

IT or not to be: The impact of Moodle in the education of developing countries

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Abstract

E-learning environments, such as Moodle, provide a technology that fosters the improvement of the educational system in developed countries, where education is traditionally performed with relatively high standards of quality. A large number of case studies and research have been conducted to demonstrate how e-learning technologies can be applied to improve both training and learning processes. However, these technologies have not been proved efficient when applied to developing countries. The challenges that must be addressed in developing countries, both technological and societal, are much more complex and the possible solution margins are more constrained than those existing in the context where these technologies have been created.

In this paper we show how Moodle can be used to improve the quality of education in developing countries and, even more important, how can be used to turn the educational system more sustainable and effective in the long-term. We describe our experience in implementing a programming course in Moodle for the Higher School of Informatics at the *Université Polytechnique de Bobo-Dioulasso*, in Burkina Faso (West Africa), joining efforts with local professors in designing and implementing the learning system. The case example has been designed having in mind a number of contextual problems: lack of lecturers, excessive teaching hours per lecturer, massive classes, and curricula organization and stability, among others. We finally discuss how the teaching effort is reduced, the students' knowledge and capacity improves, and the institutional academic model can be guaranteed with the proposal. For this reason, we claim that information technologies in developing countries are a cost-effective way to guarantee the objectives originally defined in the academic curricula and, therefore, deal with the problem of the education.

Keywords

Moodle, e-learning, education in developing countries, programming course

1. Introduction

Development and use of Information Technology (IT) offer universities tremendous new possibilities in research and education, and allow greater access to information. As universities develop and extend their use of IT they enhance their ability to improve the quality of education and meet new challenges. The application of IT in the education and learning process should not be considered a substitute for teachers, but rather an instrument to strengthen their role. Universities should promote the adoption of IT as a way for teachers to gain greater and easier access to information, a greater opportunity to interact with their peers, and new possibilities to enhance the interaction with students. Learning Management Systems (LMS) have been conceived as a support tool to improve the learning process in developed countries, fitting with an educational model with relatively high standards of quality. However, in developing countries, LMS could be used not only to pursue these goals but to offer a real opportunity to stabilize the educational system at a very low cost. LMS make the learning process more efficient through the use of a web interface that allows lecturers to manage students' assignments, post course materials, do the grading, and many other features; LMS also offer discussion forums to the students, calendars, and other interesting and useful services.

As a real example, a cooperation project between the *Universitat Politècnica de Catalunya* (UPC BarcelonaTech) in Barcelona, Spain, and the *Université Polytechnique de Bobo-Dioulasso* (UPB) in Burkina Faso, is described in this paper, implementing on Moodle (Modular Object-Oriented Dynamic Learning Environment) a computer programming course for the computer science engineering degree. The cooperation activities started in 2004 and, as part of them, a group of professors from the UPC Barcelona Tech annually develop a certain number of training missions at the UPB, as well as provide equipments to improve the local computing facilities. Surprisingly, the courses have never been taught to local lecturers (which could improve the teaching capabilities of the centre); instead the courses have always been taught to the students, supplying the lack of personnel to teach them (this is the main difficulty the University has to deal with). In parallel with this, different ways to improve the quality of the support and turn the project orientation more sustainable has continuously been searched. The possibility of performing the training from Barcelona using a LMS has initially been explored; however the alternative turned to be unfeasible due to the extremely poor Internet infrastructure in Burkina Faso (availability, low bandwidth, high cost, ...). Universities (and particularly the Naso campus of UPB which is 40 Km away from the city) do not have an operational and stable access to Internet; in addition, Internet is rarely available at home, so students had to use cyber cafés in order to access the contents available in the LMS, making the learning process very limited and unproductive.

Then, the possibility of setting a Moodle server locally inside the UPB was explored. Isolated from Internet, Moodle can still be used offering most of its already proven benefits. Even though only a limited set of Moodle features are being used in this project, the great and unexpected benefits that this improvement could have on the students' learning process, in particular, and on the teaching activities and the academic management bodies, in general, will be shown. Note that in this paper only the particular experiences of the cooperation project between the Computer Science Schools at UPC Barcelona Tech and UPB in Burkina Faso are described; however, some of the concepts addressed in this work might be applied as well to different educational contexts and developing countries.

The rest of the paper is organized as follows. Section 2 outlines the educational possibilities of IT-based learning and some previous experiences in developing countries. Section 3 shows the educational context and difficulties in developing countries, particularly African countries. Section 4 describes the proposed implementation and section 5 highlights the expected benefits. Finally, some concluding remarks and a short vision of the future directions in this cooperation project are presented in section 6.

2. Related experiences

Recent years have witnessed considerable enthusiasm regarding the role of IT in addressing educational challenges in Asia (UNESCO, 2004) and in Africa (Keats & Schmidt, 2007; and Leach, Ahmed, Makalima, & Power, 2006). Although there is a variety of on-going research programmes, there has been limited opportunity to gather data regarding the state of e-learning in this continent. Different studies try to answer this question, pointing out that there is a variety of different e-learning practices in Africa, although e-learning is still in its infancy in most developing countries (Hollow, 2009; and Unwin, 2008).

The most popular LMS used in developing countries are Moodle, WebCT, KESL.NextGen, Blackboard and Sakai/Vula. (Unwin, 2008; and Isaacs & Hollow, 2012) report that there are geographic differences in the use of different LMSs, with Sakai/Vula being used exclusively in South Africa, KEWL/NextGen being mostly used in South Africa and Tanzania, and Moodle and Blackboard with a more widespread distribution.

Open source LMS are more emphasized in developing countries due to the challenges faced when implementing proprietary solutions. (Copola, 2005) describes two characteristics that made proprietary LMSs not suited: firstly, the rapidly escalating cost of proprietary software leaves too little of the institution budget available for creative exploration and, secondly, reduced flexibility to adapt to local culture and teaching practices occurs when software development is driven by mass market economics.

(Unwin, 2008) summarizes several contrasting views regarding the advantages and disadvantages of using e-learning platforms for education. Some of the advantages are:

- Ease of access of information.
- The potential for interactivity among and between learners and teachers.
- Combination of both synchronous and asynchronous learning.
- Potential for re-use of contents.
- Bringing quality education to increasing number of students.
- Ability to supervise students at a distance.
- Facilitate the management of student records.
- Safe digital environment for students to submit work.
- Help motivate students.

However, e-learning platforms have also several disadvantages for developing countries, such as:

- The learning curve is pretty steep and it needs an important time investment just to get started, which is not easy to arrange when working on a voluntary basis.
- Many students and teachers are not familiar with these platforms.
- Need of huge availability of the teacher who already has a lot of work.

In this sense, there are few experiences (Lee, Thurab-Nkhosi, Giannini-Gachago, & others, 2005; Sife, Lwoga, Sanga, & others, 2007; and Zurita & Ryberg, 2005) to develop online courses to support blended learning in developing countries. (Andersson, 2010) presents a framework of e-learning enablers and disablers to identify the major challenges for e-learning in developing countries. Some of the findings of this study point out that in many developing countries e-learning is new and IT literacy low, so that at the beginning students may be very confused and will need additional guidance. It is important to provide alternative ways for education delivery, especially for self-studying. Finally, education is traditionally very teacher centred, so the introduction of e-learning must consider support for interactivity, feedback and self assessment.

3. The educational context in some developing countries

African universities are forced to work to increase the chances of success of students and facilitate their professional insertion. All African universities have the same fundamental mission: the development and transmission of knowledge for the training of men and women to meet the needs of their country. But, in general, the African universities share a similarity of problems which are, among others:

- Published work underused because the available literature is unknown.
- Inconsistencies in the acquisition and management of supplies and equipment.
- Universities with low exterior visibility, their offers training, skills and services are unknown.
- Enormous financial resources still devoted to communication by telephone and fax.
- Time spend in processing records is very long.
- A shortage of teaching staff that is still crucial.
- Geographic locations isolated due to the absence of reliable communication systems.

Universities are facing a lack of access to IT tools, educational services, human resources, financial resources, etc. Moreover, the unrealized transition to the Bachelor-Master-Doctorate system (BMD) since 2010, which increases the problem due to:

- The need for greater flexibility of training pathways.
- The need to allow greater mobility of students and teachers.
- The need to expand training offer.
- The need to develop centres of excellence.
- It requires the academic tracking of students.
- The need for access and dissemination of educational resources and all other useful information.
- The need for communications infrastructure and information safe and secure.

Universities develop and continuously update institutional policies in IT in order to align the educational and research objectives with technological possibilities and the human and financial resources. These policies should place the quality of teaching, learning and research at the centre of all development. Indeed, as the use of IT extends, the focus on issues such as pedagogy, content and nature of the programs becomes crucial. The urgent needs identified in Francophone African universities essentially are summarized in:

- Having a low cost communication system in real time to reach all stakeholders in universities sites.
- Ensuring better visibility the structures and activities of universities.
- Proceeding with the computerization of key services including education registration services.
- Promoting the pedagogical use of IT.
- Ensuring staff training.

Meeting these needs requires the development of IT services. These services consist of all the tools that will be offered through the backbone network to facilitate the activities of individual users and their needs. Services to develop to meet the identified needs are communication services and information and application services and databases.

At a time when globalization is installing with poor results for our country, not the reduction of poverty, but rather the perpetuation of our economic delay; network-sharing knowledge is imperative and well received by university officials, government authorities and also by the technical and financial partners (Bamako, 2006).

4. Case study: Implementation of a first year programming course

4.1. Current course organization

Traditionally, the education system in the *Université Polytechnique de Bobo-Dioulasso* is the typical Bachelor-Master-Doctorate (BMD) structure. An academic year is divided into two semesters, and each semester consists in a set of instruction units, or subjects, that must be validated by each student.

In an instruction unit, the working time of a student can be organized in several parts:

- Classroom lecture (CM, *le Cours Magistral en présentiel*);
- Problems (TD, *les Travaux Dirigés en présentiel*);
- Work practices (TP, *les Travaux Pratiques en présentiel*); and
- Personal student work (TPE, *le Travail Personnel de l'Étudiant*).

Problems (TD) are interactive sessions. Before a TD class, a list of exercises is provided to the students and, during the TD class, the exercises are corrected with the students' participation. Work practice (TP) sessions are organized into small groups, depending on the number of available equipments. The TP consists in giving the students a practical subject matter. The teacher in charge of the laboratory must be physically present to provide guidance and to make sure students really work. Unfortunately, teachers do not always have sufficient time to follow the evolution of the work done by each student. Personal student work (TPE) represents a significant

fraction of the total working time for each unit, being in theory close to 40%. However, the real situation is that TPE time is not devoted for the purpose assigned to it. In practice, all activities are conducted without regard to the personal student work, so there is a loss of 40% in the development of the instruction unit.

The evaluation of the work practices (TP) consists in giving each student a topic randomly selected from a number of issues of equivalent difficulty. At the time this assessment is running out, the teacher rates each student individually before leaving the room. By averaging 5 min per student for a reduced group of 10 students, the last student to be assessed will wait approximately 45 min to turn the evaluation. In this context, fair and equitable assessment of the students' work is almost impossible.

In addition, the lack of teaching resources, such as video projector or sound reproduction, or even more, the lack of teaching materials, such as text books or slides, or even photocopies, causes huge waste of time. In this sense, the lecturing task takes place in several phases:

- Oral dictation (DO, *le Dicté Orale*) in order to give as much formal information and detail to the students;
- Interleaved with phases of explanation (E, *l'Explication*);
- Interleaved with phases of questions / answers; and
- Phases of application exercises where the participation in the resolution of problems is voluntary.

The DO phase, on average, takes one third of the total time devoted to lecture. So this time, together with the TPE time, represent a sharp loss for the teacher and students times that, ideally, could have been leveraged to do more activities. As a consequence, there is not only a lack of teachers, but the time devoted by each of them to lecturing is highly inefficient. From the student point of view, beyond the lack of optimization of their working time, the training is incomplete, frustrating, and they do not receive any feedback for the activities eventually performed outside the class.

4.2. Opportunities with Moodle

Innovate in education does not always requires large amounts of resources. A LMS, such a Moodle, can be used through a local network. In addition, even though Moodle implements a large number of functionalities, only a reduced number of them are required to fulfil the objectives of our project. Services that can be of interest are:

- Course materials repository, available anytime, *anywhere*, although with the tight limitation that it will only be inside the campus area;
- Course organization, so that students will know exactly the type of activity and the amount of time to devote to the studying of each course module;
- Communication utilities, to allow collaboration between students and facilitate the interaction between students and lecturers;
- Assessment utilities, so that assessment can be carried out more often, the students can receive instant feedback and, in addition, the correction process by the teacher can be performed automatically.

Creating course materials and adapting them into a self-contained format can be a time consuming task.

However, this effort will be transferable and reusable and, therefore, pays-off the invested time. The scheduling of course activities and associated times is a task that requires accuracy, ensuring that the time devoted to each concept is proportional to its contribution to the course objectives. However, one of the most important tasks to be performed is to wisely select the activities to be performed and the assessment mechanisms to be applied.

Moodle offers several options to support the assessment process. For instance, keeping a repository of questions of different types (test, multiple-choice, exact text answer, and others) for each subject module allows the lecturer to choose each course a set of questions to be used for assessment. Also, a test generation with randomly selected questions from the repository allows having different evaluative tests each course or, even, different evaluative tests for each student (and thus avoiding eventual copies). Furthermore, the possibility of having automatic correction tools is very interesting. Of course, the teacher must still spend time to:

- Establish clear evaluation criteria;
- Decide the score of each response; and
- Consider the number of valid responses that may be provided by students.

But an additional advantage arises: the correcting criterion becomes really unified, ensuring a fair treatment of students. The time to prepare the correcting parameters can be as much as, if not longer than, correcting the paper copies. But again, all this work is transferable, reusable and can be shared with other teachers in the same discipline.

From the students' point of view the following features can be highlighted:

- Access to a wider variety of problems;
- Motivation to know immediately the result of his proposed solution;
- Instant feedback and knowledge of the current level of subject comprehension;
- And, above all, a way to practice problems without the pressure of the continuous presence of the teacher.

4.3. Course implementation

A first year programming course has been implemented, using Moodle in a local network, and according to the features discussed in subsection 4.2. To ensure the success of this integration into Moodle, the implementation has to be tested for several semesters and tuned according to the eventual gaps and deviations. Meanwhile, a preliminary analysis of the expected teacher and student workloads can be made.

According to the former course implementation, the time spent in each type of activity (as described in 4.1) in some typical weeks during the course can be seen in figure 1. For each regular week, there are 1,5 hours for oral dictation (DO), 2,5 hours for classroom lecture (CM) and 2 hours for problems (TD). Some often, there is a week where a 3 hours evaluation (EV) takes place.

Figure 1: Typical course workloads



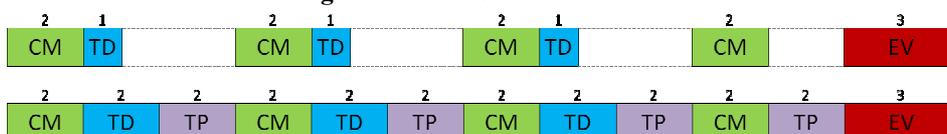
Figure 2 shows the accumulated time for each of these activities in a whole semester. These times are the same for both lecturers and students, because all activities carried out by the students need the participation, or assistance, of a lecturer. Note that, as discussed in section 4.1, the personal student work time (40% of the expected time) has been excluded from the planning, as it has been proven students do not spend any time in it.

Figure 2: Course workloads for a semester



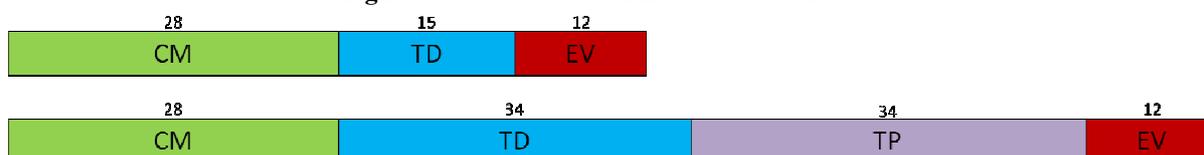
The new planning for the proposed course implementation can be seen in figure 3. The upper figure corresponds to the lecturer workloads, and the lower figure corresponds to the student workloads. Notice that the oral dictation time (DO) disappears from the planning. Instead, the student can devote the same time to read (not copying) the documentation and, therefore, pay attention to the concepts comprehension, and not the writing itself. From the lecturer point of view, the workload has been greatly reduced. Furthermore, from the student's point of view, the oral dictation is replaced by work practices what is a substantial qualitative improvement.

Figure 3: New course workloads



And finally, figure 4 shows the accumulated workloads for both, lecturers (up) and students (down), with the new course implementation. The professor time is concentrated in lecturing, clarifying concepts and organizing classroom problems, leaving some time for personal student's activities. The total professor lecturing time has been significantly reduced by about 50%. As discussed earlier, this time could be used to improve and update the course contents and, additionally, have some time to devote to other academic tasks. With respect to the student's workloads, even though the total time is very similar to the former course organization, the type of the activities with the new course proposal are more interesting from the academic point of view and, therefore, the learning process will be more efficient.

Figure 4: New course workloads for a semester



5. Expected benefits

This section analyzes the expected impacts of implementing the proposal and introducing the use of Moodle as a teaching and management tool in a developing country. The analysis is done from three different angles: students, lecturers and management/organization.

5.1 Students

5.1.1 Quantity of contents

The main problem with teaching material in developing countries is the accessibility to it, or lack thereof. Our experience at the UPB has shown that the students have to wait long hours just to get their hands on a copy of the lecture notes coming out of the single campus photocopier available to them. The implications of this is that

apart from wasting a lot of time waiting for these copies, the amount of information provided by the lecturers is kept to a bare minimum for practical reasons. Having all the information online (even locally in the campus internal network) and readily accessible would be an important timesaver for all, and will provide students with a wealth of contents that they could not have access to before.

5.1.2 Easy of access

Contrary to developed countries where access to the Internet is granted, the majority of the students from developing countries face important connectivity limitations. Many institutions do not have Internet access due to their inability to afford it or due to lack of infrastructure. This means that in many cases the students have to rely to their own means to access online information, usually by visiting Internet cafes or having to pay very high prices to have Internet access at home. Having an LMS complete with courses and teaching material at the university campus would provide all the necessary resources needed by the students and would facilitate access to a much more important amount of information.

5.1.3 Practical activities

LMS provide a wide array of practical activities such as quizzes, workshops, assignments and forums that can be incorporated in the courses. This aspect is very important for developing countries as the education system tends to be a lot more practically oriented than in developed countries. Also, our experience teaching at ESI has shown that students tend to involve themselves a lot more during practical sessions than during theoretical ones. So, we expect that these practical activities will be shown preference above the rest that are more theoretically oriented and that they will also operate as a catalyst for the adoption of LMS in the learning process.

5.1.4 Quality of contents

We also expect that the inevitable digitalization of all the teaching resources that will take place while moving the available courses into the LMS will drive a quality control process that will greatly benefit students. A lot of the teaching material used in developing countries has remained stagnant for a number of years due to reasons like lack of contact with new material and lack of time on the side of the lecturers. We believe that the process of content digitalization, coupled with the wealth of material freely available for most LMS on the Internet, will help increase the quality of the offered courses.

5.1.5 Quality and variety of activities

In addition, the LMS will allow the performance of new and more dynamic activities, including group work and cooperation. The students will be able to share and discuss exercises, experiences, works, and so on.

5.1.6 Novelty

Finally, at least for the immediate future, we believe that simply the novelty of the digital teaching process will be in itself a strong incentive for the students to dedicate time to their studies, navigating the LMS and accessing all available content. For this reason it is important to strive for a complete implementation of the LMS taking advantage of as many features as possible, capturing their interest and helping them to take advantage of everything that is offered.

5.2 Lecturers

5.2.1 Reduced effort

Although at first porting a course to an LMS requires some extra work for the digitalization and the adaptation of the contents to the new format, from that point on the time and attention required by the lecturer is greatly reduced. Quizzes and tests can be automatically generated from a pool of questions, activities can be carried out by the learners with minimal supervision and in many cases the existence of an LMS would enable the lecturers to engage in distance learning if they are unable to attend the class personally. Furthermore, various mechanisms provided by the LMS for automatic evaluation of quizzes, tests and activities will further accelerate these mundane obligations of the lecturers.

All this reduced effort translates to less time needed for preparation between teaching hours. This saved time can then be invested in other activities like research, or further self-education.

5.2.2 Quality improvement

As commented previously, the inevitable digitalization of all the teaching resources will drive a quality control process in the course documentation. In addition, the existence of an important number of courses available freely from many institutions online, along with the ease of organization an LMS inherently provides, will help the lecturers raise the quality of their courses by using new teaching material that would otherwise be complicated for them to get their hands on. Having more sources on which to base their courses, as well as a point of quality reference, will help them build their courses at a level that will be on par with the courses taught in developed countries.

5.3 Management and Organization

The existence of an LMS guarantees some level of organization for the courses taught at a school or institution. The course format can be easily defined and controlled, courses end up being better formatted and most importantly, the course is always there available for teaching, even when the professor is unable to attend. This last point is particularly important according to our experience offering teaching assistance at the UPB. Due to their lack of teaching staff, they are heavily dependent on visiting professors to fill the curriculum. However, there is no guarantee that a certain professor will be able to visit every single year to give the same course. This obviously introduces a lot of teaching inconsistencies among students of different years, since courses available each year may vary. Having a course setup at the LMS can provide a lot of stability in that regard, since it will be a lot easier for a different professor to teach it with a minor amount of preparation or, in the future, even use distant learning to complement some parts of a course when the teacher is not available. It is also very important to stress that an LMS is not only a platform for having digitized courses on a server accessible over a network. LMSs are potent management tools that can be used to take care of human resources management, wages, curriculum organization and other management task that could greatly benefit any learning institution.

6. Conclusions and future steps

The progressive use of the Internet allows the proposal of new teaching and learning instruments throughout the world. A growing number of universities are adopting online courses and digital platforms to replace or supplement classroom activities. Universities in developing countries try to follow this trend, which started in developed countries. However, the infrastructure and the level of knowledge available raise a “digital wall”. A great effort is being made to reduce the height of this wall, mainly trying to solve the digital external gap (Zurita and Bruce, 2005): the provision of infrastructures and resources to make the connection to the Internet. However, the “going on-line” in academics needs much more than Internet access, requiring changes in administrative practices and a thorough review of the structures and management of courses. Sometimes it is expected that having access to Internet and creating on-line courses will bring about those changes. Indeed, some authors have defended that introducing IT will by itself create a more democratic and participatory learning environment. However, evidence shows that this is not the case. A change in the educational media does not create a positive development, nor a change or development in the teaching styles or the pedagogical assumptions (Bruce & Ruben, 1993, Heinecke et al. 2001). Changing the medium will always change some aspects of the practice but not necessarily for the better and it will not necessarily change the conceptual or pedagogical foundations of the practice (Zurita & Ryberg, 2005). However, IT creates a possibility for reflexion and innovation. The process of adopting Moodle as LMS at the *Université Polytechnique de Bobo-Dioulasso* does not seek to create a more democratic and participatory learning process and synergies of cultural transformation; it just wants to solve specific problems: massive classes, lack of lecturers, excessive teaching hours for lecturers, coordination difficulties, lags in studies for lack of teachers, to name a few. Ultimately, it may also catalyse changes, but today this is not their goal. The use of IT as a changing agent requires a “constructive knowledge”, which sometimes also requires a pre-existing mastering of the tool, and knowledge about how to use the tool in such a context. A user has to be competent with IT tools such as forums, chats, portfolios, ... to actually be able to think creatively with them and re-organize and make qualitative changes to existing practices. In the context of our project, lecturers at the *Université Polytechnique de Bobo-Dioulasso* are familiar with IT technologies and lecturers at the UPC Barcelona Tech have long experience in the use of Moodle, making the collaboration really effective. At the same time, a change in teaching practices requires knowledge of alternative practices, and a driving force that generates the feeling of imbalance, even contradiction, which leads to the idea of need for change in pedagogical practice. Without a reason, a motivation, within the current teaching practice, aimed at developing and changing practice, there is a good chance that IT alone, we carry out these changes. The processes of change and development are complex and cannot be expected to occur automatically.

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