AUTHORING A COLLABORATIVE TASK EXTENDING THE IMS-LD TO BE PERFORMED IN A STANDARD-BASED ADAPTIVE LEARNING MANAGEMENT SYSTEM CALLED ALFANET

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The authoring process in adaptive Learning Management Systems should facilitate authors the specification of how services are to be used in the course context and how the run time adaptation has to be delivered. These specifications should be used as well to provide useful feedback to authors after the learners real experience in the course. In this paper, we deal with these aspects in the context of aLFanet (IST-2001-33288) within a collaborative task.

1 Introduction

Adaptive Hypermedia and CSCL scientific communities are working together to develop adaptive systems in cooperative and collaborative environments that present the most appropriate information according to the user needs, and with the most suitable way for its comprehension. This support can prevent users from feeling isolated in contexts such as distance learning.

In this particular context, where there are groups of students learning together and using the available services provided by specific Learning Management Systems (LMS), some pending issues affect the effectiveness in the learning process. Most of these issues are related to the lack of personalised guidance while executing course activities in these services and the variety of information and communication channels available[3]. To overcome these problems adaptive responses to learners have been provided. In particular, two different and complementary approaches have been applied. First, from the teacher point of view, predefined rules that consider course tasks have been used for situations that arise during the student interaction, which entails to know the situations beforehand[5]. Second, from the interaction perspective, dynamic recommendations have been produced based on learnt user models from the data collected from users' interactions. To this end, several machine learning techniques have been applied[15].

Both approaches intend to adapt the learning environment to the users' needs. However, the essential elements of any course, i.e. the contents and the methodology that should be followed to work with them, are usually not taken into account when adapting the learning environment. Making an analogy with the face-to-face learning, this is similar to focusing on the elements that are available in a classroom (e.g. tables, chairs, notebooks, pens, pencils, blackboard, etc.) and how they should be used (e.g. close to whom each learners should be sit, whether to use pen or pencil to write on the notebook, when the teacher should explain something in the blackboard, etc.) and not taking into account the books (yes, there are 'also' books in the classroom!) where the contents and the activities are defined. Why do not give the author of the course materials the opportunity to specify how and when the services available in the LMSs can be used? And, even more, why do not allow authors control how the run time adaptations have to be delivered?

Nevertheless, this is just half of the problem. Authors can specify the methodology, the activities and the resources to use in order to drive learners along the course, but it is up to the learners to make use of them in the way described by the author or not. Learners can be in the classroom doing something completely different from what is written in the book, or if there are no books, they can be doing what they may think can be useful for their learning. Thus, it is needed a follow up of the contents that learners are reading, the activities that learners are doing and the environment settings that learners are using. This monitoring implies modelling the elements defined in the scenario (i.e. learners, contents, activities and services) and the interrelations among them. This equals to knowing which pages of the book each learner is reading at any time, what activities the learner is doing, in which table the learner is sit while writing the activity in the notebook in pencil, and to whom the learner has asked the doubts. However, there is a frequent lack of feedback in e-learning courses[11].

We propose to address these two problems in an integrated way. On the one hand, how to facilitate authors the specification of the services usage inside the course and what adapted responses should be given at run time based on the authors' knowledge. On the other hank, how to provide feedback to the authors based on the monitoring of learners interactions. In this way, we expect to increase the learning effectiveness, since we are integrating the expert knowledge with the real learning outcomes.

To tackle this problem in every sense of it is not practical at all. Therefore, in this workshop we present a proposal to allow authors explicitly specify at design time how they want services and adaptation to be managed on run time in a collaborative task described elsewhere[614] called the Collaborative Logic Framework (CLF). The CLF is an extension of the Logic Framework methodology [2] to allow real collaboration among students. This task has been designed domain independent and is supported by a user model built from learners' interactions within the task[6]. The goal is that learners work

collaboratively to provide an agreed solution. It comprises 4 stages which are controlled by the different roles learners have during the interaction, i.e. individual, passive and active. To facilitate an efficient collaboration, learners are divided into subgroups, and one learner of each subgroup is chosen as its moderator to promote collaboration and communication inside it. Both tasks are done automatically by the system based on the learners' user model obtained at the Interaction Stage, which simulates a small CLF to teach its methodology[14]. To perform the task, the LMS provides forums and file storage areas, and allows learners to add comments, ratings and new versions to the files[a].

2 aLFanet approach to support the authoring process

Active Learning For Adaptive interNET (aLFanet - IST-2001-33288) addresses the problem of effective adaptive learning in a web-based environment that provides communication and collaboration services[b].

Focusing on the authoring process, in the introduction we have identified two problems that are not currently integrated inside LMSs. Regarding authors' design of courses, there exist educational standards that allow them to specify the characteristics of the contents to be used in the course (e.g. IEEE Learning Object Metadata), to define different types of learners (e.g. IMS-Learner Information Package) to whom the learning process has to be different, and to sequence the activities the learners will have to accomplish depending on the learners' features and the environments where these activities are to be performed (e.g. IMS-Learning Design). Thus, they allow the authors to give adaptation at design time by specifying the Instructional Design of the course. However, despite this, courses usually have these two kinds of resources, collaboration services and contents, loosely coupled, which difficult usability and learning[10]. Moreover, authors do not have at design time any facilities to control how run time adaptations have to be delivered.

The second problem (i.e. how to provide feedback to authors based on the monitoring of learners' interactions in the course) implies an auditing process on the interactions performed by the learners to extract relevant information to feed the author back the real experience on the course.Passier and Jeuring[12] call this type of feedback *group feedback*. For them, group feedback is feedback to the author of the course from a group of learners who study it. They intend to develop mechanisms based on ontologies to create a rich supply of feedback in the context of design-oriented education.

To cope with these two issues aLFanet includes an Authoring Tool and an

[a] The original proposal used surveys instead of files

[b] This project is the result of the joint effort of four developer partners (Software AG España, Universidad Nacional de Educación a Distancia, Open Universiteit Nederland and ACE-CASE) and two user partners (Ernst Klett Verlag GmbH and Electricidade de Portugal Mudança e Recursos Humanos S.A.)

Audit Module. The Authoring Tool has been implemented by ACE-CASE and allows authors to create new courses using the IMS-LD standard. However, as it has been proved in the first prototype evaluation at the four Pilot sites settled in aLFanet, creating courses IMS-LD compliant is not an easy task. To facilitate the work to the authors, pedagogical models can be defined in aLFanet that allows authors to create their courses by following the guidelines of predefined templates. Currently, a template based on concept learning[9] is being used to define the courses at aLFanet Pilot Sites. This template is not yet integrated inside the Authoring Tool, but it is expected a full integration of it in the following version. This integration can be obtained in the following ways: 1) importing IMS-LD skeletons in the Authoring Tool, that can be extended, reorganized and modified by authors, and 2) allowing authors to add links to specific services already defined in the environment (as well as to learning objects) so learners can go directly to them from the activity description.

On the other hand, after the execution of the course, the Audit Module is in charge of auditing the differences between the design and the actual learning process. In this way, authors receive feedback from the system by comparing their initial design and the real performance of learners. This module is currently under development at the OUNL. Thus, it is expected to provide authors feedback about completeness, timeliness, synonyms and homonyms as[12] have defined based on the concept learning theory.

At publication time, authors' design is translated into the run time environment, by creating and configuring the services with the corresponding parameters and access rights. Specifically, it is needed a mapping between the IMS-LD services specification and the services the particular LMS provides. During the run time, the learners' interactions are recorded and analysed. After the learning experience, feedback is given to the authors based on them.

3 Extension to the IMS-LD standard for authoring the CLF

As discussed before, the extension to the IMS-LD is going to be performed via the definition of templates. The IMS-LD specification enables the formally coding of learning designs. This opens the possibility to determine how authors actually have created learning designs and to analyse the material for occurrence patterns. A pattern is an abstraction of a set of good practices to fulfil a recurrent design problem and thereby captures successful solutions[1]. Hence, it functions as a template for new courses. Brouns et al.[4] have identified three scenarios to develop effective online courses. In the third one, the designer searches for course patterns that can be used to develop the new course. Such pattern is a kind of template that can be filled in to create the new course. Patterns can be chained like building blocks to create the new course. After evaluating the course new patterns can be derived from this and other courses.

The principle of IMS-LD is that a person assumes a role in the teaching-learning process. When in a particular role, the person has to perform learning activities to attain certain learning objectives. The activities are performed in an environment consisting of resources, learning objects and services in support of the learning process. Activities can be combined into activity-structures. The pedagogy is expressed in the method determining the activities that have to be carried out by a certain role at a specific moment[8]. The IMS-LD specification holds that it supports group and collaborative learning of different kinds since a collaborative learning experience can be described by associating multiple people and/or multiple roles to the same learning activity. However, IMS-LD provides no means to specify how the members of a group interact within each learning activity. It only states that if multiple individuals are to collaborate or work together at the same time, this has to be done through a service in their assigned environment that supports this collaborative capability[7]. For this reason, Hernández et al.[7] have proposed an extension of the IMS-LD service specification consisting of a special type of service called groupservice, which includes collaboration-related capabilities. Nevertheless, they do not say anything regarding run time adaptation requirements (which are not present in their environment).

Therefore, we bring up another proposal that address the following objectives: 1) integration of the services usage in the context of the activity, 2) control of the run time adaptation from the course design, and 3) facilitation of the feedback to the author.

In the particular case of the CLF, the author would probably be interested in specifying a maximum and minimum number of learners in each subgroup that she considers are acceptable for the collaborative task to be useful. Or she may like to specify when the learners should start discussing in a specific forum. The possibility of explicitly define the forum where the discussions are taking place allows the author to receive specific feedback on how the collaboration has been in that particular forum, that is, it is clearly defined where the discussion predefined by the author had taken place. The real experience followed by the learners can be compared to the design specified by the author.

Next, we show how we propose to support the interaction in the CLF and how to control the run time adaptation from the course design.

3.1 Extension to support the interaction in the CLF

The aim here is two fold: 1) to design collaborative activities defining the resources to be used in them, both contents to work with and services to use, and 2) to configure the collaborative activity with default, maximum and minimum values for the different properties to indicate to the run time environment the constrains introduced at design time. In order to achieve it, the template has to collect the following information from the author:

- List of learning objects specified with metadata in IEEE-LOM.
- Name of the Folder where the learners have to upload their files.
- Name of the Forum where the learners have to create new threads after the file has been uploaded.
- Activity Description, which should contain specific links to the learning objects and service elements (i.e. the folder and forums name previously defined) that learners must use in the activity.
- A property to say if an Interaction Stage is needed or not. If the answer is yes, the author has to fill a similar template without groups formation.
- Local-Properties to configure the Groups formation, such as minimum and maximum number of members in a group.
- Local-Properties to configure the criteria used to select the moderator for the subgroup.
- Local-Properties to configure the duration of each of the phases (e.g recommended duration for the individual stage, deadline for the moderator to hand in the proposed solution and final deadline for the task).

3.2 Extension to control the run time adaptation from the course design

Regarding the adaptation coverage, if defines to what extent the course designed complies with the requirements of the adaptation tasks (e.g. to be able to generate a peer-to-peer recommendation, the course needs a collaborative learning design somewhere). Moreover, from the different learning pedagogical situations that can take place, some are more relevant for the achievement of the course objectives than others. To facilitate the focus on the relevant aspects for adaptation in the course, additional information has to be provided. In this case the template addresses the following objectives:

1. Select the level of adaptation to be provided. Perhaps the author has not designed the course to be adaptable, or, she may have designed it in order to profit only from adaptation of collaboration. Thus, the author could specify in the template whether she wants adaptation or not, and if wanted, what kind of adaptation is more important in the course (e.g. if the system must promote the use of a concrete service, if it is needed to put emphasis on anticipating problematic situations that can take place, etc.). This allows to select the types of adaptation tasks to be provided.
2. Indicate the configuration data for the adaptation tasks to be performed (e.g. configuration parameters, focus of the adaptation task, i.e. learners, services, etc.). For instance, a property to allow authors indicate whether

the system is allowed to relax the deadlines defined for the CLF depending on the contextual situation. The way adaptation is provided on run time for each type of activity tells how the activity is presented to the user and how the services are going to be used depending on the individual characteristics of each user.

3. Define who should have the initiative in the course (i.e. the learner, the tutor or the system), which differs on when recommendations are obtained and how are presented to the user.

4. Define the measurement used to evaluate the students' performance. This value is critical to give the feedback to the author, as well as to validate the effectiveness of the learning.

4 Discussion and Future Works

This paper intends to give some light to the problem of authoring adaptive courses in collaborative environments. However, there is still a lot of work to be done. Therefore, we do not present a closed proposal, but an initial approach to be used as a starting point and discussed in the workshop.

Our proposal is based on templates to allow authors design courses, guiding the author on how to use the adaptive capabilities of adaptive LMS. In aLFanet, an Authoring Tool is used to design IMS-LD compliant courses and an Audit Module will provide feedback to authors' course design. These two components will take into account the considerations discussed here to be implemented in aLFanet.

Fortunately, thanks to the use of educational standards, we can build concrete scenarios explicitly described in terms of IMS-LD made up of learning activities and materials, well known types of users with their corresponding roles (tutors, learners, moderators, etc.), relevant features to define users' profiles (learning styles, knowledge background, preferences, etc.) and clear learning objectives to achieve.

To conclude let's emphasize that our approach tries to complement adaptive needs in threefold. First, to guide learners in the CLF collaborative task according to the design time specifications provided by the authors. Second, to control from the design time how the issues that cannot be predicted at design time should be managed on run time (e.g., a particular user has uploaded a report of interest to support a course activity). Third, to provide sensible reports to authors to help them to evaluate how learners are dealing with course activities.

Acknowledgments

The authors thank aLFanet partners for their work in the project and the European Community for the economical support for this research.

References

1. C. Alexander, *The Timeless way of building* (Oxford University Press, 1979).
2. AusAid (Australian Government's overseas program), *The logical framework approach* (AusGUIDELines contents, 2002).
3. J.G. Boticario, E. Gaudioso, F. Hernández, O.C. Santos, A. Rodríguez, C. Barrera, *Current Problems in eLearning and the aDeNu approach* (Eadtu Anual Conference E-Bologna, 2003).
4. F. Brouns, R. Koper, J. Manderveld, J. van Bruggen, P. Sloep, P. van Rosmalen, C. Tattersall, H. Vogten, *An Exploration of Technologies for the Inductive Analysis of Learning Design Patterns* (in press, 2004).
5. R.M. Carro, A.M. Breda, G. Castillo, A.L. Bajuelos, *A Methodology for Developing Adaptive Educational-Game Environments.* Adaptive Hypermedia and Adaptive Web-Based Systems, eds. P. de Bra, P. Brusilovsky, and R. Conejo (Springer-Verlag, pp. 90-99, 2002).
6. E. Gaudioso, O.C. Santos, A. Rodriguez, J.G. Boticario, *A Proposal for Modelling a Collaborative Task in a Web-Based Learning Environment.* UM'03 Workshop User and Group models for web-based adaptive collaborative environments (University of Pittsburg, 2003).
7. D. Hernández, J.I. Asensio, Y.A. Dimitriadis, *IMS Learning Design Support for the Formalization of Collaborative Learning Patterns.* 4th International Conference on Advanced Learning Technologies (in press, 2004).
8. R. Koper, B. Olivier, *Representing the learning design of units of learning* (Educational Technology and Society, in press, 2004).
9. C.B. Leshin, J. Pollock, C.M. Reigeluth, *Instructional Design Strategies and Tactics* (Englewood Cliffs, 1992).
10. B. Mehlenbacher, *Designing Web-Based Training: Combining Usability Issues and Learning Theory.* IPCC-SIGDOC, 2000.
11. E. Mory, *International ConferenceFeedback research revisited.* Handbook of research for educational communications and technology, ed. D.H. Jonassen (MacMillian Library Reference, 2003).
12. H. Passier, J. Jeuring, *Ontology based feedback generation in design-oriented e-Learning systems.* (IADIS e-Society, 2004)
13. O.C. Santos, J.G. Boticario, E.J.R. Koper, *aLFanet.* Advances in Technology-Based Education: Toward a Knowledge-Based Society, eds. A. Méndez, J.A Mesa, J. Mesa (m-ICTE, 2003a)
14. O.C. Santos, A. Rodríguez, E. Gaudioso J.G. Boticario, *Helping the tutor to manage a collaborative task in a web-based learning environment.*IV: Intelligent Management Systems, eds. R. Calvo, M. Grandbastein (AIED'03, pp. 153-162, 2003b).
15. S.G. Smith, A. Blandford, *ML Tutor: An Application of Machine Learning Algorithms for an Adaptive Web-based Information System.* IJAIED Vol. 13 (2002).