



The use of Moodle and R environments as support for a probability and statistics course: an experience in a teacher training program

Luciane Mulazani dos Santos

Santa Catarina State University, Joinville, Brazil – luciane.mulazani@udesc.br

Elisa Henning*

Santa Catarina State University, Joinville, Brazil – elisa.henning@udesc.br

Ivanete Zuchi Siple

Santa Catarina State University, Joinville, Brazil – ivanete.siple@udesc.br

Abstract

This paper describes a blended learning experience in the classroom of a probability and statistics course in an initial teacher training program at a public university. The technological platform for conducting this experiment consisted of the Moodle LMS and the R statistical software to support the classroom activities of this course. In the context of this experience, we discuss the potential of technological tools in terms of the dynamic virtual expansion of activities in the classroom, providing an enriching forum for reflections.

Keywords: Blended learning; Moodle; R environment; Probability and statistics; Initial teacher training.

1. Introduction

Starting with the assumptions that learning combined in real and virtual environments can be a good strategy to meet the challenges of a society of information and knowledge, and that the use of contemporary technologies in education provides a wide set of possibilities for developing different learning activities in the processes of teaching and learning, in this paper we report an experience of the activities performed in a probability and statistics course, in which the Moodle LMS and R (R CORE TEAM, 2014) statistical software were used. This experience is motivated by the search for alternatives to motivate students to participate as active agents in the teaching learning process of a probability and statistics course in undergraduate programs. Blended learning is the combination produced by the articulation between classroom learning and distance learning. The blended learning model seeks to take the best of classroom learning and online learning, as Owston, Garrison and Cook (2006, p 348, apud OLIVEIRA, 2013, p.26.) describe: "Blended learning has the potential to integrate immediate, spontaneous, and rich verbal communication with reflective, rigorous, and precise written communication, as well as visually rich media and simulations." In Brazil, this model has legal support in statute No. 4.059/2004 of the Ministry of Education (BRASIL, 2004), which allows higher education institutions to introduce into their educational and curricular organization of their accredited university programs, an offering of program courses using an online model, as long as this offering does not exceed 20% (twenty percent) of the total credit hours of the program. Under this statute, an online model is defined as any didactic activities, modules or units of teaching-learning that are centered on self-learning and with the mediation of learning resources organized into different information supports using remote communication technologies. New information and communication technologies are present in everyday life of contemporary society, encouraging and enabling further use of software in teaching, especially in statistics. There is already a consensus among educators that statistics courses should be accompanied by some kind of technology to reduce the need to perform manual calculations and allow students access to data sets related to case studies and real situations (SCHUYTEN & THAS, 2007; VERZANI, 2008; GOULD, 2010). Using an approach that is strictly



manual can make statistical learning tiring, running the risk that the students' interest in interpreting, analyzing and discussing the results, which is the most compelling part of this science, and that relates to the student's cognitive activity, stays in the background, or worse, does not occur (CAZORLA; SANTANA, 2010; BORBA *et al.*, 2011). With that in mind, Moodle and the R statistical language and environment were used, both of them free. The choice of these technologies was due to the potential convergence of the extension of activities done in the classroom and complemented in the virtual environment.

2. From the brick-and-mortar to the virtual classroom: An experience in a teacher training program

The course Probability and Statistics (EST) is a mandatory course in the Mathematics, Physics and Chemistry Teaching programs of a public university, with a total of 60 hours per semester. This course has the overall objective to enable students to understand and use statistical methods in their respective area.

Statistics plays a vital role in almost all sciences, and statistical methods are commonly used to analyze the results of experiments, testing their significance in physics, chemistry and mathematics. Furthermore, it is the role of future mathematics teachers to teach the statistical content, as stipulated by law, for children and young people in primary education. According to Lopes *et al.* (2010), the current curriculum guidelines in Brazil suggest that mathematics teachers encourage students to observe phenomena, make hypotheses, do data collection, and process and analyze data from the point of view of scientific research. They also recommend the reading and interpretation of graphs, tables and measurements published in several forms of media, so that students learn to think critically about such information.

It is hoped that by completing this course, the student will be able to perform descriptive evaluation of data, characterize the level of confidence of parameters using estimates, validate statistical hypotheses of datasets, recognize the level of association between variables and perform projections of scenarios based on regression methods.

The methodological approach that we present has been adopted with undergraduate students from the second half of 2013. The professor teaching the course agreed with the students on the use of R and Moodle for carrying out tasks from the syllabus. The aim, therefore, was to offer students the possibility to use R as a tool for performing statistical analysis and Moodle as an extension of the classroom, a virtual learning environment.

So the course had as its methodological proposal the development of a continuous connection with students via Moodle, with activities that crossed between the real classroom and the virtual classroom. In other words, besides being able to get any course information on Moodle, students could perform practice tests, ask questions, do online exercises and use the discussion forum to post their work and comment on the work of classmates. Besides the four initial assessments given in the syllabus, the professor suggested an optional final project to students, which would be a fifth component of their final grade.

To complete the final project successfully, the student had to do the following: For a topic of the student's choice, calculate a confidence interval or apply a hypothesis test, depending on the topic chosen. The complete research design had to be described, including:

- i. Data collection - sample size and collection method;
- ii. Exploratory data analysis - graphs, descriptive measurements;
- iii. Inference - estimation by confidence intervals or some hypothesis test;
- iv. Discussion of the difficulties and limitations of the project.

The work could be done individually or in teams of up to three, but preferably two students. The work had to be posted on the Moodle discussion forum.

To perform the proposed work, the students used the R environment to conduct data analysis, build charts and perform the confidence test of the proposed problem. Students used R as a computational tool throughout the course, not only in the final project. Students used the Moodle LMS environment



to do practice tests, ask questions online, access supplementary course materials and use the discussion forum to post their work and discuss the work of classmates. Moodle is a learning management system (LMS) that supports the creation, development and management of virtual learning environments. It is publicly available (open source) and developed collaboratively by professionals from different fields, offering a set of tools that can be selected by the teacher to create remote courses or sequences of courses, depending on his or her teaching goals.

One of the advantages that the online environment provides is the flexibility to configure the way that the student experiences and interacts with it. In other words, besides being able to define the use of the features, through their visibility or invisibility, the professor can create views that give different perspectives to these tools and make unique educational spaces (MOREIRA; MONTEIRO, 2010, p.89).

3. Results and Discussion

We will discuss here the potential of the virtual learning environment to the extent that this experience allowed students to construct learning in a more pluralistic and participatory manner. The fact that the students shared their work on the discussion board allowed both the students and the professor to exchange ideas and achieve significant developments on this forum, which we will discuss below.

So students who did the final project were able to use investigative processes and statistics and probability in practical situations. The discussion is therefore based on the results of the projects.

Thus, we show the projects and results of the second half of 2013. Five studies were conducted, with ten students involved, on the following topics: an evaluation of university faculty, laboratory waste, an estimation of the average amount of Mini-Bis chocolates in a 30g package, an estimation of the average amount of Bib's chocolates in a 40g package and the average weight of packages of jelly beans. It can be observed that the students chose topics taken from the real world, some of which are very connected to everyday problems such as the issue of waste from laboratories, supporting Lopes' idea (2008) on types of significant practices in statistics education.

It is necessary to develop a pedagogical technique with situations where students engage in activities, which consider their contexts and can observe and build possible events through concrete experimentation, collecting and organizing data. The learning of the stochastic only complements the education of students if it is significant, if it considers situations that are familiar, that are contextualized, investigated and analyzed (LOPES, 2008 p.58-59)

At our university, there is an evaluation of the faculty by the students done every semester. In the final project on the evaluation of faculty, the question raised was: Do students in the Chemistry Teaching program believe that the way that the evaluation of the faculty is done brings benefits to students? And is it easy to understand the way the questions are presented in the university portal? Initially, the students researched all of the students in the Chemistry Teaching program, concluding that twenty-seven percent (27%) of the sample did not participate in the evaluation process. And in the opinion of fifty-six percent (56%) of respondents, the evaluation does not cause the desired effect (teaching and learning), implying that there would be a great effect if there were more student participation. In the Moodle discussion forum, posters discussed the sincerity of the students when answering the evaluation questions and the lack of interest of students in participating in the evaluation process and the need for adjustments in logistics of the research. In one of her posts to the discussion forum, the professor stated her concern that the university administration should see the discussions raised in the Moodle forum. And in fact, she was able to have the ideas from the discussion forum presented to the internal faculty evaluation committee at the university, allowing the team to see the input of the chemistry students in relation to the new evaluation process.

The lab waste project was inspired by work done by the Department of Chemistry, University of Londrina (UEL). The group investigated if in the laboratory classes, the procedures given to students addressed issues concerning waste generated in the lab. Also they looked at student interest in courses, lectures or workshops on waste treatment. The sampling involved students in the Chemistry Teaching program, with ninety-six percent (96%) of respondents saying that waste issues are not addressed in the



laboratories and ninety-four percent (94%) had interest in courses or lectures on the treatment of waste.

In the discussion driven by students on the Moodle forum, some counterpoints to the lack of treatment and student interest in the topic were evident, including one student who noted that a small number of chemistry professors had addressed the lab waste issue in their classes. In one of her posts to the forum, the professor saw some possible outcomes for such work, including a possible funding request to the Chemistry department to implement actions related to treatment of lab waste. The results of the discussions were taken to the Chemistry department for discussion and reflection on the subject. For the projects related to an estimation of an average (candies), there was much discussion among the groups, due to the characteristics of the research, which involved issues of candies, color, shape and weight. In the forum, it can be seen that this theme had the highest participation with multiple posts and comments of interest on the topic. The groups also showed some interesting results on the analysis, such as the jelly bean project, which found that the weight of packaging was higher than indicated and that the jelly beans were predominantly red in color.

The limitations, which could affect the results, are due to the randomness of the sample not being guaranteed. However, the group noted that the packages were all acquired in the same store, due to time constraints for the execution of the project. As a result, it is assumed that the packages were all from the same batch. The same tests could have different results if the packages were from different lots. We took advantage of the moment to discuss the question of the necessity of randomness of the samples.

From a quantitative point of view, students who did the project passed the course. But we are aware that this does not mean that they really learned the content. But, considering qualitative aspects, the activity provided a better interaction between the teacher and the students. The availability of presentations in Moodle and the group discussion forum as an alternative to oral presentations made this a more dynamic process. All students involved actively participated in the discussions, each in their own time and environment. In the following semesters, we are studying how best to evaluate the results in both aspects: quantitative and qualitative.

Nevertheless, the presented results agree with Silva (2014). For the author, the use of technology in the classroom is considered a path of no return, since it facilitates the practice in the classroom, motivating students to learn and helping to solve problems. All these principles are aimed at training teachers to be able to have a critical view of the content, knowledge, their own practice and the social context to which they belong.

4. Conclusions and final thoughts on working with an LMS in initial teacher training

The approach of statistics with methodologies based on problem solving and the use of educational technologies in undergraduate programs is very important for future teachers to learn, not just as experts in their field, but as professionals who are constantly learning. It is essential that the teacher seek methodologies that promote the learning of certain content. Teacher training programs should be concerned with preparing their students both on the subject matter directly related to their specialized area as well as that linked to the teaching profession. Specifically addressing the use of technology in education, it is essential that the issues arising from the use of technological tools, such as mathematical software and virtual environments for teaching and learning, have their place in the curriculum of teacher training programs, including the courses that make up the knowledge-specific curriculum, such as probability and statistics courses.

The use of R and Moodle provided students the experience of working with statistical software, as well as knowing, participating and interacting in a virtual environment, revealing a practice that enabled them to go beyond the traditional concepts of class, enabling the exploration of free environments that may be used by these students, future teachers, in their respective professional practices. Therefore, the use of these tools in the statistics classes enabled the exploration of the potential and the limitations of the tools, making them thus more experienced teachers in training to deal eventually with this and other types of technologies.

When teachers in training can experience activities involving problem solving mediated by technology, they experience a situation that can help them as a teacher in the future. It will be easier, having prior knowledge, to accept roles that require their participation in integrating educational technologies into the classroom. If, along with this experience as student teachers they also see themselves truly as teachers, in the sense of participating in the discussion forum either technically or pedagogically, they can see both sides of the same system, they will have a better understanding of the many particularities of the teaching and learning processes, both virtually and in the classroom. On the other hand, it is important to discuss the challenges, both for the teacher and the future teacher, of using LMS environments such as Moodle and statistical software in classroom activities.

One of the great challenges of the LMS environment refers to the time for mediation. It is important to reiterate that an activity such as the discussion forum like the one described here requires, in addition to technical training, time and dedication from the teacher. The teacher has an important role in both classroom teaching and distance education, usually requiring different approaches. For these approaches, he should propose interaction methods that enable the student to make several connections, enabling cooperation and exchange of ideas. Thus, both the time to do the initial setup for the development of activities, as well as the mediation must be taken into account. Therefore, the number of students in a class should be taken into consideration when proposing activities that use discussion forums, considering that the mediation of the teacher can be compromised if you have a very large number of participants. As for the R environment, a limitation may be the interface, given that the software is a programming language and therefore some students may show some resistance and/or difficulty in programming.

However, it is critical that students have more effective contact with technology and problem situations in which they can maximize the use of the technology. Statistics courses are a fertile ground for exploring the potential of these tools applied in problem situations, allowing the exchange of experiences and debate of ideas, showing themselves to be a privileged space for interaction and decision making on the basis of contributions arising from these reflections together.

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