Using Open Education Tools for a Higher Education Virtual Campus

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Abstract— **Current research proves that using a virtual campus as a learning management system (LMS) can increase the students' sense of community and enhance student performance, all the while LMSs have become a main component of how traditional teaching universities interact online with their students. We developed our university virtual campus CVUPT continuously since 2008, based on new technological developments but also on new Open Education Tools. Since our university is a research-oriented university, we used data to inform and guide an LMS review and strategic development process. This paper analyzes the use of this Moodle based virtual campus by a traditional university and how the implementation of different Web 2.0 technologies as open education tools have affected students-teacher interaction.**

Higher education; e-learning; MOODLE; Open education tools; virtual campus; OER (key words)

I. Introduction

Electronic learning (eLearning) has become an integral part of education over the past decade and universities have embraced worldwide also teaching at distance using electronic online tools but also integrated online tools in traditional campus-based education. The tools used for universities to support online the traditional education are usually named Learning Management Systems (LMS) or Learning Content Management Systems (LCMS) are available in various versions, both open-source and commercial, or they are simply named learning platforms [1] [2]. Traditionally LMS offer different levels of access to information, interaction as they focus on access control, learning content provision, communication tools and organizations of user groups.

Virtual Campus have made its first appearance in Europe around the mid-1990s and mainly in the context of European Union strategic documents [3] [4]. It is used mainly in the context of integrating Information and Communication Technologies (ICT) to enhance learning in higher education, especially in traditional, campus-based settings. Since then, virtual campuses have become even more popular, quite often replacing the term of learning platform or LMS [4] [5]. When the new input of free and open source software as well as the web 2.0 technologies there is an even impact on higher education learning system, resulting in a profound impact on how universities needed to adapt to how their students learn. Web 2.0 technologies enabled users to create knowledge which becomes ubiquitous. From these innovations, the new concept of Open Educational Resources (OER) has emerged. Higher education institutions have been changed by the integration of virtual learning environments, new virtual campuses with integrated web 2.0 technologies. While OER include usually full courses, focus more on content and resources, Open Education Tools refers to tools produced with free, open and adaptable software and which remove various barriers on its production or adaptation [6] [7] .

In Romanian higher education, the level of implementation of the new educational technologies is wide spread, mainly due to the involvement of the Romanian educational institutions in various European and international projects [4] [8] Moodle (Modular Object-Oriented Dynamic Learning Environment) is among the most widely-used virtual learning environments in Romanian universities basically because it is a cost-free technology that enables faculties to create their own online courses easily and free of charge. Still it is not cost free as several human resources need to be considered for an operable environment and this was developed by dedicated departments in each university and led to nation-wide training programs [9].

This paper analyzes the use of a Moodle based virtual campus of a traditional university and how the implementation of different Web 2.0 technologies as open education tools have affected students-teacher interaction. These developments have been made on a virtual campus that is Moodle based.

II. Virtual Campus in Higher Education

The Virtual Campus of the Politehnica University of Timisoara (CVUPT) is the e-Learning platform currently used for many of the online educational processes occurring inside the university. It hosts courses and users from Distance Learning and Masters' Degrees programs, as well as various other courses, mainly in a blended learning format.

Currently, the configuration of the platform includes an archive of the previous years, consisting of functional read-only "snapshots" which allow students and faculty to review

the materials and activities existing at the end of the respective academic year (Figure 1).

In order to measure and evaluate the different techniques and model scenarios for use [10], as to see the difference in student-teacher interactions we had to devise sets of real data in a machine ready format. The source of this data is represented by the Virtual Campus platform (CVUPT), based on the popular open-source learning management system Moodle. Before constructing the data set, the collected data must be evaluated in terms of quality, quantity, format, and relevance to the next steps in our study.

In out proposed scenario, we collected a large amount of information about users (their interaction with the platform, academic history, roles on the platform, etc.), the educational objects with which they interact, course structures, etc. In order to achieve relevant predictions, it is necessary for the dataset to contain information collected from several successive academic years. Currently, the last six academic years are available for analysis. At the beginning of each academic year, the platform is updated to the latest official Moodle version, which sometimes requires changing the structure of the collected information. Thus, it is necessary to find the appropriate common data structure for converting the different data formats.

Next, we will present the comparison of the six existing instances of the CVUPT platform, corresponding to the academic years: 2010-2011, 2011-2012, 2012-2013, 2013-2014, 2014-2015, and 2015-2016. We will interpret the relevant data according to the scenario, the structures in which it exists, as well as the differences between the six years of study by correlating the data of the platform's instances.

For the purpose of the present study, the instances of the archive were used, because the current platform has lost some data in the logs either due to the resetting of the courses at the beginning of the academic year, or to the periodical purge from the system of expired accounts, alumni, or others similar factors.
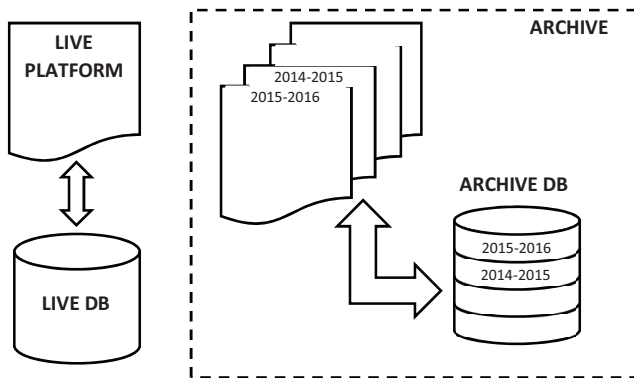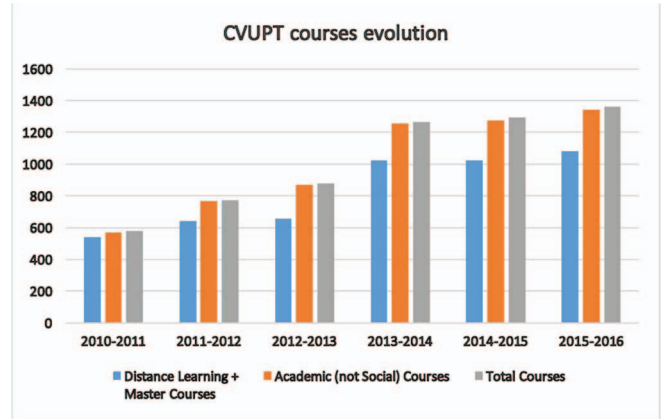

Figure 1.   CVUPT diagram

Figure 2.   Virtual Campus Course evolution.

In figure 2 is presented the evolution of the CVUPT platform during the last six complete academic years, from the perspective of number of courses (from different study programs) and user roles (students and tutors). There is a clearly visible increase of yearly courses for each category (Figure 2). This is mainly due to the official university policy of encouraging the presence of all master's programs in the university on the platform, the deployment of new distance learning and reduced frequency programs, as well as the tutors' willingness to use CVUPT as a support for undergraduate courses, mainly in a blended learning mode.
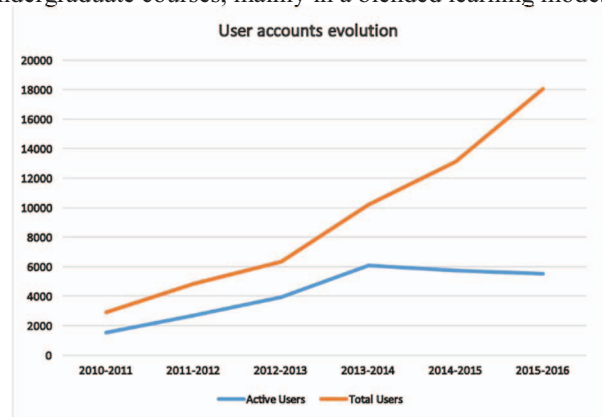

Figure 3.   CVUPT accounts evolution.

We can clearly observe in Figure 3 a surge in user accounts on the platform proportional to the increase in courses. The perceived difference between the total of student and tutor accounts and the number of users on the platform is due to: administrative accounts, the use of the platform as logistical support for national and European projects (whose users have no other role on the platform), as well as alumni who cannot access current courses (and are purged after a certain period of time). The last category of users represents the main factor in this discrepancy.

III.   DATA ANLAYSIS METHODOLOGY

For conducting our analysis, we have run the necessary queries on the databases of the archives, through the use of the "Ad-hoc database queries" plugin, available in the official

Moodle online extensions repository. This allowed us to get results from the comfort of a web-browser, while still accessing the raw data from the existing databases. The actual records were kept anonymous, most queries just returned counted results of events which occurred in the corresponding period.
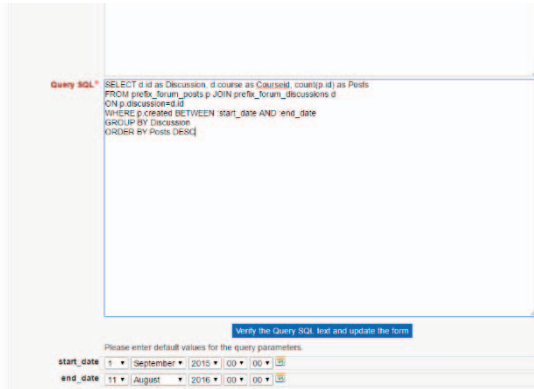

Figure 4. Example of query run in the "Ad-hoc database queries" plugin.

The analyses were therefore quantitative [11], which allowed us to objectively measure to evolution of the number of posts or chat sessions, for instance, but not the content of those posts, or the feelings of the users in regard with the platform or the educational process. For using the data extracted from CVUPT for analysis, of particular importance was correctly identifying the courses and the users across the platform's many different installations. This was achieved by using the unique identifier for the courses in the database (the primary key) [11], and the username or id for the user accounts. For this procedure to work properly, it was essential that the unique identifier (which auto-increments on record insertions, continuing existing records) not to be reset from one instance to the next. Upgrading to the next version is done by using the official Moodle update mechanism on top of the existing instance, with the initial database, adapted for the current Moodle version.

This ensures that all of the existing users and courses remain unchanged. In order to prepare for the beginning of the next year, the courses are then reset, the activity data is erased and the new user enrollments are processed. This means that all the activities from the previous year are eventually lost. It is therefore necessary to keep a copy of the platform for each academic year, a "snapshot" of all the existing courses and users as they were at that time.

IV. OPEN EDUCATION TOOLS ANALYSIS

Another source of information relevant for our learning analytics scenarios is the users' interaction with the educational objects and activities available in each of the courses. Tools provided by Moodle can be sorted into two main categories: activities (facilitating communication, evaluation and the execution of complex pedagogical processes) and resources (means for the distribution of didactical materials in a structured format, such as documents or presentations) (Table 2).
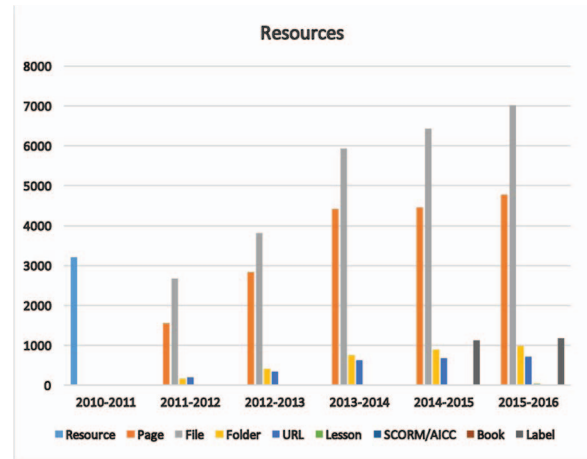

Figure 5. CVUPT Open Educational Tools.

Figure 5 emphasizes the difference in each year based on the introduction and development of new web 2.0 tools and it shows the number of tools implemented in the courses. Based on Figures 5 and 7, the most popular activities in CVUPT during the six years analyzed were: the assignment tool, forum, OU blog and the quiz. We observed a constant increase in assignment-type activities during the latter years. The data collected from the use of this tool could be used in reliably predicting the academic performance or in alert systems. However, these scenarios require access to the rest of the data on the platform regarding the interaction between users and the application.
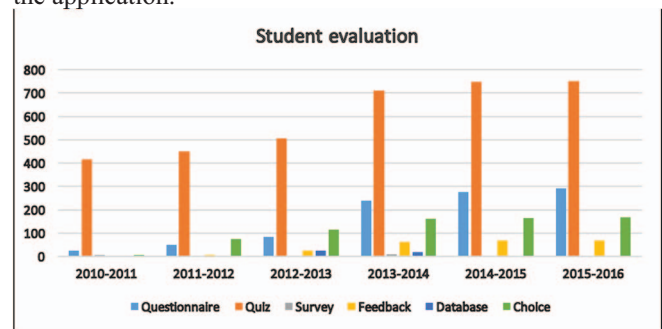

Figure 6. CVUPT Tools.

We can observe from Figure 5 that for the 2010-2011 academic year, the resource tools are not detailed per type (file, page, folder, URL, etc.). This is due to the fact that they were only introduced in the 2.0 version of Moodle, and were not available in Moodle 1.9, which is the version of the first platform in the archive. In order to use the data acquired from this instance, further data processing is required. We also see an increase in the number of resources correlated with the increase in courses. Since files and pages contain actual information, they observed the biggest growth, while folders and labels only provide content management.
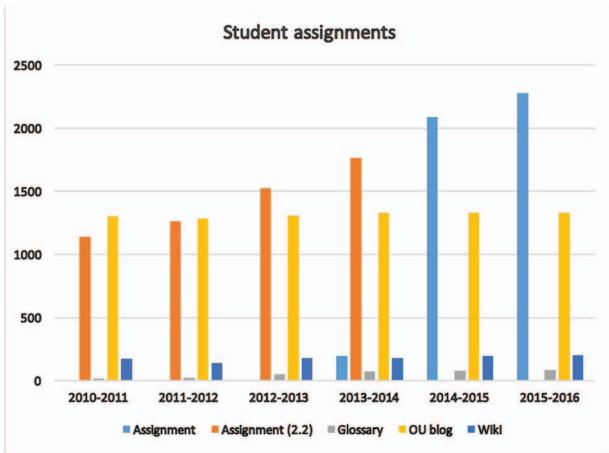
Figure 7.   CVUPT Student content creators.

From Figure 7 we can see that CVUPT was used for a high number of homework or project submissions as assignments and this has stayed constant over the analyzed six years, with an increase similar with the percent increase of new courses. But with the introduction of Open Education Tools more assignments and student activities were done using wikis or blogs and these has increased as well as student interactions in these Figure 9.
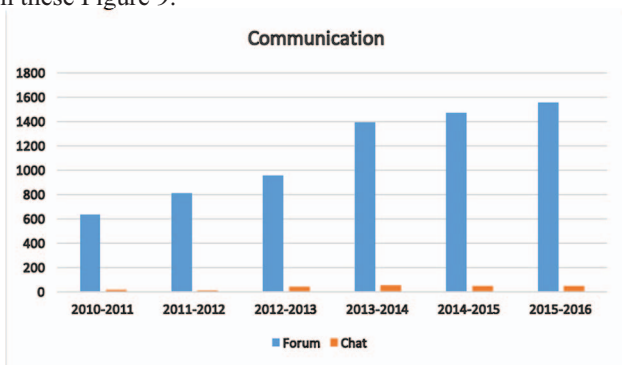

Figure 8.   CVUPT Communicaton Tools.

We analyzed the users' interaction with the new web 2.0 tools (a major contribution to the platform since 2012-2013) for prediction scenarios, as well as the information that these resources actually contain for use in recommendation systems (Figures 6, 7).
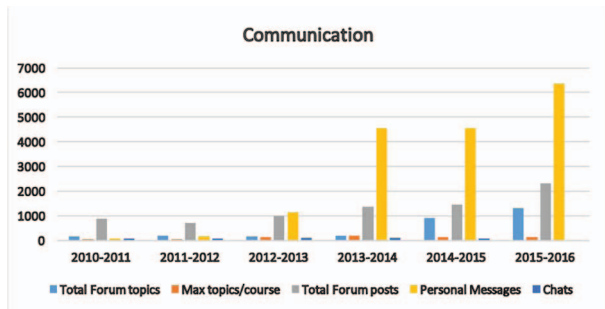

Figure 9.   Communication Evolution.

The forum tool is a valuable and popular communication instrument, and the data gathered by this resource can be used for Social Network Analysis (SNA) techniques. Some of the data obtained by the OU blog activity, like the comments, can also be used for SNA. Many of the tools that can generate text data (OU blogs, wikis, forums, etc.), are also valuable in recommendation systems scenarios.

From Figure 8 and 9 it can be observed that since the introduction of the Open Education Tools in 2011-2012 and the training performed in that year and the following one [9], a high level of communication between students and between students and teachers has occurred. This communication was text analyzed and will be presented in detail in a future paper, but it was mainly related to project work assigned to students and students sharing external resources, by guiding themselves to search for accurate and useful online content.
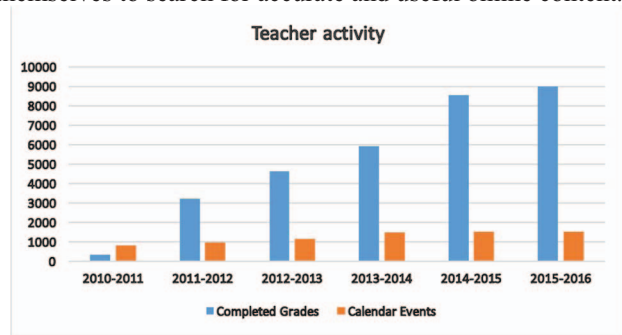

Figure 10. CVUPT teacher activity.

Figure 10 shows that teacher activities in CVUPT has increased constantly over the years with a major increase from 2014-2015 when more tools were integrated. Teachers used calendar as student reminders for assignments, and more and more teachers informed the students privately, online about their grades (before the students got their grades publicly from a post on the university hall).

V.   INTERACTION ANALYSIS

Almost all user interaction in Moodle, from the login procedure to reading a forum post, almost any mouse-click is recorded in a centralized log. This structure is implemented as a "logstore", a relational table in the database which hasn't had any major changes up until the update for the 2014-2015 academic year. Since this is only one one table, and the application hosts a large number of courses, users as well as interactions, this table has millions of records. This is the reason why obtaining real-time statistics from one single source would be time-consuming, and simply not feasible.
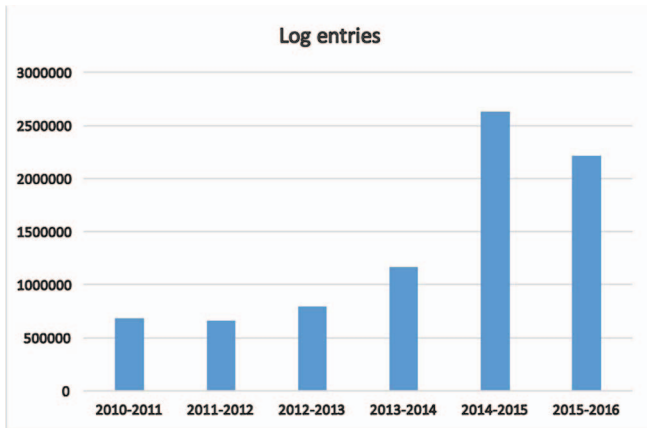
Figure 11. CVUPT Logs.

By using the archived instances of the platform, logs can be exported individually and then processed for relevant information. The current, live instance would need a specialized procedure, centered on optimizing access times while still performing nominally in a production environment.

From Figures 11 and 12 we can see a constant increase in the users logs on CVUPT, the only decrease being during 2015-2016 but this is due to the new way the actual CVUPT (based on Moodle 2.9) records the logs as well as the extended time which a user can spend online quietly on CVUPT (no clicks) until he is logged off (30 minutes beside 10 minutes). We can also see that from 2014-2015 user interaction on CVUPT was much higher (doubled then the previous years) all because of the intense activity facilitated by the new possibilities of new tools. Which is similar with other findings [12].
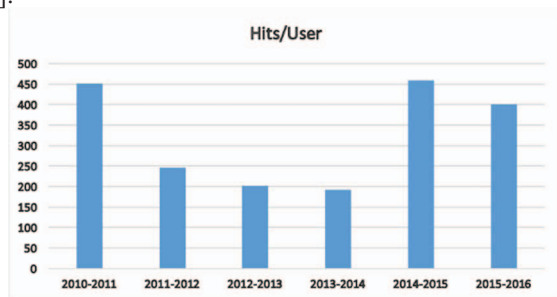

Figure 12. CVUPT Hits per user.

VI. CONCLUSION

At the current stage of our research, we have identified the relevant information and extraction procedure from the CVUPT virtual campus. We analyzed the usage of different Open Education Tools (OEP) available on the platform, the year when they been introduced and looked at their impact on communication and interaction.

The regular increase in users and courses was explained by the dynamic nature of the study programs, as well as the growing interest that teachers developed in using the CVUPT. The evolution of usage by the users of different OEP was analyzed and possible motivations were formulated. While not all the tools available have been used to their fullest potential, adoption of the core aspects has been more than satisfactory. We can see that with the introduction of the new OEP the interaction and communication level have increased constantly and in some cases beyond our expectations. This shows us that by introducing OEP, training teachers on using them in a specific pedagogical settings can be useful for the student interaction, raising their interest in certain activities and not ultimately reaching the goals of better retention and higher grades.

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