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Data mining for modeling students' performance: A tutoring action plan to prevent academic dropout☆

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ABSTRACT

E-learning systems generate huge amounts of data, whose analysis may become a daunting task which makes it necessary to use computational analytical techniques and tools.
We propose the use of knowledge discovery techniques to analyse historical student course grade data in order to predict whether or not a student will drop out of a course. Logistic regression models are used for the purpose of classification. Experiments conducted with data on over 100 students for several distance learning courses confirm the predictive power of our proposal. Using the resulting predictive models we have designed a tutoring action plan. Applying this plan, we managed to reduce the dropout rate by 14% with respect to previous academic years in which no dropout prevention mechanism was applied. Our main contribution is a tool and a tutoring plan that can be used by our educational institution (and others) to reduce dropout rate in e-learning courses.
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1. Introduction

E-learning systems have huge benefits but they also raise major challenges for the educational community, including student dropout detection and prevention without direct contact between instructors and students [1].

Current methodologies stress the importance of continuous assessment and student coursework. As students complete the different activities, instructors start to gather information on student grades for activities. This information is potentially very interesting, for example, for implementing tutoring actions to prevent student dropout. For example, Fig. 1[1] shows the grades (used as a benchmark for this research) attained by a group of students (rows) for three specific activities (columns), taken from the Moodle platform.

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[1] The table is in Spanish because it is a real excerpt from a gradebook of a course that we teach. The English equivalents of the main items in Fig. 1 follow:
- *Actividad*: Activity
- *Caso*: Case
- *AEC*: Continuous Assessment Activity

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Actividad 2. AEC: Caso ...	Actividad 3. AEC: Caso ...	Actividad 7. AEC: Caso ...
65,00	86,00	90,00
100,00	94,00	100,00
0,00	0,00	0,00
85,00	86,00	55,00
95,00	86,00	0,00
98,00	100,00	0,00
100,00	100,00	0,00
95,00	67,00	95,00
90,00	94,00	100,00
85,00	94,00	0,00
80,00	89,00	88,00
0,00	0,00	0,00
73,00	81,00	0,00
63,00	86,00	83,00

Fig. 1. Excerpt of a course gradebook.

Instructors may find the analysis of the generated data for a real course, with lots of students and countless activities, to be a really daunting and difficult, if not impossible, task. Data mining [2] looks like it might be a very interesting option for easing this task, as shown by experiences reported in [3–7], which are examined in more detail in Section 2.

In this research, we propose the use of predictive data mining techniques, specifically logistic regression, to predict, based on the activity grades attained by each student in a traditional course, i.e. non-MOOC (Massive Open Online Course), whether or not the student will drop out of the course. Special attention is paid to the time at which situations occur that require tutoring to put students back on the right academic track in the future. The research results support the original hypothesis, which is based on the idea that activity grades can be used to predict student dropout.

In the second part of our research, we applied the historical dropout models (from the 2013/14 academic year) to 2014/15 students in order to identify potential dropouts. These models, combined with a special-purpose tutoring action plan, proved to be useful tool for reducing the student dropout rate in the courses used as the benchmark for this research.

Precisely, the main contribution of this paper is the proposal of a method for dropout detection that let us launch a tutoring plan of actions to prevent it. This whole process will let our educational institution (and other similar ones) to reduce the student dropout rate in e-learning courses.

The remainder of this paper is organized as follows. Section 2 describes the e-learning platform used as a benchmark in our research and presents the related work. Section 3 explains the process of mining students' activity grades. Section 4 presents the proposed tutoring action plan. Section 5 discusses the application of the proposal. Finally, Section 6 outlines the preliminary conclusions and future lines of this research. The proposed system is denoted by LOGIT_Act in this paper.

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