

iPlan: a model of lesson plans to help teaching process in Web learning environment

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Abstract — This paper presents iPlan, a model to implement a system to support the creation of lesson plans. It was the result of a systematic review on tools that help teachers on authoring courses that must be delivered through the World Wide Web (Web). The iPlan system aims to simplify teachers' workload while preparing lessons that will be available online in some Learning Management System (LMS). It will provide authoring tools that enable teachers to create and edit lesson plans based on Pedagogical Patterns. By Pedagogical Patterns we mean tested lesson plans or roadmap lessons. Teachers will be empowered with means to create custom patterns, as well. The main feature that distinguishes this study from previous researches is the integrated approach with LMS, lesson plans and pedagogical patterns. In order to allow teachers to store new pedagogical patterns, iPlan uses iRepository, a repository of educational digital content which is also integrated with Moodle. iPlan is being developed for Moodle environment and will be distributed under the GNU Public License (GPL).

Keywords — *pedagogical patterns; learning design; educational modeling; distance learning; blended learning; web learning.*

I. INTRODUCTION

World Wild Web (Web) technologies and tools has been increasingly used to provide education, under face-to-face, blended, or distance learning model. A consequence of this process is the increased demand for teachers that are capable of preparing courses tailored for being delivered through the Web. However a significant number of teachers involved in Web courses are not prepared to produce courses really designed to the digital world. As a result, courses are simply adaptations of the ones they used to prepare for classical classroom.

There were two movements that significantly increased the demand for regular production of Web-courses. The

popularization of Learning Management Systems (LMS), that started to support courses in distance learning, face-to-face, or blended models and , as a consequence of the first movement, the increasing number of institutions offering courses with it. An interesting example is provided by the Open Universities around the world.

Here we are using the term LMS to describe any system that allows students to have personal accounts on it and teachers to upload and manage digital content to be delivered to these students. Additionally any LMS must provide some functionalities, such as tools to manage students' activities. Also, it can deliver activities to the students and receive their answers. This kind of ideia has a long history, e.g., the system Plato had in 1965 all these features [1]. However, we are only considering the web-based LMS, that is dated from years 1990.

As previously mentioned, the maturity of LMS technology, which potentialized Open Universities and its massive usage, created new demands. When the Open University of the Netherlands target the systemic production of Web-courses, they started modeling all pedagogies used in their courses and this process was the genesis of the Learning Design specification [2]. Today this is a world wide standard named by IMS Learning Design (IMS-LD), which is maintained by IMS Global Consortium with participation of researchers from several countries.

The IMS-LD specification was designed to promote exchange and interoperability of instructional contents. The content encoded in this standard can be reused in different environments, since it can understand the specification. Its first released version was published in 2003.

However, due to the IMS-LD complexity, its use resulted in a new problem: the difficult that teachers that are non specialists in Information and Communications Technology

(ICT) have faced to use the specification to produce lessons [16]. This demand originated two complementary types of tools, the editors and the players of IMS-LD. The first is the authoring tool to produce lesson plans and the last one is a runtime system, to interpret and play the learning design for learners.

Nevertheless, even with the evolution of these systems, teachers continued resisting on adopting IMS-LD in their course production [3][4], pointing the need of new tools to help teachers in their job. Under this context, the main motivation of this project is to tackle this problem.

A. The proposition of an integrated solution

First we mapped from a literature review how lesson plans are used in web-based courses, by identifying tools used and the teacher experience with these tools (Table I). We also searched for the main features pointed out in literature and by teachers contacted by our research group.

This analysis let us to the definition of a new model to help teachers to manage lesson plans in Web-courses, the iPlan project. Its main target is to empower teachers to produce their lessons with better quality, even teachers with reduced experience with ICT.

The iPlan model has two main features designed to simplify the teacher's work: it is integrated to the LMS, and it provides Pedagogical Patterns [5]. These features were designed in iPlan model to allow a teacher with basic skills with LMS of being capable to build and manage a Web course. Under this model, the teacher has access to tested plans or roadmaps lessons, as pedagogical patterns.

In order to increase the range of this project, which deals with lesson plans as major subject, we decided to adopt the IMS-LD specification [6][7], since it permit interoperability with another systems.

The IMS-LD provides a structure to describe a wide range of units of learning (UL) that can be, for instance, a lesson, a lecture, an activities roadmap, or a complete course. The IMS-LD scheme represents the learning designs by semantic annotations to allow its automatic interpretation by computers [8].

The IMS Global Consortium also offers a guide of best practices and implementation of Learning Designs (LD) [9]. This guide claims that the "design and development of education is an incremental process that systematically follows the stages of analysis, design, development, implementation, and evaluation"¹.

The first stage to create a unit of learning is the analysis stage, in which the didactical scenario must be set. It is captured in a narrative, usually on the basis of a checklist.

The second stage is to produce a diagram from the narrative in a more formal basis. It is suggested to transform the narrative in a Unified Modeling Language² (UML) [10]

¹ In the first paragraph of subsection 3.2.1 of URL: http://www.imsglobal.org/learningdesign/ldv1p0/imslld_bestv1p0.html (last accessed in 25 Apr, 2014)

² Unified Modeling Language is a standard object oriented design modeling language for computational systems, standardized by Object Management Group (OMG) for system specifications and design.

[11]. Its final outcome is an XML (eXtensible Markup Language) document with the diagram encoded.

The last two stages are the transformation of the document description in the actual content (resource), then this content and its learning design must be evaluated.

From this brief description it seems that the process to produce units of learning requires computational tools, even more if the authoring is performed by teacher that is non specialist in ICT.

B. Related Work

The current technology tools offered to teachers for dealing with lesson plans are the editors and players for IMS-LD. An editor allows teachers to construct their lesson plans, and a player is devoted to run for students the lessons prepared with the editor. The main target of these editors and players is to permit teachers to create and run their lesson plans with reduced difficulties. Today there are several editors and players, some of them performing both roles. Examples of editors to create units of learning are Reload [12], LAMS [13], and CADMOS [14]. Some examples of players are CopperCore [15], again, LAMS and Reload systems.

However the usage of these LD tools is quite complicated for common teachers, those non ICT specialists. It is usually necessary knowledge about the IMS-LD specification [16].

Another source of difficulties with using LD tools is the lack of integration with the LMS. Besides, it is necessary to learn how to use one or two more tools. All the cited tools are in this context: they generate an IMS-LD document, but the teacher-author must export it to a file in a common format and, using the LMS, import this file.

However, CADMOS (Courseware Development Methodology for Open instructional Systems) has some particularities that are noteworthy. CADMOS is the newest tool among those cited, with its first release from 2011. As the most popular tools such as CopperCore, LAMS, and Reload, CADMOS is also an independent tool, but it presents two basic differences: it can directly export the lessons to the format of an specific LMS; the exported lesson is quite simple, composed only by a list of web pages (the resource page or label in Moodle). Fig. 1 presents CADMOS interface showing how a sequence of contents, generated in CADMOS, will be presented within Moodle, with its preview option.

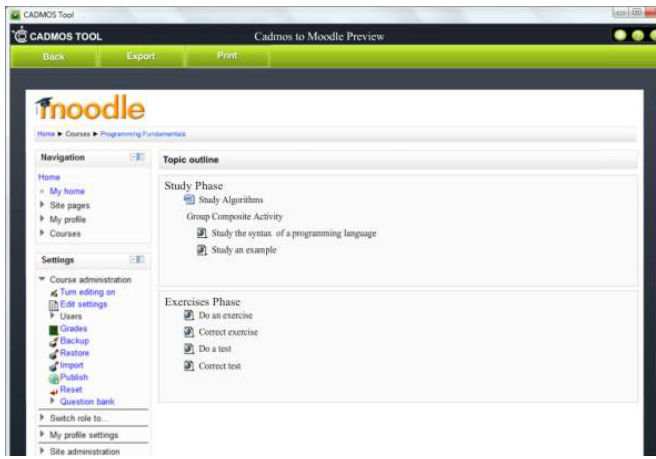


Fig. 1 - Cadmos Preview Screen

III. TABLE I. IMS-LD CAPABLE TOOLS

| System Name | Capabilities | | |
|-------------|--------------|--------|----------------|
| | player | editor | LMS integrable |
| Cadmos | X | X | X |
| Coopercore | X | X | |
| Cosmos | | X | |
| LAMS | X | X | X |
| Mot + | | X | |
| Open GLM | | X | |
| Prolix GLM | | X | |
| Re-Course | | X | |
| Reload | X | X | |

The LMS linked with CADMOS is one of the most popular in the world, the Moodle³ (Modular Object Oriented Dynamic Learning Environment) system. However the previous cited difficulties are still present in CADMOS solution: i) it is necessary for the teacher-author to know the principles of IMS-LD to produce a unit of learning; ii) the teacher must learn how to use another system, besides the LMS; and iii) the teacher-author must, after using the LD editor for producing lesson plans, export them to the LMS format, and import them lessons into the LMS (Moodle).

Recently, LAMS also released a version with support to LMS integration, but its main features remain unreachable to non ICT specialists because the need of IMS-LD specification knowledge is present yet.

In this scenario, this research aims to develop a theoretical framework and an instantiation of it to a particular LMS, to allow teachers to produce class plans for online courses. It is based on pedagogical patterns integrated to the LMS. The resulting tool must be capable of producing learning designs that can be stored in a repository and reused in the same LMS or shared with, exported to and executed in any other IMS-LD compatible environment.

II. RESEARCH QUESTION

The research questions considered here are related to the difficulties pointed in introduction. In the literature, the IMS-LD specification is used to systematically manage lesson plans, focusing interoperability. Since the specification is complex, there are several tools to edit and play lesson plans under IMS-LD encoding. Usually these tools are stand alone applications, divided in two groups previously cited, the editors and the players to IMS-LD specifications.

But these tools are not accessible to teacher with reduced background in ICT [4][16].

These difficulties could partially explain the reduced number of works using a systematic process to manage lesson plans. To tackle them, this project has the following central research question:

How to allow a common teacher (non ICT specialist) to manage their own lesson plans in an online environment?

As cited before, our proposition is to deliver an integrated tool, incorporating to the LMS a simple lesson plans' editor and a repository of pedagogical patterns.

IV. SYSTEMATIC REVIEW AND FINDINGS

In order to understand the context of the use of authoring tools to prepare online courses by teachers, a systematic review was conducted. It considered papers published since 2003.

The revision strategy was, first to consider the papers title. If it was not clearly attached to the interest topic ("online course", authoring, and teacher), it was considered inconclusive, and it had its abstract read. This first study classified papers in one of four categories: no relation, inconclusive title, little relation and direct relation.

An example of title that was classified as *no relation* with the research subject was the paper "Simulation of mixed-signal circuits for crosstalk evaluation". On the other hand, the paper entitled "My Computational Education" was classified as *inconclusive*. Examples of papers classified in the categories *little relation* and *directly related* were, respectively, the papers "Online course quality factor analysis based on fuzzy mathematics" and "Design and implementation of an undergraduate bioinformatics curriculum in an online environment".

In step two, each paper in categories *little relation* and *directly related* were completely studied to determine the current knowledge about the benefits that these tools brings to teachers' work, the limitations and restrictions that teachers have to use this tools.

³ <https://moodle.org>

The main implication of this work for research is a need for more and better empirical studies on this subject.

The review also provided a set of findings: i) there are no tool dealing with class plan generation that, in simple steps, that teacher can choose a model and the system generate a class plan; ii) the use of editors and players of IMS-LD specifications is almost always performed by ICT specialists; and iii) no empirical studies was conducted to show how much a non-specialist teacher can comfortably work with these tools.

No systematic review about this subject research was found. Only studies written in English were included.

V. THE PROPOSED MODEL IPLAN

Considering the literature review performed and discussions with teachers, some possible solutions arose. One is to make available "good models" to the teacher and other is to integrate the editor of lessons into the teacher's LMS.

The idea of "good models" can be put in formal basis using something similar to design patterns, that were introduced in 1977. According Alexander [17], each pattern associates a common problem with a tested solution to it, and this solution can be reused every time that the problem arise.

The concept of design patterns was the inspiration to the Pedagogical Patterns idea, whose:

"...intent is to capture the essence of the practice in a compact form that can be easily communicated to those who need the knowledge. Presenting this information in a coherent and accessible form can mean the difference between every new instructor needing to relearn what is known by senior faculty and easy transference of knowledge of teaching within the community." ([18], p. 1).

In this sense, a pedagogical pattern is an initial framework for teachers to start their lesson plans. But the pattern could be personalized, commented and/or shared. For this purpose, our proposition integrates a cooperative repository to the lesson plans editor.

The model proposed here have two axes to simplify the teachers' work:

- i. the editor and player integrated to the LMS; and
- ii. the provision of Pedagogical Patterns [5], with units of learning in an integrated repository.

In one hand, the usage of pedagogical patterns can avoid teachers to invest time to learn about Learning Design to their lesson plans production [4]. More than that, the patterns can be a framework to guide the teacher's work. This framework conducts the teacher's work in a similar way a software framework can help a software developer [19].

In another hand, this approach allows a community of teachers to create new digital content, lesson plans or even pedagogical patterns, to improve existing ones, to store it for reusing or sharing them in a repository that implements collaborative features [20].

In this context, this paper presents a systematic review on tools that could simplify the teachers' work on lesson plans creation for web-based courses. This review helped us to define the iPlan model, which is the paper main contribution. Since iPlan is integrated with a repository of lesson plans and one LMS, it simplifies the teacher's work. The iPlan instantiation is under development, and it will be deployed to Moodle system using others packages from our research group, as iAssign [21] and iRepository [20].

A. iAssign module to interactive activities

The iAssign⁴ is a Moodle plugin, with two versions, the first one to Moodle 1.9 and the second to Moodle from version 2.0 until 2.6. It was not tested under the testing version 2.7. This plugin allows the incorporation of other systems, like Java applet. In this context, these applets (or HTML5 packages) are called by interactive Learning Modules (iLM).

B. iRepository module

The iRepository is another Moodle plugin that allows storage and retrieve of digital content and permits to a Moodle teacher to collaborate with another teacher. A teacher can publish an item to a group of friends or to all other users in Moodle with (at least) teacher's role. Since it is integrated to Moodle, it is possible to register from a single label to a complete course.

Considering these plugins, the iPlan model is a new layer to leverage the teacher's production in the LMS. The iPlan can allow teachers to organize their courses with more facilities. It will not be necessary to have knowledge about IMS-LD, since it will have access to pedagogical patterns already registered in iRepository.

VI. IPLAN INSTANCE

The instance of iPlan is being implemented under the Moodle architecture, since our research group has adopted this particular LMS from the year of 2006. The primary reason that drove us to adopt Moodle was the Moodle plugin architecture that brings us the possibility of eliminate the time necessary to develop a new LMS. This is possible because of two reasons: Moodle is a free software (anyone can access its source code); and its internal architecture is modular and extensible. Besides, it has a great number of contributors.

The secondary reason to adopt Moodle is the outcome from contribute with Moodle development. It has a large basis of users. In accordance with Moodle statistics, it is used in more than 240 countries, counting with more than 77 millions of users, as shown in fig. 2, an snapshot from this site took on 25 April, 2014. It also noteworthy that Moodle presents a good interface to its users [22], and in the last years Moodle incorporated interesting skins using HTML5 format.

Another important aspect of iPlan is the usage of learning object repositories. Under a repository environment it is possible to exchange objects [23][24], allowing collaboration between teachers.

⁴ Information about iAssign, including its source code can be found at the URL <http://www.matematica.br/ia>.

| Metric | Value |
|------------------|-------------|
| Registered sites | 64,232 |
| Countries | 235 |
| Courses | 7,521,887 |
| Users | 71,726,876 |
| Teachers | 1,153,662 |
| Enrolments | 103,589,549 |
| Forum posts | 134,103,244 |
| Resources | 69,099,000 |
| Quiz questions | 214,420,852 |

Fig. 2 - Moodle statistics with countries and registered users.

A. Seamless Integration with Moodle

The current Moodle architecture divides its plugins in several categories, such as modules, blocks and filters. The iPlan package is, in Moodle terminology, composed of the course format and a block. Course formats are plugins that determine the layout of course sections and how the course main page looks like in both view and editing mode [25].

From the teachers' point of view, using Moodle in editable mode, a lesson can be created by the selection of a pedagogical pattern, from a list of them. Then iPlan generates an editable section matching the prescriptions of the selected pattern in terms of activities sequence. The next step is to fill the content. Teachers can click over each editable area, and then iPlan will show a palette with suggestions of content options supported by the selected pedagogical pattern. This pattern is loaded from the content iRepository [20].

The contents can have any level of granularity: from fine-grained ones, e.g. a simple text or an interactive activity under iAssign [21] module to a coarse-grain, like an entire section of Moodle topic.

The resulting content from iPlan, with all resources referenced, can be stored in the same repository for reuse and eventual sharing process.

From the Moodle administrator's point of view, iPlan allows that a pedagogical pattern can be selected after a course creation, with basic content already available. In future, this kind of feature could be incorporated to the Moodle kernel, allowing the administrator directly chooses a pattern at the moment the course is created.

Since the iPlan roadmap is registered in iRepository, it could make available to the teacher several informations about its usage, e.g., iRepository could register how many courses are using a particular plan or one specific pedagogical pattern.

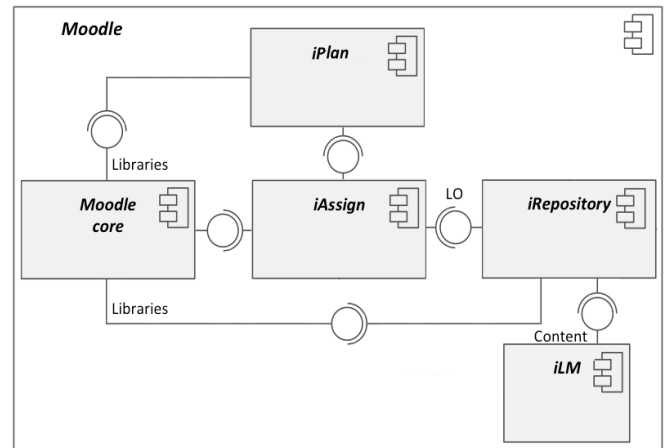


Figura 3 - UML Component Diagram for iPlan in Moodle

B. The iPlan model

The iPlan plugin can use services provided by iAssign and its basic components (such as its online editor), as well as services from iRepository. Considering this service of register and retrieve plans, iRepository can be understood as a Learning Object Repository (LOR) server. iPlan must invoke a repository method to retrieve, update or store any content. The iRepository can also be used as a repository of class plans generated by iPlan, as well.

Fig. 3 shows a UML component diagram describing the relationship between iPlan, with Moodle core, iAssign, iRepository and an interactive activity under any iLM (like iGeom [26], iGraf [27] or iVProg [28]). In Fig. 4 is presented the current iPlan main interface, in a creation of a lesson plan.

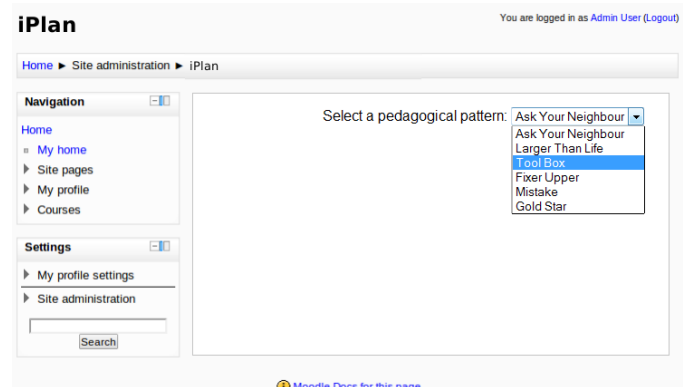


Fig. 4 - Main interface of iPlan with a lesson plan

In the Fig. 4 it is shown an interface where the teacher can choose the pedagogical pattern. The patterns into the selection list, presented at the figure are:

- Ask Your Neighbor: a pattern to incentive cooperation between pairs of students;
- Larger Than Life: a pattern to expose student to the real world situations of work;

- Toolbox: a pattern to stimulate the reuse of code;
- Fixer Upper: a pattern to connect freshmen students to real world problems;
- Mistake: a pattern to teach students to recognize their mistakes;
- Gold Star: a pattern aiming to increase the students' motivation.

Those are some patterns from a list of fourteen that Bergin introduced in 2000 to help students from Computer Sciences [5]. His research group, in 2012, released a revised list of patterns with seventy five patterns. Since iPlan is intended to be used by several teachers, it is expected that new patterns could be created, perhaps with differences from subject to subject.

VII. RESULTS

In this paper we presented the iPlan model and its instantiation to Moodle that aims to provide an integrated environment to manage web-courses. This model integrates a lesson plans editor and player in a LMS, using pedagogical patterns in a cooperative repository.

This model is been instantiated to Moodle system, using other Moodle packages to increase interactivity in the student's activities, specially iAssign and iRepository packages.

The iPlan package (instance in Moodle) is a lesson plans editor that simplifies the teacher's work during the preparation of online courses. The teacher can choose a pedagogical pattern, from a list, and fill it with the desired content.

The iPlan development is justified by the lack of a similar tool, as a systematic review showed. Despite the great usage of the Web to deliver courses, it were found just a few work effectively focusing the process of course production and even less work on tools to help teachers to prepare and deliver their lesson plans for online courses.

In particular, the great effort to build a standard to lesson plans with IMS-LD has been failed with teachers. As pointed by Arpetti, Baranauskas, and Leo, "in recent years, many efforts have been made to develop more efficient representation languages and tools and to promote the diffusion of Learning Design among teachers, but results have not yet reached the usability levels required for a wide spread among teachers" [4]. In this sense, we believe that the simplification achieved by iPlan can be a good contribution to the teachers' work.

The first simplification must be the integrated environment, the iPlan under Moodle LMS. Another key simplification is the integrated repository of pedagogical patterns that can liberate teacher from the repetitive task of redesign each class from scratch.

Besides, the teachers will be free of the necessity of learning about the IMS-LD or any other educational modeling language or system.

The iPlan system is under implementation to Moodle and will be freely distributed, under GNU Public License.

VIII. FUTURE WORK

The present stage of iPlan is its implementation. After its first deployment, iPlan must be used in a controlled-testing group. The third stage will be the effective use of iPlan in courses that will run inside our research group, after which its redesign must be initiated.

After the third stage, we plan to exam several questions:

- How effective iPlan is to the teacher?
- In how extent it help student?
- How can be helpful the data collected from the iPlan usage to improve it?

Considering the evolution of iPlan, it will be important to implement levels B and C of IMS-LD specification. This can leverage the interoperability of iPlan with other systems.

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