Modeling collaborative learning activities on e-learning platforms

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Abstract

The scenarization of educational activities, especially those that are going to take place within e-learning platforms, has for a number of years represented a major challenge for groups working to favor the emergence of educational standards. In this paper we describe a meta-model, LDL (Learning Design Language), to formalize scenarized activities. We particularly highlight the correct adaptation of this meta-model for modeling various collaborative situations.

1. Introduction

Today, it is easy to find "lesson plans" or "pedagogical scenarios" made available on the Web by teachers themselves for their peers [1] [2]. These scenarios are usually described by a textual description giving links to resources, sometimes completed by an organization plan. Moreover, the progress made in the fields of semantic Web, architecture modeling and protocols of interoperability leads naturally the distance education designers to imagine opened, tailorable platforms that could be adapted to their users' needs. The scenarization of the activities is part of these new technical possibilities of tailorability offered to teachers. Researchers in this field are trying to increase the degree of educational freedom teachers have. To do so, they do not favor any educational model *a priori* in their models or tools. Teachers have the choice and the responsibility to decide on the organization and content of the computer-based activities they plan. It is probably for this reason that the scenarization of educational activities, especially those that are going to take place within the e-learning platforms, has for a number of years represented a major challenge for groups working to favor the emergence of educational standards.

The OUNL was a pioneer in this subject with its initiative of proposing the EML (Educational Modeling Language) meta language [3]. This meta language has been adopted by IMS and has resulted in the IMS-LD standard specification [4]. Even though EML has been adopted by IMS, there remain barriers to its adoption. Particularly, it is not always easy to model a collaborative learning situation using IMS-LD level B and C. Several teams [5], [6], [7] have developed extensions to IMS-LD or competing meta models, tools and methodologies for modeling and implementing learning activities on e-learning platforms.

In this paper we propose an alternative meta model which is particularly well-adapted to modeling collaborative activities.

2. Classes of « Situation »

Throughout their life, learners face numerous and varied educational situations. These situations differ mainly in the way they organize the relation between the teacher, the learner and the groups i.e. the team or the class to which both belong.

According to these criteria, it is possible to distinguish typical situations:

- A frontal situation, in which participants have individual activities and no relations with the other participants, except with the teacher who oversees, stimulates, coordinates and controls. The teacher has a central position in the exchange and in communication.
- An open situation in which participants can cooperate freely with their peers or with the teacher(s). In these situations, each participant is supposed to produce results.
- A collective situation in which participants cooperate in order to solve a collective problem which has been given to them. In these situations, any participant's contribution is considered as the group's contribution.

In real educational practices, these various forms can be combined with each other in hybrid educational situations that can evolve over time. From a scenarization point of view, to guarantee the teacher's freedom, the meta-model should make it possible to model all situations and their possible combination.

3. A lifelong learning example

The chosen example is inspired by a real lifelong learning scenario proposed by the "Centre National d'Enseignement à Distance" (the CNED, a French educational institution in charge of organizing distance training). It highlights the heterogeneousness of educational situations encountered by students during a course. CNED offers each year, under the condition to have the baccalauréat (a high school degree), a course in astronomy and astrophysics. This leads to a degree delivered by the University of Paris IX. Part of the learning objectives is to acquire a basic knowledge of astronomic observation and its means. Registered lifelong learners usually don't know each other. They may have different objectives: personal, civil, social and/or employment-related [8].

The narrative: during the course, each learner has access to the lessons one chapter after the other, according to a well defined progression. For each lesson, s/he has to learn it and to do exercises. S/He can communicate with her/his peers to get help. For instance, learners have to observe the sky with the naked eye. Each learner has to make sketches of her/his planetary observations justifying theoretically their positions and movements. Each learner does the exercises and sends them to their teacher. The teacher annotates them, marks them and sends them back. If the learner has sent enough work to her/his teacher throughout the course with "good" marks, the administration gives her/him the authorization to start the examination preparation phase which consists of questions given one by one by the teacher to the group. Each time a learner answers, a new question is given to the group. Finally, the course is validated by a final examination.

This example illustrates various basic situations listed above: individual ones coordinated by a teacher i.e. frontal distant (course learning), open ones (the exercise phase) and collective ones (the examination preparation phase).

4. Learning Design

We agree with R. Koper & al [9] that the learning design is the human activity of designing units of learning, learning activities or learning environments. From our point of view, a scenario is the specification

of a learning activity. It specifies the « why, who (in terms of roles), where, when, how » related to this activity. It is the result of a learning design activity.

The previous example highlights that learning situations are usually complex. An educational modeling language is supposed to provide the means to describe various learning situations, and to specify the related learning activities. We call this the specification of a scenario.

4.1. Scenario, scenarized activity, operationalization, execution

A scenario is the specification of a future learning activity which becomes a "scenarized activity". To create a corresponding activity in a targeted environment, like the CNED educational environment, a scenario has to be "operationalized". This consists firstly in choosing the participants, then attributing roles foreseen by the scenario to the proper participants, and finally selecting the services and contents required by the scenario.

The execution of the operationalized scenario will provide the means (resources, services, tools, etc.) to the learners, teachers, tutors, etc. to take part in the activity. Other activities may take place simultaneously within the scenarized activity; we call these "spontaneous activities". Given their unpredictable nature, they cannot be specified in any scenario, neither can we control or follow them.

4.2. Scenario production

As such, the scenario is only an arbitrary notation system intended to describe the future activity. This notation has to be as independent as possible from the context of its execution (for reasons of interoperability).

To produce a scenario, the first step is to design the conceptual model of its corresponding activity. The various components of an activity are gathered in a meta-model which establishes the concepts and the inter-concept relations. A model of the activity is built using the concepts defined at the meta-model level. For instance, the concept of role is defined at the meta-model level, whereas the name of the roles will be given at the model level. From its conceptual model the scenario can be automatically generated in a machine-readable language.

With our meta-model LDL (Learning Design Language), the scenario design starts with: 1) the identification of its interactional structure, i.e. the way the exchanges are going to be organized, 2) the definition of the roles involved, 3) the definition of the arenas which are the places where the activities will

take place, 4) the definition of the rules that the participants will have to follow, 5) the definition of the participants' positions i.e. the various points of view which they would have to express during the activity.

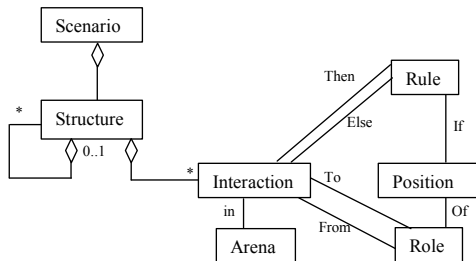Those concepts are illustrated in Figure 1 and detailed in the following section.

Figure 1 : Simplified UML representation of LDL

5. Learning Design Language (LDL)

LDL is an EML and thus respects corresponding updated specifications [10]. In this section we only describe the main concepts of LDL.

5.1. Activity structure

In the CNED example we can distinguish successive phases. Each phase organizes the progression of the numerous interactions between the participants: distance learning of the course, homework to be sent to the teachers, debate with their peers, etc.

In LDL, a phase corresponds to a structure. A simplified version of the CNED scenario is illustrated in Figure 2. It can be broken down into a sequential structure of two phases: "study" and "examination".
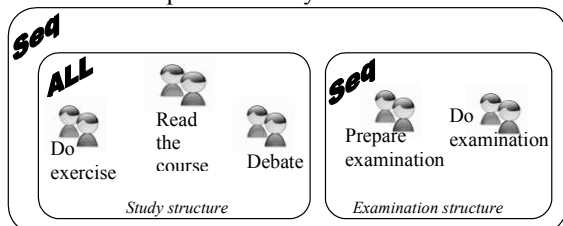

Figure 2 : Part of the structures (designed with ModX [11], a graphic model editor)

In the "study structure", the learner can play in any order: "read the course", "do exercise", "debate". In the "examination structure", the learner sequentially prepares the examination and takes it on the planned date.

In each of these phases, the interactions are organized according to a parallel or sequential structure.

In LDL, a structure specifies the order in which the interactions will be played. Three types of structure exist: 1) the "sequence" ("seq" on figure 2) in which the interactions play one after the other; 2) the "selection", in which certain interactions are chosen from the set of interactions and played in sequence; 3) the "all" structure, in which all the interactions will be played without a predefined order.

A structure can contain other structures, as shown in the example. The way to gather structures depends on the phases the designer of the scenario has specified. We consider the structure as the backbone of the scenario.

5.2. Participant interactions

The interactions fit into the structures previously described. They specify the exchanges the participants will have during the learning activity. They usually consist of verbal communication, document exchange and collaborative productions. They are situated: they occur in contents or via services. These interactions depend on the capacity of the places where they occur (for instance, a content can be read, a service can offer communication functionalities, etc.)

In its simple form, an interaction is an action from one participant to another in a specific place. The initiator is called "the addresser", the other is called the addressee. The place where the interaction takes place is "the arena".

The type and the number of interactions reflect the degree of cooperation between the participants. In our meta-model, an activity is reflected by an interaction. Thus, LDL is "intrinsically cooperative" in the sense that the activities modeled are based on participant cooperation.

5.3. Participant roles

In the CNED example, participants have "coherent" interactions. The ones who read the course, do the exercises and take the examination are the learners. The ones who write the course, annotate a piece of work and mark an examination are the teachers.

A set of interactions reflects a "thematic" role. Thus, in LDL, a role is defined by its corresponding set of interactions.

During the performance of an activity, a participant's actions will be limited by the interactions which define her/his role.

5.4. Activity arenas

The activity arenas specify the places where the activity will take place: a service or a content. A forum,

a search engine or a chat room are considered as service arenas. A course, an exercise, a photo album or a web site are content arenas. This spatialization guides the modeling and delimits the interaction perimeter. Participants interact in these arenas through the interactions specified by their roles.

5.5. Rules

The LDL concepts described above facilitate the design of learning activities in which participants receive instructions as to what they have to do. We propose to add the means to allow the adaptation of the activity's performance with regard to the participants' reactions.

To do so, the model includes rules. Rules are used to define the start and the end conditions of interactions and structures. They are also used to personalize the learning activities according to what we call participant positions. For instance, a rule can be defined to propose complementary lessons to a learner who has declared that s/he is not able to do an exercise.

5.6. Individual positions of the participants

A position is a general concept which covers different notions such as: participant point of view, her/his availability, the difficulty of an activity, a mark, etc. It represents the value a participant associates with an activity concept.

The position value is tested in the conditional part of the rules. As rules control the activity's progression, participants can influence this progression through their positions.

5.7. Observables

Simply to know what is going on, the participants need observation points. We have introduced the concept of "observable". For instance, the following entities are observable: interaction state (visible, started, stopped, etc.), structure state (visible, started, stopped, etc.), progress of the participant in the activity.

Observables are used to build different views on what is going on. In the CNED example, teachers can use this view to know who is having difficulties in which exercise. An observable can also be referenced by the scenario itself, as a position. A rule condition can refer to an observable. For instance, a rule could be: if a learner starts to prepare for an examination even though s/he has never sent any exercises, then notify the teacher.

6. LDL expressiveness

6.1. Modeling activities dependent on each other

The scenarization of educational activities addresses an important question: how to coordinate learning activities with pedagogical ones. Indeed, these two kinds of activity interfere with each other. The first ones, dedicated to learning, are usually performed by learners. The second ones, dedicated to supervision and remediation, are carried out by teachers. From a conceptual point of view, these two activities are not subordinated to each other. To facilitate their modeling, we propose to add a property to the position: scope.

As stated above, a position is linked to a participant and only known by her/him. It could sometimes be useful to let this position be known by others. For instance, the mark obtained by a learner should be known by all teachers and by the administration, the availability of a teacher should be "public", etc. In the example above, some of the learners' positions should be visible for the teacher in her/his supervision activity.

The scope can help to specify whether the position has to be visible for all the participants of an activity, for all the participants of a scenario, or for participants involved in other scenarios. We say that the scope is respectively one activity, the whole scenario or the execution infrastructure.

6.2. Modeling open situations and collective ones

At the beginning of this paper, we have proposed three canonical types of collaborative situations. The first one is easy to model with basic concepts of LDL, we have however introduced another property to the position concept, called the partition, to facilitate the modeling of the other two.

In the open situation, participants have individual problems. Their position only holds for themselves. In the collective situation, one participant's position applies to every participant in the collaborative activity who has the same role.

The CNED example contains one collective situation: preparation for the examination. This consists in repeating the following: the teacher proposes a question to the group of learners preparing for the examination; when one learner gives the answer, it is considered as the group answer; then the teacher asks the next question. In a certain sense, in this case, the position of one participant represents the group position. The partition of the position is thus "collective".

The partition of a position can be "individual". For instance, in the lesson study activity, each participant has to take position individually (s/he does the exercise or declares that s/he will not do it).

7. Infrastructure and experimentations

This paper would not be complete without mentioning the existence of an infrastructure dedicated to scenario execution. Called LDI (Learning Design Infrastructure), it features a player: the participant interface to LDI. This player gives a participant the means to interact via Internet through the contents and the services of a CSCL environment. The first developments have been made for the "cartable électronique" environment (electronic schoolbag) used at the University of Savoie. Some experimentations are in progress. They consist of auto-training scenarios and distance evaluation ones, using IMS-QTI exercises. The results of those experimentations will be the subject of a future paper.

8. Conclusion

This work is part of a larger project whose objective is to develop a complete editorial chain of learning scenarios: from scenario authoring to its execution using ICTs (Information and Communication Technologies). One of our general objectives is to make teachers' everyday work easier while using on-line environments and specialized software to operationalize and to execute learning scenarios.

The objective of this paper is to present LDL, a new language for modeling educational activities in order to produce executable activities in existing digital environments. LDL has been developed by the "scenario team" of the SysCom Lab, in conjunction with researchers from the Arcade team from the Clips Lab and the Pentila Corp.

LDL relies on a powerful meta-model which allows the representation of various situations with few concepts:
▪ the unified concept of an arena for both content and service simplifies the meta-model and the learning design,
▪ with the positions, the participants can partially influence the activity progress This learner-controlled approach is particularly recommended for lifelong learning [12].
▪ the partition of a position allows the design of both collaborative activities expecting one contribution for each participant and the ones in which the contribution of one participant represents the group contribution.

▪ the scope of a position provides the means to link several different but dependent activities.

These concepts distinguish LDL with respect to other meta-models like the very interesting one proposed in IMS-LD.

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