Taking Advantage of the “Big Data” in Learning Management Systems

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Abstract – This work presents a novel learning management system (LMS), named *Catalyseur*, which allows the students to easily access pedagogic contents as well as allowing them to directly complete the exercises on the web. Meanwhile, the LMS acquires data about the students' completion status of exercises and lessons and the time before the examinations these exercises and lessons were completed. An artificial intelligence (AI) predicting student performance at an examination depending of their completion status is continuously updated with new data acquired by the LMS. This AI model is then used to automatically send messages to students about how they are expected to perform at the next examination.

1. INTRODUCTION

Course websites and learning management systems (LMS) are now used in almost all undergrad courses [1]. From these web platforms, the students can access to documentation and exercises provided by their instructors. Such as any modern internet web services and social networks, LMS collects an important amount of data from student browsing. For example, the open-source and widely used LMS Moodle saves each student click into the database, this database being accessible for the instructor.

A Québec expression says : « Trop, c'est comme pas assez » (“Too much; this is like to less”). Meaningful information about student progress in the course and their understanding is difficult to extract from these data. It was demonstrated that the advantages of proactive and systematic feedbacks could greatly improve student learning [2]. Due to a high number of students, it is impossible to give individual feedbacks to students each week in undergrad courses. However, the data can provide valuable assistance [3].

To take advantage of this type of “Big data” in order to create meaningful and pedagogic analytics for the students and the instructors, the Department of Chemical and Biotechnological Engineering of the Université de Sherbrooke, developed its own LMS.

Figure 1: Course structure in the *Catalyseur* LMS.

Figure 2: Lesson page including a Jupyter Notebook on the left and a complementary video on the right.

2. THE LMS

The LMS imposes a rigid course structure. Indeed, the course must be separated into themes or chapters (Figure 1). Each theme contains two sections. First, the lesson section principally consists of videos to watch

Figure 3: Exercise page with the integrated Python console on the left. The statement, as well as the forums allowing the students to ask questions amongst themselves, are on the right.

and of Jupyter Notebooks (Figure 2). Second, the exercise section allows the students to directly resolve the problems in an integrated console (Figure 3).

All the lesson and exercise status are saved into a database. With these data, statistics are automatically created for the instructor. For each exercise, a percentage representing how many students have completed a specific exercise amongst all students having begun the exercise is automatically calculated. A similar percentage is calculated for the lessons. The instructor can then easily and rapidly know which subject matters pose problems and can then review specific material that would be beneficial for most of the students.

A Python script editor and console have been integrated into the LMS. In courses in which exercises must be completed by mathematical computation, the students are encouraged to write their codes directly in the LMS. All students' codes are also saved into a database. The instructor can then check the codes associated to a red status in order to find out the common errors made by the students.

The *Catalyseur* LMS has yet been successfully integrated into programming, mathematical, statistical and transport phenomena courses. The students appreciated the simplicity of the interface and the graphics and progress individual analytics automatically generated. The instructors also appreciated to have access to meaningful and easy-to-understand data as well as to have access to all students' codes. From their point of view, the *Catalyseur* LMS features greatly improved the teaching, as the lecture periods were more oriented on problems that most of the students were facing.

3. IMPLEMENTATION OF AI

Each lesson and exercise has its own page. Another particularity of these pages is the status button unique for each page for each student.

These status buttons are initialized to the grey color, meaning an absence of status. After watching a video lesson or after having begun an exercise, the student can switch this button to the red status (lesson not totally understood / exercise not yet completed) or the green button (lesson completely understood / exercise completed). The students are encouraged to switch the status as it creates progress graphics in the LMS main page, and it calculates individual percentages of progress in the course.

By planning the examinations, the instructor is invited to check which themes must be completed by the students in order to perform adequately. After having completed the examination corrections, the instructor is invited to upload the student notes into the Catalyseur LMS.

A Python server is continuously using the new information provided by the different instructors who use the Catalyseur LMS in order to improve the artificial intelligence (AI) system (Figure 4). This AI takes as input data the student completion status of lessons and exercises included in the themes that were supposed to be completed, the time at which these lessons and exercises were completed, and the student results at the examinations. Persistently, the AI system improves a model approximating the student performance to an examination depending of her or his completion through the different themes and the time remaining before the examination to complete the lessons and exercises.

Figure 4: Data flows

With the AI model, the LMS automatically creates messages to students according to their theme completion. For example, if the student is overdue according to the AI model, a message would say that she or he should get updated on exercises and lessons in order to improve her or his result to the next examination. On the contrary, a student having completed most of all available exercises and lessons would get a positive message.

4. CONCLUSION

This AI system sending automatic messages to the students was implemented only a few months ago. For now, it is impossible to determine if this new LMS feature allows to improve the performance of the students.

Most courses using the *Catalyseur* LMS are oriented into a flipped classroom pedagogy for undergrad courses. Through the last years, it has been observed that many students do not perform well as they do not complete the exercises until the day before the examination. Then, these automatic messages should theoretically stimulate the students to continually work and being updated in the different courses all along the semester.

References

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