TrivialCV: Competitive activities for the classroom integrated in a Moodle Virtual Campus

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Title—**TrivialCV: Competitive activities for the classroom integrated in a Moodle Virtual Campus.**

Abstract—**This article describes TrivialCV, a toolkit created to facilitate the management of team-based competitive activities within the classroom. TrivialCV was designed as an instructor-oriented tool, in order to foster the organization of this type of innovative activities by facilitating the instructor's task. This goal is achieved by providing easy-to-use graphical tools and a kit of integration services that allow TrivialCV to be integrated with popular e-learning tools (e.g. Moodle-based environments). Integration is achieved by using an extensible plugin that can be generalized to support different e-Learning tools and even different external activities. The article describes the general architecture designed to integrate TrivialCV with different e-learning tools, and the specific implementation developed to integrate it with the Virtual Campus at the Complutense University (based in Moodle v1.9).**

Index Terms—**Educational Technology, Computer Aided Instruction, Virtual Learning Environments, Game-based Learning**

I. INTRODUCTION

THE NEW LEARNING PLANS designed in Spanish Universities as part of the convergence process for the European Higher Education Area (EHEA), as well as the need to develop professional capacities in students, have increased interest in applying new teaching methodologies aimed at increasing student participation in class. The objective is to move further and further away from the "master class" model (essentially one-sided instruction, followed by a final exam) and to get closer to models in which students actively participate in class and perform activities continually throughout the course.

That said, capturing student attention and developing participation in class is not easy since students, by default, tend to adopt passive roles. Various ways of getting students to participate exist, from the punitive (you have to take part, or you do not pass), to the reward-based (positive points are given for taking part). Getting students to become

intrinsically interested in daily class activities is complicated [1], [2].

The field of pedagogy usually mentions factors such as collaboration and competitiveness as ways to increase intrinsic motivation in students. To take advantage of these aspects, many researchers deem positive the possibility of organizing structured collaborative or competitive activities in the classroom [3–5], as well as the incorporation of these activities as part of the evaluation process. [6]. In practice, however, these ideas often come in conflict with the reality of everyday teaching activity, when organizing these kinds of innovative activities means an overload of work for the teaching team.

In this paper, we will describe the design, development and implementation of the TrivialCV system, a tool that allows for the preparation, management and development of competitive activities in class. This facilitates the instructor's work through integration with existing Virtual Campus (VC) systems[1]. The system downloads lists of students from the VC, prepares groups, manages competitions and, finally, uploads the results of these into the VC as one more factor to be included in evaluations.

The article is organized as follows: In Section II, the general context of the application is described, including the motivation behind the project and related work within the field. In Section III, the TrivialCV tool and the structure of the competitions are presented, while in Section IV, the architecture of the integration with the virtual campus is described. Afterwards, in Section V, we describe step-by-step the management of a competition using the TrivialCV tool, and in Section VI, the principal conclusions and lines of future work are described.

II. GENERAL CONTEXT

A. Competing and Collaborating to Increase Motivation

The notion of increasing intrinsic motivation in students is not a new idea, and has often been defended by different authors in the academic field [1], [2], [7]. These ideas have gained special traction within the growing interest awakened by the use of videogames for academic purposes. Authors who defend this kind of use of digital games center their argument on the importance of activities which motivate

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[1] The tool is called TrivicalCV, where CV is the Spanish abbreviation for a Virtual Campus.

people, and the benefits provided by this type of game regarding increasing motivation [8–12].

When searching for the elements that make video games attractive and motivating, various authors have identified distinct characteristics that make games especially engaging for players [13]. Two of the most commonly cited features are precisely competition and collaboration [6], [14–17].

This suggests that it would be ideal to be able to prepare activities that use digital games (or that incorporate elements of games) to promote collaboration among students and to take advantage of students' competitive nature in order to increase their motivation.

B. Design of Competitive Activities for Teams

In previous years, the authors of this work have informally rehearsed the development of competitive activities in the form of "games of Trivial Pursuit™ for teams", in which students are divided into teams, and the instructor asks the teams questions that are based on the syllabus of the subject, as the instructor keeps track of the score.

The results of these informal competitions were always intriguing. Students quickly "get into the game" and become involved in the competition in a significant way. In this type of competition, the instructor asks a question based on the syllabus, and the team has one minute to solve or answer the question. If the team does not know the answer to the question, or there are doubts about the validity of the answer, the instructor uses the board to explain what the correct answer was, and why it was correct. This way, classes become review sessions that allow students to refine concepts in a format that also allows instructors to detect which parts of the syllabus are more complicated.

Unfortunately, the format of this activity requires a great deal of preparation on the instructor's part. Before the session starts, the instructor has to prepare the questions and answers, as well as the explanations to be provided in case of doubt. When the session begins, it is necessary to organize the students into teams, either arbitrarily (which is faster) or let them choose their own teams (which is slower). Once the session has started, the instructor needs to figure out a way in which s/he will present the questions to the students (by speaking out loud, on the board, using a video projector), manage turns for each team and keep score of the various teams' performance.

If the instructor also wants to recognize the performance in these competitions as part of the grade for the subject, it also becomes necessary to write down which students were part of which teams and then incorporate the results into the lists of grades. In the end, the workload for the instructor ends up being excessive; much of the time in the competitive session is wasted on organizational tasks; and, if the group is large, it is difficult to translate the results of participation as part of the final grade.

C. Class Activities Connected to the Virtual Campus

The use of new technologies and specific tools could reduce the overload of work that teachers face when organizing activities in the classroom. In order for that to happen it would be important to address two principal criteria: the simplification of tasks for the instructor, and the integration of tools that already exist that evaluate and follow student performance (e.g. a Learning Management System or LMS).

In the past few years, universities in general, and specifically Spanish universities, have adopted models of *blended learning* [18], which combine normal face-to-face classroom activity with the use of LMSs such as Moodle, BlackBoard or Sakai. In many cases, this adoption is not simply the implementation of an isolated system; rather, these e-learning systems are integrated into the universities' basic services, such as enrolment management [19], thereby creating so-called Virtual Campuses (VCs).

In this way, it is becoming increasingly common to use these tools for communication with students, collecting work and assigning marks, especially when continuous training models with multiple evaluable activities are used [20]. This suggests the possibility of engaging these tools to simplify the management of the types of activities described in the previous section, as well as with the storage and processing of marks obtained during these activities.

This idea would be in line with the interest that comes from using an LMS as a connection between normal classroom activity and other activities supported by ICTs such as the use of educational games [21] or virtual worlds [22]. In fact, these e-learning environments are one of the most common means by which distinct types of activities are applied.

III. TRIVIALCV

The idea behind the TrivialCV tool is to maximize the results of putting learning online by automating the process of creating and preparing activities such as those mentioned in the previous section, thereby reducing the workload of the instructor as much as possible.

To this end, a format (specifically focused on team competition) is adopted. It is a design based on the mechanics of the Trivial Pursuit™ game, in which students are divided into four teams and answer pre-formulated questions, receiving points for correct answers. As with Trivial Pursuit™, an element of chance is included: the questions are picked randomly from a group of categories.

The design of a game with Trivial Pursuit™-style questions and answers offers the advantages of being easy for students to understand, as well as having the excitement of competition; that is why it is commonly used as a format for pedagogically-oriented competitions (such as, for example, the FLEQ system [24])

The TrivialCV system, however, is not simply limited to showing questions and answers; it also facilitates the rest of the process by incorporating a visual editor to create question banks, as well as the possibility of connecting to an LMS to manage lists of students and their grades.

The following subsections contain detailed descriptions of the design of TrivialCV competitions, and how they can be managed by the instructor.

A. Playing the game

The game consists of a competition where teams answer a set of multiple-choice questions (with one or more possible

Fig. 1. Screenshot of a question while a competition is running. Big fonts and high contrast colors are used to facilitate the use of a video projector.

Fig 2. Summary screen. The teams can see their current score and in which categories they have scored at least one point number.

answers). The game goes in turns, and in each turn, each team receives a question that is selected at random. Each correct answer gives the team one point and the objective is to get at least one point in each one of the categories. In the case of a tie (e.g. the class finishes before any team has secured all the categories), the team with the most points wins.

Given that the tool was conceived to assist the development of active participation in class, the interface has been designed to be shown in class with video projectors (see Figure 1).

The instructor goes through the questions and each team has a limited amount of time (sixty seconds, by default) to provide an answer. For this reason, the questions have been limited to brief queries with multiple-choice answers, thereby making data entry easier and helping create sessions that are quick, agile, and that maintain the attention of students.

Answers are selected by the instructors on their computer, and the tool shows whether the answer was correct, along with a brief explanation. Depending on the time available for the session, it is also advisable for the instructor to devote additional time to elaborate on the answers, using the blackboard to provide a more detailed explanation.

The design works under the assumption that the game ends once one team correctly answers a question in each one of the categories, or once class time is finished (see Figure 2). When the competition ends, the game shows which team has won, waits for user confirmation and then stores the results of the competition for grading.

B. Questions and Answers

Game categories are loosely related to one or more question files which are normally used as topics (for example, ten topics, ten question files). In the preparation of categories, the instructor chooses which question files are to be used for each one of the six categories. In this way a category can contain questions from various files (and, as such, from various topics.)

When it comes time to create the question banks, the instructor can use a battery of pre-existing questions or use a graphic editor to prepare questions (see Figure 3). TrivialCV's visual quiz editor gives instructors the chance to edit the questions and the six categories in the game.
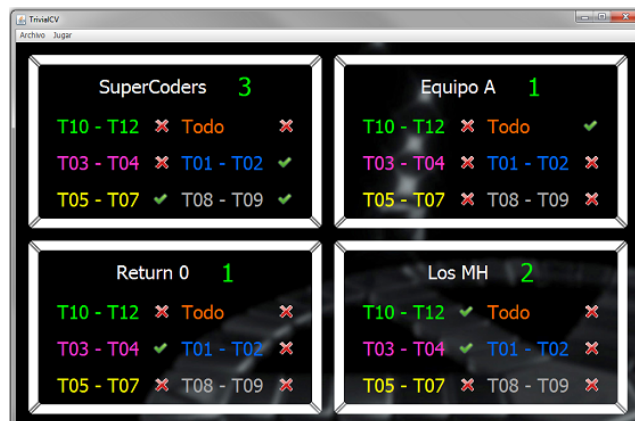
Questions and categories are stored in an XML file which is read and interpreted by the TrivialCV game engine. The editor allows the instructor to create sets of questions, edit a previously-created set of questions, or prepare a ready-to-play compressed file with a series of questions and topics.

For each question, the instructor can choose the wording of the question, the possible answers to the question and the response message which is shown after teams respond to the questions (see Figure 4.)

C. Integration with Virtual Campus tools

Aside from permitting the expansion of question banks and facilitating activity management during class, the main contribution offered by TrivialCV is the possibility of integrating the process with the most-used Learning Management Systems.

As we have previously seen in Section II, it is becoming more and more common to use the e-learning tools of virtual campuses for handling partial scoring and the management of student lists.

The TrivialCV tool is designed to work together with an LMS. This integration allows instructors to:

- Connect to the LMS using their usual user name and password.
- Download lists of students from a specific course in the LMS.
- Organize teams of players based on the student lists downloaded from the LMS.
- Upload the results of the competition as a grade to the LMS.

This integration is performed in a transparent way for the instructor, although, from a technical point of view, it does require solving distinct integration problems, as are described in the following section.
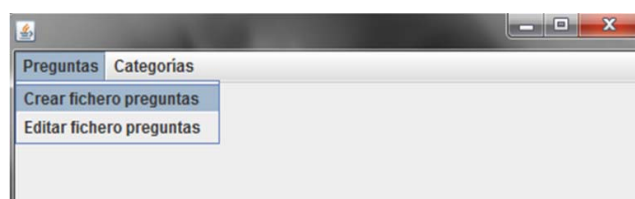

Fig. 3. The visual editor facilitates the creation and management of question databases.
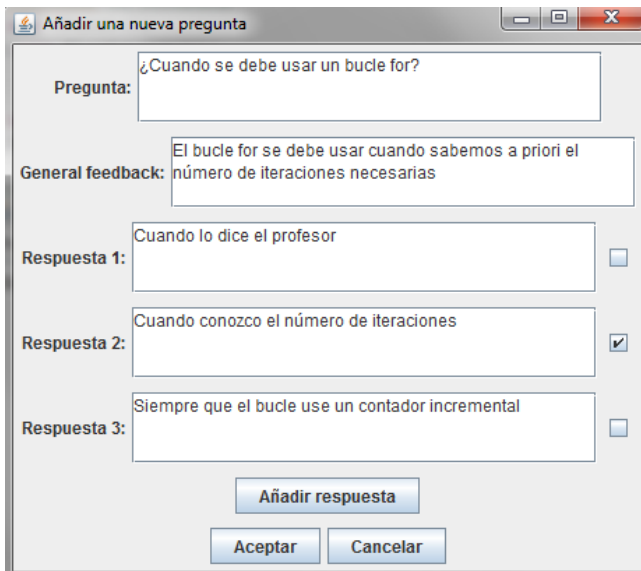
Fig. 4. Editing a question using the visual editor. The questions are then exported to XML files that can be loaded and interpreted by the TrivialCV game management engine.

IV. INTEGRATION ARCHITECTURE

The integration of the TrivialCV tool with existing LMSs attempts to automate those tasks which are more mechanical in nature, and to facilitate the integration of competition results with the e-Learning tools that are used regularly in class. Additionally, looking ahead at facilitating future development, the integration system has been designed in a generic way, so that it can be applied to different LMSs and can even be re-used for other kinds of activities.

The following sub-sections describe the generic integration architecture of the TrivialCV tool and a generic LMS, along with a description of how, specifically, integration was performed at the Universidad Complutense de Madrid (UCM) with its Moodle-based Virtual Campus.

A. Generic Architecture Integration

Keeping in mind the integration objectives that were previously set out, the requirements for integrating the TrivialCV tool into an LMS are as follows:

- Permit the ability to work offline, so that instructors can use the TrivialCV tool in competition situations where there is no internet connection. In these cases, the instructor would download the student lists beforehand, and then upload the grade afterwards.
- Facilitate the tasks associated with creating TrivialCV competition activities and storing competition results, using the functions in commonly-used LMSs.

In order to comply with the requirement that the management be centered on frequently-used tools, we have focused on two main elements which are typically present in e-learning tools:

- Educational activities. These are the elements which the instructor uses to interact with the LMS. Typically, LMSs contain extension mechanisms that allow for the creation of new types of educational activities specific to the LMS; or in a more generic way by using specifications such as IMS LTI [25] and IMS BLTI [26].

- Services. These are elements that are opaque to the instructor which provide the basic and common functionalities to the LMS and on which the educational activities offered by the LMS are constructed. Depending on the specific LMS, the abstract concept of "Service" could be offered as a framework, or as a library of functions. Normally, LMSs also provide mechanisms that allow for the creation of new services, and these services can be used for one or more activities in particular. Indeed, there are also proposals for service standardization such as IMS LIS [27].

To integrate TrivialCV into an LMS, the architecture needs to contemplate both a new educational activity and a new service. Figure 5 shows the structure of the Generic Integration Architecture with an LMS.

The new Educational Activity has two aims: to provide a mechanism to notify students that the competition is going to take place during the course (e.g. to give them information beforehand, or the list of subjects they should review) and to create a point of integration between the Educational Activity and the Evaluation/Grading System from the LMS.

For this, TrivialCV defines a new type of Educational Activity. This activity allows for the creation of new activities within an existing course and places them in the course calendar. The activity is gradable and grades can be included as one more factor within the marks of each student.

In turn, the new Service also has two aims: to provide the functionality needed to manage TrivialCV activities and to provide an extension to the LMS that can be used by an external application to exchange data and modify the state of the new activities. For this purpose, the TrivialCV service defines a generic REST-ful Application Programming Interface (API), that details the communication protocol that should be used by the tool to exchange information with the LMS.
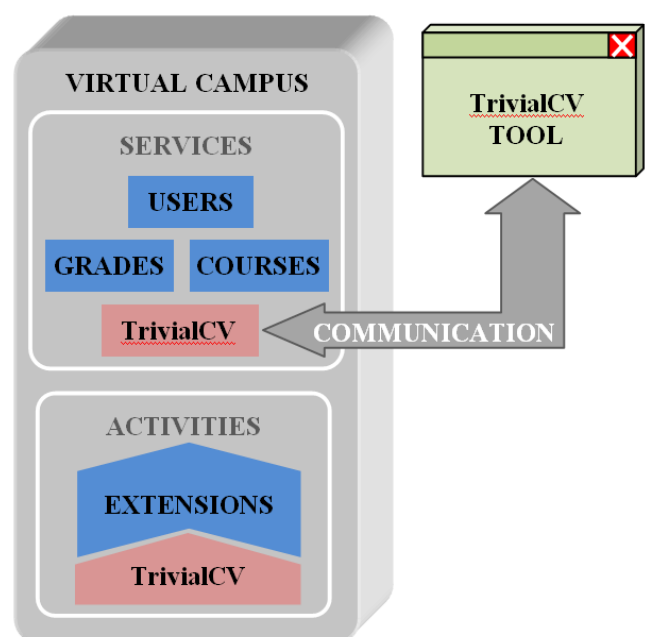

Fig. 5. Generic integration architecture. The tool communicates directly with a listener service. The service can internally affect and modify the different TrivialCV activities within the system.

In particular, this API allows the TrivialCV tool to download the information necessary to carry out the match (e.g. get the lists of participating students and competitions for a particular course, or store grades).

This structure also provides the ability for off-line work, saving lists and grades within the TrivialCV tool itself until the results can be synchronized with the LMS.

B. Specific Integration with UCM's Virtual Campus

To carry out the pilot projects, the generic architecture described in the previous section was implemented with the integration of the TrivialCV tool with the Moodle-based Virtual Campus available at the UCM. While the UCM currently uses two e-learning platforms as part of its virtual campus (Sakai and Moodle), we focused on the Moodle platform given that it is more widely used.

For this experience, we created the tools required to integrate TrivialCV with Moodle 1.9, the version which is currently supported at UCM [19]. To implement the integration architecture, the following modules were developed:

- The TrivialCV Activity. This new activity is implemented as a new Moodle module so that the TrivialCV activity can be used as a new activity within Moodle, and can be added to any course in the LMS. Furthermore, this activity is integrated with the Moodle grade book, so that each TrivialCV activity will appear as a new column within the grade book for each course (an example of this appears later, in Figure 8).
- The TrivialCV Service. This Service, implemented within the TrivialCV Activity itself, provides the REST API to be able to consult the courses that the instructor is teaching, the students registered in the courses taught by the instructor, TrivialCV activities within each course, and the submission of grades from competitions.
- An authentication extension. With Moodle 1.9, authenticating an external application requires specific configurations and code to allow an external application to access the system without needing to use a browser.

The result of this development work is therefore a collection of extensions for Moodle 1.9 (the TrivialCV Activity, the TrivialCV Service, and a Simple Authentication module for External Tools) which needs to be installed by the system administrator. Once the extensions have been installed, the instructor can configure a new competition, perform it and then publish the results in a simple manner, as is described in the following section.

V. DEVELOPING A COMPETITION

As we have seen in previous sections, the tool makes the work of the instructor easier during different stages of preparing and organizing competitive activities in class, thanks to both the use of the question editor and integration with the VC. The following subsections provide an example of the use of these tools for preparing and developing the activity, and finalizing the activity by uploading the results.

A. Before the Session

The question bank editor allows the instructor to create his or her own or to revise one that has already been created. This allows the instructor to choose questions that, for their difficulty or subject matter, are the most appropriate for the session that will be carried out.

At the same time, before the session begins, the TrivialCV tool can download, from the LMS, a list of students who are registered in a course, given that once the session actually starts the instructor may not be able to access the network).

To do this, the instructor activates the server connection to the LMS (from the TrivialCV tool) and introduces his or her user name and password (see Figure 6). The program logs into the LMS and shows the instructor a list of courses that the instructor is teaching, so that the instructor is able to download the list of students participating.

The instructor can use this moment to add a new TrivialCV-type activity to the course, and this activity may be used to store and manage the grades at the end of the session (see Figure 7).

This step can also be done at the end, just before uploading the results of the competition. Given that there may not be an internet connection in the room, the following steps can be performed while working in offline mode with the TrivialCV tool.

B. Running the session in the classroom

The main objective of the TrivialCV project is centered on completing activities within the teaching space, promoting attendance and participation in class. In a session within the teaching space, the instructor who is in charge of the session can connect a computer (with TrivialCV already loaded onto it) to a video projector.

When the session begins, the instructor can use the tool to organize teams randomly, based on the previously-downloaded list of students. In the event that teachers prefer students to organize themselves into teams, the tool offers an interface to keep track of which student was part of each team.

Once the teams have been created, the session begins and TrivialCV is used to manage the competition. The tool moves through turns from one group to the next, choosing the categories and showing the questions. Optionally, the tool can also show a timer that shows the maximum time available to answer the question.

Once team members have agreed on an answer, the instructor inputs the answer into the system, and the system shows whether the answer is valid or not (and the reason why.) This explanation can be used by the instructor to lead into a discussion to reinforce a particular concept and to consolidate the students' understanding. During the match, the system stores the scores of each team, displaying them at all times and keeping track of which team is winning.

The game continues until one of the teams wins (by having answered at least one question from each category) or until the instructor finishes the game (possibly because the class is over). The results are stored so that the instructor can process them later.
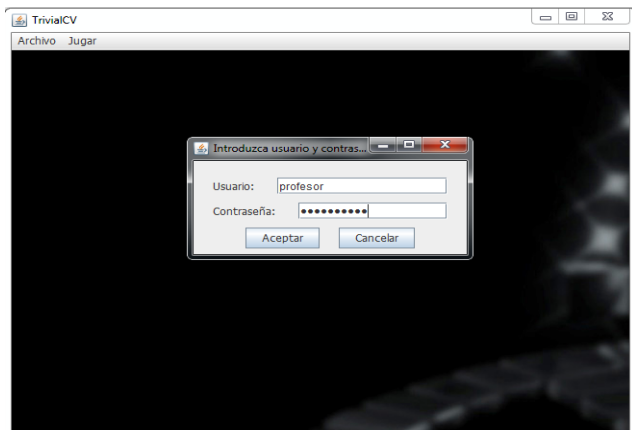
Fig. 6. The instructors can log into the Virtual Campus directly from the tool, using their user name and password. Then, the tool displays a list of their courses so that they can download the lists of students or upload grades.

Fig. 7. Preparation of a TrivialCV activitiy from Moodle. The activities can include detailed descriptions of the competition schedule and expected contents. Later, this activity will be used to store the grades and will appear in the grade calculator.

C. After the Session

The instructor can set the criteria for turning the score into a grade. By default, the winning team is awarded the maximum grade, while all other teams are assigned a grade proportional to their team score.

However, the instructor may also decide to use alternative models: to value all teams equally or to assign at least a passing mark to each team. The instructor can also tweak the grades of individual students who have been identified as being especially active or passive.

Once the instructor is satisfied with the evaluations, these can be exported as an Excel spreadsheet or uploaded directly to the LMS to be part of the final grade. When uploaded automatically, the evaluations are stored as the grade of the TrivialCV Activity (created before the session or at that moment) and can therefore be used as part of the grading via the grade calculator in the system (see Figure 8).

VI. CONCLUSIONS AND FUTURE WORK

The introduction of competitive or collaborative activities into the classroom can be a way to achieve increased student participation in class. This is becoming especially relevant with the adaptation of the EHEA. However, it is also necessary to reduce the workload that these additional activities represent since, in the majority of cases, instructors are not receiving additional help to create these innovative activities.

In response to these concerns, in this paper we have presented the TrivialCV tool to facilitate such activities. The tool encourages development of this kind of activity, making the process as simple as possible for the instructor. To this end, we can benefit from the possibilities for integration offered in modern LMSs that are being adopted at universities to be used in support of the management of student lists and grades. This makes it easier to carry out these activities in the classroom, with the aim of increasing attendance and participation in class.

The availability of a visual question editor, along with the use of an open XML format to store the questions should allow for the use of TrivialCV in various ways. In addition, we expect to able to provide support to other question creation tools, allowing users to, for example, import quizzes that comply with the IMS QTI specification [29].
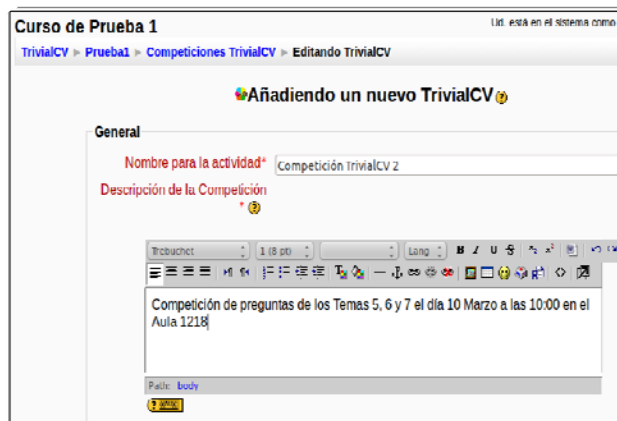
This would allow users to import groups of questions that have been developed with other tools.

Regardless, the principal contribution that TrivialCV makes is to the integration of these activities as part of ongoing evaluation processes. TrivialCV can be integrated into a Moodle environment as set out in Section IV. In addition, the Integration Architecture has been conceived to be applicable to other types of activities and LMSs, thereby opening up possibilities towards other innovative activities within continuous evaluation processes.

In the future, we will count on being able to use these Moodle extensions that have been developed for TrivialCV for the integration of other activities. Even so, it will be necessary to improve the Simple Authentication Extension that was developed, in order to be able to integrate these extensions into production environments.

With regard to effectiveness and applicability of TrivialCV-type competitions in class, during the 2010-2011 academic year, a pilot course was carried out with the first group of first-year students to enroll in the new grades compliant with the European Credit Transfer System. These new grades highlight the importance of continuous evaluation and participation in class. In the pilot course, a TrivialCV competition between students was developed for a class on Fundamentals of Programming.

Fig. 8. Game results uploaded to the Moodle server, along with the other grades from the course.

The result was a success from the point of view of the students' active participation throughout the session, and served as a unique opportunity to revisit concepts from the entire course. Students reacted positively to the initiative, and that has led us to organize new activities in upcoming courses. Our new competitions will be more formal, and with a real impact on the final grade awarded to the students.

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