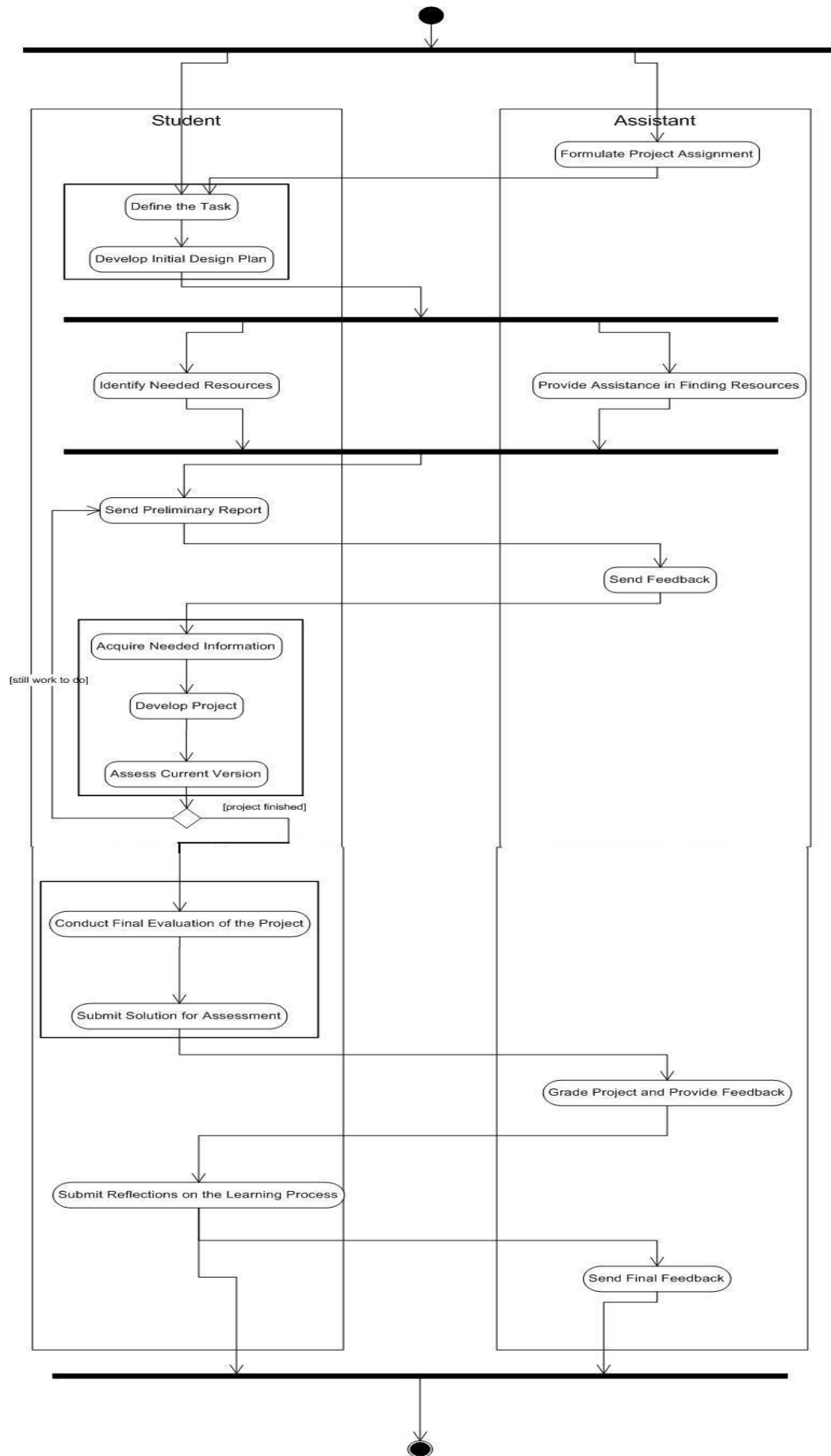


Fig. 3. "Project based learning" – UML activity diagram

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