Contextualisation of reusable learning systems: theoretical and practical analysis, approach and case study

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Abstract: In this paper, we focus on assisting the contextualisation of reused scenarios. The target public is instructional designers who aim to reuse existant learning scenarios, to contextualise them according to their learning context, and to execute them by means of a chosen learning management system (LMS). Most of the works in the literature focus more on the problem of reuse (for example, by proposing technology learning standards), and less on the problem of contextualisation.

We propose, firstly, a process of contextualisation, based on a multi-scale conceptual framework, complemented by case studies, allowing a deep investigation of the contextualisation issue. Secondly, with respect to the proposed contextualisation process, we propose a design process based on a model driven architecture (MDA) approach for the contextualisation of reusable learning scenarios. Thirdly, we propose an approach supported by a tool for the technical contextualisation of learning scenarios, independent from any LMS, in order to define corresponding learning scenarios which are specific to the chosen LMS and that will ensure its execution. Finally, a case study is provided to prove the feasibility of our approach and the first results of the evaluation are given.

Keywords: contextualisation; instructional design; learning management system; LMS; learning scenario; model driven architecture; MDA; reuse.


Biographical notes:
1 Introduction

The constant evolution of the internet and its democratisation have made many tools available that can implement an increasing number of educational activities and reinforce the importance of technology enhanced learning (TEL) (Hoic-Bozic et al., 2009; Martin-Blas et al., 2009; Miller and Miller, 1999; Wagner et al., 2008).

A TEL system is defined as a complex system formed by a set of interdependent and heterogeneous components, organised in space and time in order to satisfy a learning goal (Drira et al., 2007). This definition is quite general and depends on the perspective considered. For a learning scenario centred on collaboration between students, a wiki that supports such a collaboration is the core of the TEL system. A learning management system (LMS) that supports the learning scenario of the teacher is the core of the TEL system for this situation.

In our research, we are interested in TEL systems implementing learning scenarios in LMS.

An LMS is a software system that supports distance teaching and learning. It allows many administrative functions that are relevant for TEL systems, such as the management and control of courses, students, teachers and also some technical services, such as backups, statistics reports, language management, etc. Within courses, it offers many interesting functions, e.g., for collaborative learning, assessment, communication by means of extremely powerful tools such as forums, chats, wikis, blogs, quizzes, etc. (Paulsen, 2003). The power of current LMS allow the scenario and orchestration perspectives to be dealt with, as presented by Stellar network excellence (http://www.stellarnet.eu/d/1/1/Orchestrating_learning). Moreover, most LMS integrate a plug-in system to extend their capacities.

Our work is intended for instructional designers who aim to reuse existent learning scenarios, to contextualise them according to their learning context and to execute them by means of a chosen LMS).

We define context as the set of rules imposed on a TEL system by another part of the system. We define contextualisation as the process of adapting the design artefacts of a TEL system with respect to its context.

We do not address the problem of reusing learning scenarios based on learning technology standards, such as IMS-LD (http://www.imsglobal.org/), and the associated tools, such as Reload (http://www.reload.ac.uk/) or Coppercore (http://coppercore.org/), because the use of a standard limits designers to using a compliant LMS.

Indeed, in our case, the instructional designer has defined their learning scenario by reusing a domain specific language (DSL) (Abdallah et al., 2008), or by reusing a
pedagogical template as explained in Drira et al. (2011). A DSL is a metamodel that allows an accurate description of specific needs and partially overcomes the challenge that implies for tutors of designers in using previously cited standards tools (Drira et al., 2008). A pedagogical template is a model with parameters that can be personalised according to the reuse context.

In this paper, we are interested in the issue of the contextualisation of reusable learning scenarios. Our investigation of contextualisation is based on answering the following questions: What are contextualisation needs? How to contextualise? When? How to assist instructional designers in performing contextualisation?

We propose a conceptual framework based on the multi-scale approach which is a solution for analysing complex systems. This framework focuses on studying three scales (context, learning system and learning systems’ components) and their relationships. To allow a deeper understanding of the contextualisation problem, we complement this conceptual framework with a detailed case study of a learning scenario, called Mepulco³, implemented in two different universities, and we highlight the impact of context on learning scenarios.

Based on theoretical and practical results, we propose a process of contextualisation responding to the aforementioned questions. This is a three-step process involving: organisational contextualisation, technical contextualisation and deployment contextualisation.

Since organisational and deployment contextualisations were treated in other papers (Drira et al., 2011; Caron et al., 2007), we will focus on assisting designers in performing technical contextualisation and we will present our approach called assistance for contextualised modelling of learning systems (ACoMoD), based on a model driven approach (MDA) and the tools developed. Assisting technical contextualisation means that we assist instructional designers to bridge the gap between the reused scenario and the LMS specifications. In addition, we assist designers to take contextual rules concerning the use of the LMS tools into account, in order to avoid LMS configurations that contradict the contextual rules, e.g. the use of an inadvisable or prohibited tool. We show the feasibility of our proposal through a case study carried out in the context of a project called ‘METAmodelising to build web environment to support learning by project’ (MetaWep) (Warin et al., 2007).

This paper is organised as follows. In Section 2, we thoroughly investigate the contextualisation issue by proposing a conceptual framework, complemented by case studies. We conclude this section by proposing a contextualisation process based on the results of the framework and experiments. In Section 3, we study how we can create the proposed contextualisation process within an MDA based instructional design process, which is explained in the same section. In Section 4, we deal with our proposal for technical contextualisation based on MDA and the tools developed. In Section 5, to show the feasibility of our proposal, we detail a case study. In Section 6, we analyse the results and discuss the advantages and disadvantages. We finish our paper with a conclusion, as well as future works.
2 The contextualisation of reusable learning scenarios

2.1 Proposed contextualisation framework

The aim of our framework (see Figure 1) is to study the interplay between a learning system and its context. The concepts of this framework are based on the multi-scale approach which is a solution for analysing complex systems (Drira et al., 2007).

2.1.1 What is multi-scale?

A multi-scale approach proposes a set of methodological principles organising the study of a complex system in different scales, and the study of links between them. Multi-scale modelling as used in other disciplines – material simulation (Lu and Kaxiras, 2005), biology (Hunter et al., 2006) – relies on modelling a system on several scales and creating link objects between the scales in a coherent manner. A link object is an intermediary entity that is responsible for managing the coherence between scales’ models with respect to a multi-scale problem. Our framework uses multi-scale to study the multi-scale problem of contextualisation.

2.1.2 Scales and views definition

The scales to be considered in our framework (see Figure 1) are the context (macro scale), the TEL system (meso scale) and TEL system components (micro scale). These scales are studied according to two views: anticipation view and action view. See White (2007) for a discussion about the definitions of scales and views.

We define a TEL system as a complex system formed by a set of interdependent and heterogeneous components, organised in space and time in order to satisfy a learning goal. Components can be actors, resources or tools.

Figure 1 A multi-scale view of a learning system and its context (see online version for colours)
The context has been the subject of research in different areas [for example, Bradley and Dunlop (2005), Brézillon (1999) and Jovanović et al. (2007)]. For our purposes, we consider that the learning system context is a set of contextual rules that influence the design and execution of TEL systems. A contextual rule can be a practice, a constraint or a prescribed guide. Structurally, context can be viewed on different levels, for example: institutions (universities, etc.), sub-units of these institutions (faculties or departments), curriculum and courses. Each level imposes its specific contextual rules on the learning systems.

### 2.1.3 Study of interdependence between scales

Context influences the learning system with some constraints but, reciprocally, the learning system also influences its context and can require adaptation.

In the anticipation view (see Figure 1), the learning system should be contextualised in order to suit the design context; for example, the economic and human resources available influence design decisions. We define contextualisation as the process of adapting uncontextualised, or partially contextualised, design artefacts of a TEL system with respect to the design context.

The context is a dynamic and variable structure which continuously evolves. Thus, in order to be able to carry out the design, it is necessary to establish a set of contextual rules. The evolution of the context is taken into account in the action view (see Figure 1). Indeed, during runtime, the design goes on with the adjustments of the learning system when the context changes or evolves (runtime context); for example, when a resource is no longer available, it must be replaced.

When designing a new instance of the TEL system, the context must be updated according to trace analysis results from the previous instance of the TEL system (see Figure 1).

In this paper, we focus on assisting contextualisation at the design stage. Adaptation to context at run time is addressed by other ongoing research.

In this section, we have presented the conceptual framework of contextualisation. It is difficult, and perhaps impossible, to generalise a set of contextual rules that are valid and suitable for all TEL systems. In order to be able to implement solutions to assist designers in contextualising their TEL systems to the design context, it is necessary to understand how the context influences designers’ practices. For this reason, we have complemented our theoretical study with real experiments.

### 2.2 Investigating contextualisation needs through case studies

To illustrate and allow a deeper understanding of the contextualisation problems presented in a theoretical manner above, we describe two case studies of the implementation of the same learning scenario, based on the Mepulco method (D’Halluin et al., 2008), with respect to the same LMS (Moodle). These implementations were carried out in two different institutions in different universities: the Institute of Technology at the University of the Littoral of Opale Coast (http://www.univ-littoral.fr) in Calais (France), and the engineering school ‘Polytech’ (http://www.polytech-lille.com/english) at the University of Sciences and Technologies of Lille I (France).

In this section, we briefly present the Mepulco method, the two deployments and, finally, we highlight the impact of contexts on the reuse of learning scenarios.
2.2.1 The Mepulco method

Mepulco (Talon et al., 2005; Mepulco; Warin et al., 2007) is an active (Felder et al., 2000) learning method for supervising student projects.

Mepulco has two goals. The first one is to help groups of students to succeed in creating a joint product with respect to a deadline, and develop different skills, such as analysis, synthesis and argumentation. The second one is to help tutors to supervise different steps of a project and to provide a justified evaluation for the final product.

Mepulco is based on regular meetings in order to organise progression, to control the project and to ensure that deadlines are respected.

The principles of Mepulco for both tutors and students are published in two documents: the student kit and the tutor kit (Talon et al., 2005; Mepulco1).

These kits firstly describe the steps of project creation and supervision. Secondly, they describe the organisation of regular meetings and the subjects that are dealt with. Thirdly, they describe the allocation of roles within a group. Fourthly, the kits give guidelines for writing the final report and preparing the final presentation. In addition, the kits provide a set of document templates e.g. request for a project, specification of requirements and progress report.

Each project carried out according to Mepulco is based on distance activities such as a website, a blog, an LMS (for example, Moodle) or others. The design of such a TEL system respecting Mepulco is the task that we are interested in.

2.2.2 Mepulco implementation in the University of Calais

In the Institute of Technology at the University of the Littoral, undergraduate students carry out a project called project of synthesis in their courses.

Each project is assigned to a group of two to six students. The aim of the project is to create software. The subjects of projects are usually proposed by teachers, and sometimes by companies. Proposed subjects are presented to students at a specific meeting. Then, each group of students has to choose a subject and a supervisor (usually the person who proposes the subject). The work lasts six months and, at the end, each group has to provide a final report and to orally explain their work.

To improve the quality of supervision, Mepulco is used. Thus, it was necessary to design and implement the TEL system recommended by Mepulco. For this aim, the LMS Moodle (Moodle4) (see Figure 2) was used. The TEL system implemented on Moodle is a course composed of six resources: three pdf documents, an internet link, a discussion forum and a wiki.

Figure 2  TEL system on Moodle for one team in Calais (see online version for colours)
The pdf documents and the internet link are intended to help understand and learn about Mepulco. The discussion forum aims to facilitate the collaboration of students. The wiki must be filled in by students in order to take charge of the project’s supervision. It is divided into many sections including: project explanation, actor’s presentation, document library and useful internet links. Each group has to complete its own wiki, according to the Mepulco guidelines.

2.2.3 Mepulco implementation in the University of Lille

The fourth year students in the data-processing and Statistics Genius department of Polytech’ Lille must carry out a project called ‘Information system project’. In order to improve the quality of both the supervision and the final products, Mepulco is applied.

The projects in Polytech’ Lille are little different from those in Calais. Indeed, the same subject is common for all students who are put into groups of five. Four tutors with different skills ensure the supervision of all groups. Regular meetings are planned in the students’ timetable.

To design and implement the TEL system recommended by Mepulco, the LMS Moodle used in Polytech was used (see Figure 3).

Figure 3  TEL system on Moodle for one team at Polytech (see online version for colours)

The TEL system produced is composed of 21 resources: three forums, three pdf resources, four wikis, five duties, a poll, four Moodle databases and a link to an external resource. The designer at Lille prefers to use many tools. For example, they use a forum as a library of group documents (documents as attached files to discussions in the forum). They choose to use a class assignment to encourage students to produce their weekly activity reports and to use four wikis. Each wiki aims to satisfy one of the principles of Mepulco: project explanation, actor’s presentation, document library and useful internet links. These choices are quite different from those of Calais.
2.2.4 Analysis of the two implementations

Both TEL systems represent the implementation of the same learning method in two different instances of the same LMS. However, the two implementations are very different. In order to investigate these differences, there has been a detailed study of:

- observation of the progression of the student projects on Moodle
- questionnaires
- individual partly-directed talks with the students
- partly-directed talks with tutors.

These various experiments highlighted that, from one side, the organisational rules specific to each course influence the use of Mepulco, for example the number of supervisors, the number of students in each group, and whether the subject is common or specific to the groups. In Calais, each group, which must have between two and six students, has a different subject and only one tutor ensures the supervision; while in Polytech Lille four tutors with various competencies ensure the supervision of groups which must have five students, and which all have the same subject.

From another side, the choice of LMS tooling to implement Mepulco depends on the designer’s preferences, for example the designer of the Mepulco system in Lille prefers to use forums to implement the library of group documents, while the designer of the Mepulco system in Calais prefers to use a page of a wiki. However, all choices made consider both the rules of each institution (e.g., chat is denied in Calais), and the lessons learned from previous experiences of use of Moodle (e.g., the number of forums used should be less than five).

In Polytech, in order to improve the implementation of Mepulco for the next promotions, a set of good practices was identified and synthesised in a document intended for designers. In Section 5, we used three samples of good practices to test our proposal.

To sum up, these experiments have complemented our conceptual framework by clarifying how the design context influences designers’ decisions and strategies. In the next section, we propose a contextualisation process which answers the following questions: When to contextualise? What to contextualise? According to what?

2.3 Proposed contextualisation process

We propose dividing the context of a learning system into three sub-contexts: organisational context, technical context and deployment context. Each sub-context is relevant for a contextualisation step as shown in Figure 4. The contextualisation process involves: organisational contextualisation, technical contextualisation and deployment contextualisation (see Figure 4). We define each sub-context and contextualisation type as follows:

- *The organisational context* represents a set of rules and constraints related to the organisation of a course or a curriculum. In the case of Mepulco, addressed in the previous section, the number of supervisors, the number of students in the group, and whether the subject is common or specific to groups are examples of organisational context elements.
• **The organisational contextualisation** is the activity of adapting a reusable abstract learning scenario to create a contextualised learning scenario, taking into account the specificities of the organisational context.

• The LMS is the first part of the technical context. We consider that the cross from a learning scenario, independent from any LMS, to a learning scenario specific to a selected LMS is a contextualisation task. In fact, sometimes there are divergences between designers’ pedagogic choices and the LMS allowed functionalities. This mismatch gives rise to a huge amount of work in order to contextualise these choices. As explained in the previous section, it is relevant to consider contextual rules when making LMS specific choices (a set of guidelines, generally identified from trace analysis from previous experiences). Thus, the second part of the technical context is related to the rules of use for LMS tooling.

• **The technical contextualisation** consists of creating the LMS specific scenario starting from a learning scenario independent from a LMS with respect to contextual rules and practices.

• **The deployment context** concerns all of the elements already existent in the LMS which will ensure the delivery and execution of a learning scenario.

• **The deployment contextualisation** is the activity of integrating the new elements of the scenario to be deployed in the LMS with the elements already deployed; for example, if some students or groups are already created, it is not necessary to recreate them; if there is a common forum used by all students, it is pointless to define a new one with the same role.

*Figure 4*  Proposed contextualisation process (see online version for colours)
In order to implement the proposed contextualisation process, it is necessary to specify the process to adopt in designing learning systems. Since we are interested in a model driven approach (MDA), in the next section, we explain how to carry out the proposed process within an MDA. Before that, we will present an MDA and show how it can be used as an instructional design process.

3 Reuse and contextualisation within an MDA of TEL systems design

3.1 Fundamental concepts of an MDA

The model driven architecture (MDA) proposed by the OMG (2011) is a specific approach of the software engineering field that defines a theoretic and practical framework to allow the generation of codes from models.

The main goal of an MDA is to separate the business side of a system from the technology side, so that the interoperability of the business side across different implementation choices is allowed. For this aim, MDA defines a platform independent model (PIM) and transforms it into a platform specific model (PSM), using the platform model (PM). The main techniques used are modelling and model transformation.

The MDA proposes three conceptual points of view associated, respectively, with their models (Miller and Mukerji, 2003):

A computation independent model (CIM) is a view of a system from a computation independent viewpoint. A CIM is sometimes called a domain model and it expresses the requirements of the users.

A PIM is a view of a system from a platform independent viewpoint. A PIM exhibits a specified degree of platform independence, so as to be suitable for use with a number of different platforms.

A PSM is a view of a system from a platform specific viewpoint. A PSM combines the specifications in the PIM with the details that specify how that system uses a particular type of platform.

3.2 MDA based instructional design, reuse and contextualisation

For TEL systems design (see Figure 5), a typical design process based on MDA can be described as follows:

First, the instructional designer informally defines the learning scenario that they aim to create and the resources needed (CIM).

Second, to formalise the CIM, they define a model of the learning scenario (PIM) with a specific pedagogic metamodel. This metamodel allows an accurate description of specific needs.

Third, in order to transform the learning scenario model into an LMS specific scenario model (PSM), which conforms to the LMS metamodel, transformation rules are defined and applied (Bézivin, 2006). Transformation rules express refinements from the pedagogic metamodel to the LMS metamodel.

Finally, a code generator/deployer interprets the LMS specific model and communicates with the LMS in order to deploy the final TEL system.
In the literature, we can find some recent research interested in TEL systems design based on an MDA (De Moura, 2007; Martel et al., 2006; Abdallah et al., 2007; Caron et al., 2006; Laforcade et al., 2007). To our knowledge, there isn’t any work that focuses on ensuring the reuse and contextualisation of learning scenarios. Currently, the emergent solution is to define new models for each specific need (De Moura, 2007; Martel et al., 2006; Caron et al., 2006). However, this solution requires modelling tasks that cannot be assumed by beginner designers without the assistance of a computer scientist. This is why we believe that it is necessary to facilitate reuse and to guarantee an agreement between reuse and contextualisation.

Reusable learning scenarios can be formalised in models, learning scenario models. These models can be contextualised to suit the reuse context. Table 1 summarises the application of previously defined contextualisation needs in an MDA based instructional design process.

In our research, we are trying to find an assistance solution for designers for each kind of contextualisation. Drira et al. (2009, 2011) have proposed solutions for assisting the reuse of learning scenario models and their organisational contextualisation. The approach of Drira et al. (2009) is based on adapting models in order to take into account the specificities of organisational context. The approach of Drira et al. (2011) is based on pedagogical templates. In the remainder of this paper, we present a solution to guide designers in performing the technical contextualisation. We present our approach called ACoMoD and the corresponding implementation.

### Table 1

<table>
<thead>
<tr>
<th>Step</th>
<th>Sub-context</th>
<th>Contextualisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIM-PIM</td>
<td>Organisational context</td>
<td>Organisational contextualisation</td>
</tr>
<tr>
<td>PIM-PSM</td>
<td>Technical context</td>
<td>Technical contextualisation</td>
</tr>
<tr>
<td>PSM – deployed system</td>
<td>Deployment context</td>
<td>Deployment contextualisation</td>
</tr>
</tbody>
</table>

### 4 MDA based technical contextualisation of learning scenarios

Our ACoMoD approach (see Figure 6) is presented in Figure 4. It is based on two tools: Gen-IC to model contextual rules, and Gen-COM to assist technical contextualisation.
Figure 6  Overview of ACoMoD approach with its two tools (see online version for colours)

Figure 6

4.1 Gen-IC: contextual rules modeller

In ACoMoD (see Figure 6), the tool that ensures the modelling of contextual rules is Gen-IC, which is intended for administrators.

Figure 7  Use-case diagram for Gen-IC (see online version for colours)

Figure 7

Figure 7 is a use-case diagram of Gen-IC use. Gen-IC allows the institutional structure to be modelled. For example, for a university: its domains, departments, curricula, courses, etc. Next, the Gen-IC assumes to dispose metamodel of the target platform (see Figure 10). Indeed, the LMS metamodel is a model of the mechanisms and services offered by the platform (Selic, 2005; Atkinson and Kühne, 2005). After choosing the target LMS and importing its metamodel in Gen-IC, it becomes possible to define the contextual rules which will be used by Gen-COM (see Figure 6). The basic concepts of the contextual rules database schema are presented in Figure 8.

Each contextual rule, ‘ContextualRule’, concerns one or many LMS elements,
‘LMSElements’. This association helps Gen-COM to identify pertinent assistance messages, ‘AssistanceMessage’, to suggest to a designer when they choose to use an LMS element at the moment of contextualisation. A class association is attached to the association between ContextualRule and LMSElement, and represents some values, such as the maximum number of a LMS element.

In this way, Gen-COM can easily identify rules to activate for each designer, according to the course that they select. It should be noted that the LMS metamodel is the main link between Gen-IC and Gen-COM, as both use it. The first defines the contextual rules, and the second allows the LMS specific model of the learning scenario to be produced, as shown in Figure 6.

**Figure 8** Class diagram of basic concepts (see online version for colours)

4.2 Gen-COM: technical contextualisation tool

The aim of Gen-COM is to assist designers to define a learning scenario specific to a selected LMS in a well-defined context, starting from a learning scenario which is independent from any LMS. Based on an MDA approach, we must remember that:

- the learning scenario is formalised in a model called a scenario model
- the LMS is formalised in a metamodel
- the target is to create an LMS specific scenario model that conforms to the LMS metamodel so that it can be later deployed and executed in this LMS.
There are two fundamental elements behind the design of Gen-COM. The first is to hide all the technical difficulties related to the mapping of the scenario model for the LMS specific scenario model. The second consists of providing designers with guidance and help in making the right decisions with regard to contextual rules.

The scenario of Gen-COM use can be described as follows. First, when the instructional designer authenticates, Gen-COM identifies their technical context from the contextual rules database. This is composed of the LMS which will be used and the relevant contextual rules attached to the LMS metamodel. After that, the designer selects the scenario model to contextualise and Gen-COM generates the assisted contextualisation interface (see Figure 9). The principle consists of dissecting the scenario model to build the pedagogic toolkit and dissecting the LMS metamodel to build the technical toolkit. The semantic signification of each element in the scenario model and in the LMS metamodel is as follows:

- each concept represents an activity, a resource or an actor
- each attribute of a concept represents a property of it
- each association expresses a relation between two concepts: two activities (e.g., complementary use), two actors (e.g., collaboration rules), two resources (e.g., simultaneous use), a resource and an activity (e.g., associating a resource with an activity), a resource and an actor (e.g., assigning an actor to a resource) and finally an activity and an actor (e.g., assigning an actor to an activity).

Thus, the activity of the contextualisation of the scenario model consists of choosing the LMS tool(s) to be used for the creation of each pedagogical element. Within Gen-COM, this task can be done by matching element(s) of the technical toolkit with each element of the pedagogical toolkit by the simple action of drag and drop from the toolkits to the central match area (see Figure 9). When the matching of two elements is validated, the instructional designer should also match their attributes.

All of the instructional designer’s choices are stored in an XML document by Gen-COM. This document is going to be used later at the stage of generating the LMS specific model.

The principal interface of Gen-COM also contains two important components, ‘choices summary’ and ‘contextualisation sheet’ (see Figure 9). The ‘choices summary’ component provides the instructional designer with the possibility of constantly consulting their validated choices. The ‘contextualisation sheet’ provides the instructional designer with assistance, according to the contextual rules of use of the LMS tools. According to the display mode of a contextual rule, the update of the contextualisation sheet is done. There are two display modes for contextual rules, which are ‘displayed constantly’ and ‘displayed when activated’. If the display mode of a contextual rule is ‘displayed constantly’, then the corresponding assistance message is added to the contextualisation sheet from the beginning to the end of the process. However, if the display mode is ‘displayed when activated’, then the corresponding assistance message is added to the contextualisation sheet when it concerns the LMS tool chosen by the instructional designer. A mouse is linked to the technical toolkit in order to detect the chosen tools and to check the contextual rules database to see if there is a relevant contextual rule to activate.

When the instructional designer finishes, Gen-COM automatically generates the LMS specific scenario model based on the scenario model and the stored validated choices.
The final Moodle specific model of Mepulco is an XML file produced by Gen-COM that describes the specification for deployment desired on Moodle platform. To deploy the scenario on the Moodle platform, a deployment tool proposed and tested by our research team is used. This tool is called GenDep (Caron et al., 2006, 2007; Caron, 2007). GenDep is based on generating specific engines giving a model specific to a LMS and the LMS metamodel. GenDep interprets the specific model and communicates with the LMS through SOAP in order to automatically deploy the model elements.

Figure 9  A screenshot of Gen-COM (see online version for colours)

5 Case study: the MetaWep project

In order to show the feasibility of our proposal, we describe a case study with a designer in the context of the MetaWep project previously introduced. This designer aims to contextualise a Mepulco model with respect to a Moodle LMS in the context of Polytech (see Section 2.2 for details of Mepulco and Polytech context).

Next, we present the Mepulco model, the Moodle metamodel, three contextual rules for use and the final Moodle specific model of Mepulco.

5.1 Reusing a pedagogical model of Mepulco

The scenario model of Mepulco (see Figure 10) is a representation of the principles explained in Section 2.2.1. It describes that in the context of an information system
project (ProjectSysInfo), supervision by a team is ensured (TeamPursue). A resource corresponding to the Mepulco kit, and another one corresponding to the project subject (KitProject), are attached to the project and are common to all the students. The team supervision comprises the activities of welcome, document collecting and meetings.

**Figure 10** Mepulco model (see online version for colours)

5.2 Reusing a Moodle metamodel

We used the recommendations of Selic (2005) and Atkinson and Kühne (2005) as a basis in order to elaborate the Moodle metamodel. This metamodel is enormous so, in Figure 11, we only present the pertinent part for our case study.

5.3 Contextual rules used

We based the experiment described here on three rules:

1. the maximum number of forums to use is two
2. the chat tool is not recommended
3. the wiki tool is recommended for project supervision.

These rules were modelled with Gen-IC and stored in the contextual rules database.
Figure 11  Moodle metamodel

Table 2  Final decisions

<table>
<thead>
<tr>
<th>Pedagogical concept</th>
<th>LMS concept</th>
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<tbody>
<tr>
<td>ProjectSysInfo</td>
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<table>
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<tr>
<td>AffectPursueToProject</td>
<td>AffectThemeToCourse</td>
</tr>
<tr>
<td>AffectKMepulcoToPursue</td>
<td>AffectResourceToTheme</td>
</tr>
<tr>
<td>AffectKProjectToPursue</td>
<td>AffectResourceToTheme</td>
</tr>
<tr>
<td>AffectTeamPursueToPursue</td>
<td>AffectWikiToTheme</td>
</tr>
<tr>
<td>AffectStudentToTP</td>
<td>AffectUserToWiki</td>
</tr>
<tr>
<td>AffectWelcomeToTP</td>
<td>AffectWikiPageToWiki</td>
</tr>
<tr>
<td>AffectDocsToTP</td>
<td>AffectWikiPageToWiki</td>
</tr>
<tr>
<td>AffectLinksToTP</td>
<td>AffectWikiPageToWiki</td>
</tr>
</tbody>
</table>
5.4 Contextualisation with GEN-COM

The designer used Gen-COM according to the scenario described in Section 4.2. They were guided by the contextual rules enumerated above. Here, we mention an example of how the designer interacted with Gen-COM. According to an assistance message proposed by Gen-COM, the designer changed an initial choice of using a forum tool to realise ‘Pursue’ and decided to use wikis. They explain that they hesitated between wiki and forum. The assistance message recommending wikis for supervision convinced them to choose Wiki, particularly because of the possibility of collective redaction. The final contextualisation decisions are summarised in Table 2, and the LMS specific model is presented in Figure 12.

Figure 12 Final contextualised model

6 Results and discussion

This case study within the MetaWep project made checking the feasibility of ACoMoD and highlighting the advantages and disadvantages possible. The advantages raised by this study are:

- The designer is provided with technical assistance in contextualising a learning scenario to define a new LMS specific scenario. Henceforth, the designers can carry out this task without needing a computer scientist.
- The designers can incrementally construct their specific LMS models so that they can improve their proficiency of the LMS.
- The contextual rules are integrated in the design process according to a contextualisation process. Thus, the administrator finds a formal means to communicate contextual rules to the designer. Furthermore, the designer is assisted more because the rules are communicated to them at the right time.
The idea of attaching rules to the LMS metamodel elements gives rise to another benefit, by bringing a solution for the institution to build a personalised use of platforms. For example, the choice of Moodle to deliver courses implies that it is possible to use any LMS tool. Expressing that tool is prohibited through a contextual rule which allows a contextual definition and use of the LMS.

In spite of these advantages, the case study raised some limitations:

- Currently, Gen-IC allows administrators to model contextual rules related to LMS elements. An extension of Gen-IC is suggested and concerns the possibility of modelling contextual rules that concern the use of LMS for specific learning scenarios. For example, for the third rule which recommends wiki for project supervision, it would be better to express a contextual rule that concerns ‘wiki’ and ‘TeamPursue’ for the pedagogical model.
- There is a suggestion to allow the reuse of LMS specific scenario models. Thus, designers working in the same context and implementing the same pedagogy will be able to reuse already contextualised models.
- In order to give the designer freedom in their decisions, Gen-COM guides the designer to make better decisions by proposing assistance messages without imposing any choice. This principle was appreciated by the designer but they also suggest having more feedback regarding whether their final choices respect the contextual rules, or not. Thus, Gen-COM should be enhanced by a component (a journal of contextual adequacy) that displays the summary of all the contextual rules and the adequacy of the designer’s decisions with regard to these rules.

7 Conclusions

This paper has thoroughly investigated the contextualisation issue of reusable learning scenarios. For this aim, we have proposed a conceptual framework, mainly studying the interdependence between a learning system and its contexts. We have complemented our conceptual framework with real case studies leading to the proposal of a contextualisation process.

In order to propose assistance solution to designers in performing different tasks in this contextualisation process, we have instantiated it within a specific instructional design process based on an MDA. Since the tooling of all tasks in this process would need more than one paper, we have focused on technical contextualisation which aims to assist designers in defining an LMS specific scenario model starting from a learning scenario model, with respect to contextual rules concerning the use of LMS tools.

To check the feasibility of the approach and to highlight the advantages and limitations, we have detailed a case study in the previous section.

Regarding related works, we can resume our contribution as follows. First, we propose a theoretical and practical study of contextualisation which is rarely tackled in the literature, compared to the reuse issue, in spite of the complementary nature of both issues. We also propose a contextualisation process and its creation within MDA as a design process.

Second, we propose a novel approach for helping designers to contextualise their
learning scenarios with an LMS, based on incrementally constructing LMS specific models so that designers can improve their LMS proficiency. Our approach is based on hiding technical difficulties so that beginner designers can perform contextualisation by themselves. Third, to our knowledge, the integration of contextual rules in the contextualisation process in order to help instructional designers in taking more adequate decisions hasn’t been addressed in related works.

Our ongoing research concerns the implementation of many components, mainly those related to the reuse of LMS specific models, to the contextual rules coupling pedagogy and platform, and to the journal of contextual adequacy.

In the next step, we will test the usefulness of our tools with a greater number of designers with different profiles, working in different contexts.

References


