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Learning Analytics as Data driven decision making in High Education: a case study

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Abstract

This work leads with the application of Learning Analytics (LA) methods in high education as data driven for making decision, where a real case study is presented. The LA method has been applied to a course on HVAC Facilities and Energetic Certification of the Master in Industrial Engineering at the Polytechnic University of Valencia (UPV), Spain. Thus, data collected during the whole academic year 2020-2021 by the institutional LMS platform of UPV have been analyzed. Results show that LA can be a successful data driven for detecting the students at risk, boosting their retention, personalizing contents and improving students learning. Finally, a tailored dashboard is proposed for students' improvement monitoring.

Keywords*: Learning analytics, LMS platform, reverse learning, gamification, high education, data driven, Applied Computing, Education, Human computer interaction (HCI)*

Introduction

According to the 1st International Conference on Learning Analytics and Knowledge hold in 2011 (Long & Siemens, 2011), learning analytics (LA) is "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs". The spread out of the coronavirus pandemic has drastically increased the use of digital tools in high education and

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suddenly, due to the social distancing, face-to-face courses have become online classes (Vargas-Salgado, Bastida-Molina, Alcázar-Ortega, & Montuori, 2020), (Montuori, Alcázar-Ortega, Vargas-Salgado, & Bastida-Molina, 2020). All meetings started to be carried out through telecommunication applications that specialize in providing video chat and voice calls. Thanks to this fact, the opportunity to capture digital data from students' leaning, such as big data sets within online environments, have highly growth in high education. Therefore, LA techniques, together with computational analysis techniques from data science and artificial intelligence (AI), are now more than ever unique and extremely useful tools for research learning and improving teaching, tracking student progress, analyzing university data and designing assessments (Montuori, Alcázar-Ortega, Bastida-Molina, & Vargas-Salgado, 2020), (Jones, 2019) .

LA has been used in pioneer universities worldwide as a predictive model to detect students at risk of abandon, allowing students' retention or understanding and improving students learning outcomes, behavior, and processes (Waheed, Hassan, & Aljohani, 2018). The Austin Peay State University adopted a LA engine that, based on students' academic profiles, suggests to them courses and make recommendations (Srinivasa, 2021). On the other side, the Purdue University in West Lafayette, Indiana, USA, is trying to change how the learning process occurs by using LA predictive models. It offers to students a learning analytics dashboard to track their performance and be aware of their status (on track or falling behind) (Sclater, Peasgood, & Mullan, 2016).

Sakai, that is is an open-source free software which can be freely modified and customized, is currently in use at the Polytechnic University of Valencia, where the work here presented has been carried out. While it is true that there have been successful application case in higher education, the present work evidences that LA is still an emerging field of education

1.Methods and materials

The present work has been carried out according to the methodology stated next. Firstly, the teaching methods applied to the course on HVAC Facilities and Energetic Certification have been identified. Secondly, the types of data available for Learning Analytics have been classified. In line with that, Key Performance Indicators (KPI) have been designed to measure the impact of different data available on the learning process. Then, through the application case, KPIs have been validated as data driven for decision making crossing results with the final marks of students. According to the obtained results, further developments and improvements have been highlighted.

1.1.Identification of the Learning methodology

The learning methodology designed for the aforementioned course is based on the Flipped teaching with gamification of the classroom activities (Martínez-Navarro, 2017). According to this methodology, the pedagogical approach has consisted of organizing the students' work according to three stages:

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a) At home, prior to the session in class, the students are asked to elaborate by themselves the simplest topics. To do that, the institutional LMS of UPV, called PoliformaT, has been used. To complete this task, the students need to study content on Lessons, watch didactic short videos and answer short questionnaires.

b) In the classroom, the most complex topics are worked out by the professor. Under the teacher's supervision, students are asked to solve complex problems. Furthermore, the class activity has been gamified by using the game-based tool 'Kahoot!' (John, 2014). During each class, a questionnaire to check the class topic learning is proposed to students. As a friendly competition, students are then asked to play during the class with the support of 'Kahoot!', which helps to fix the key concepts. Furthermore, the problems solved during the class by students have been collected into an online portfolio through the tool PoliformaT in the section ''Task''. A total of about 15 activities have been collected during the whole course.

c) At home, after the classroom session, students will have time for reviewing contents, as well as to solve the proposed problems during the class.

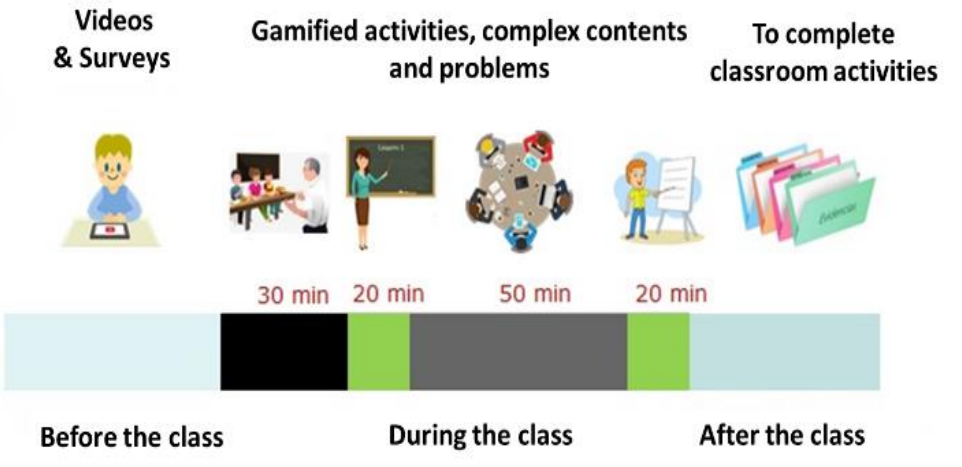

Fig. 1 Design of Learning methodology

2.Application

The proposed LA methodology has been applied to a real case of study at the Polytechnic University of Valencia (Spain). Specifically, the analysis has been carried out on the course on "HVAC Facilities and Energetic Certification" (HFEC), which takes part on the Master Degree in Industrial Engineering. This course is one semester-long and it is taught by a single

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teacher with 6.0 ECTS, 4.2 ECTS of which are theory and the remaining 1.8 ECTS are practical. During the academic year 2020 – 2021, 20 students were enrolled.

In accordance with the presented LA techniques, the performed analysis has been based on the data obtained through the following tools:

Institutional LMS in use at the Polytechnic University of Valencia (LMS implemented by Sakai)

2.1.Justification for the selection of data

The academic course on HFEC is an online course that has been taught through the e-learning platform Microsoft Teams. The flipped classroom has been adopted as learning methodology. Students had to develop some preliminary works at home before classes in addition to the regular activities during the class and after. These activities before the class were compiled in the Lessons section of the institutional LMS, 'PoliformaT'. In addition to the flipped classroom activities to pass the course, students were asked to solve 12 problems and 4 computer practices during the course. Moreover, the learning environment during the class was gamified by introducing goal-orientated activities with the support Kahoot!. Finally, two partial exams were done, one at the middle of the course and the other one at the end of the course. Optionally, in case of failing some exam, students had the opportunity to have another recovery exam to retake one or both partial exams.

The spread out of the coronavirus pandemic has accelerated the adoption of the online teaching in high education. Initially, this course was face-to-face, but it had to be turned into online to prevent the contagious. This fact, together with the introduction of the flipped teaching and gamification tools, gave the possibility to monitor student improvements and to register an enormous quantity of data in the LMS platforms and other digital tools, such as Kahoot! and Microsoft teams.

2.2.Identification of the learning analytic purpose

The collected data was examined by learning analytic techniques with the following purposes:

Prediction, to identify students "at risk" of dropping out of the course.

Intervention, providing educators with information to support students through their learning process.

Data visualization in the form of so-called Dashboards (Campbell, Deblois, Peter, & Oblinger, 2007), to provide general information about the learning level through data visualization tools.

Customization and adaptation, to provide students with tailored made materials and customized learning tools.

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2.3.Definition of the Learning Analytic KPI's

To carry out this analysis, the following KPIs have been designed:

Number of downloads of academic documentation, per student. This information is obtained from the "Statistics" tool, provided by the LMS 'PoliformaT'

Number of accesses to PoliformaT during the course. This information is obtained from the "Statistics" tool, provided the LMS 'PoliformaT.

Percentage of activities completed in Lessons (Flipped Classroom). Each activity in Lessons was tracked in the LMS, within the section "Grades".

Percentage of correct answers with respect to the total number of questions in Lessons (Flipped Classroom). After each class, students were asked to reply in Lessons to a control questionnaire. Results have been registered in the section "Grades" of the LMS.

Percentage of participation in Kahoot! during classroom hours. During the class, students were asked to answer a short questionnaire on the game-based platform Kahoot! to check they comprehension on the class activities that were carried out. The platform provides with a ranking of student's replies and a report of the results.

Percentages of correct answers with respect to the total number of questions in Kahoot!. Data were collected from the game-based platform records.

These parameters have been validated with the overall results of the exams performed during the course. It should be noted that all students participated to both exams.

3.Discussions and results

In this section it is presented the dashboard implemented to allow the professor to monitor the activities of the students enrolled in the course, to predict the risk of student abandon and to provide to students a tool of self-monitoring of the learning achievement.

The quick score presented in this dashboard allows the professor to analyze big data in an easy way, without becoming overwhelmed. Complementarily, the dashboard presented in Fig. 2 shows an individual analysis per student. For this purpose, a scale of different colors (from red to green, traffic light style) shows in a graphic way if the learning improvement of the student is running well or some problems have risen. By means of this dashboard, in a quick view, the professor is able to analyses if the student is participating during the classes (Kahoot!), if he is progressively doing the Flipped Teaching activities (Lessons) and if he is studying (or, at least, downloading) the didactic material provided in PoliformaT. The marks achieved in exams provide additional information regarding the level of understanding and learning of the subject. In the same way, the dashboard provides student with a visual tool to check their own improvement during the course.

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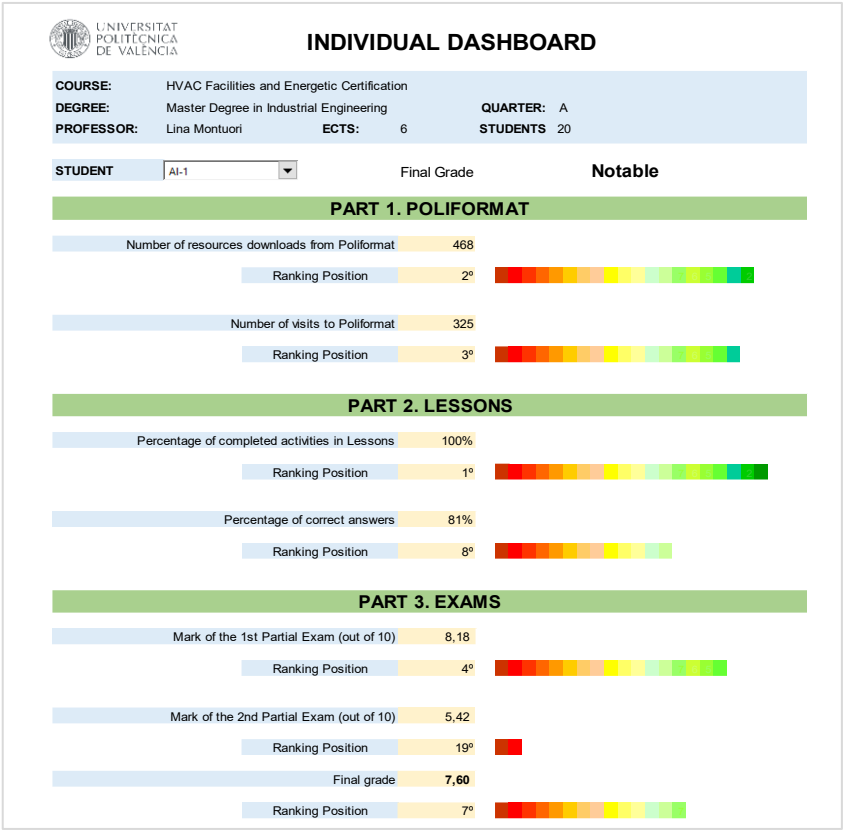

Fig. 2. Individual dashboard

Conclusions

The work presented in this document designs a novel dashboard for performance monitoring of University students, according to different KPIs. This method is usefull for teaching purposes as it helps to empirically identify the impact that each of the considered dimensions has on the student's learning process. On the other hand, the designed dashboard allows individualized monitoring of each student, which is useful not just for professors, but also for students so as to get an input about their own learning process. Further research on this topic could be related to the development of group dasbords to monitor the aggregated performance of a whole class or the students enrolled in some particular course. Consequently, from the point of view of the group, the global dashboard would make possible to determine which activities affect with a higher or lower degree to the learning outcomes evaluated in the group of students.

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References

AVELLA, J. T., KEBRITCHI, M., NUNN, S. G., & KANAI, T. (2016). Learning analythics methods, benefits and challenges in higheer education: a systematic literature review. *Journal of Interactive Online Learning, 20*(2), 1-17.

CAMPBELL, J., DEBLOIS, PETER, & OBLINGER, D. (2007). Academic Analytics: a new tool for a new era. *Educause Review, 42*(4), 40-57.

JOHN, R. (2014). *Canvas LMS Course Design.* Birmingham. ISBN 978-1782160649: Packt Publishing.

JONES, M. L. (2019). Learning analytics and higher education: a proposed model for establishing informed consent mechanisms to promote student privacy and autonomy. *International Journal of Educational Technology in Higher Education, 16*(24).

LONG, P., & SIEMENS, G. (September/October de 2011). Penetrating the Fog: Analytics in Learning and Education. *Educause Review*, 31-39. Obtenido de https://er.educause.edu/-/media/files/article-downloads/erm1151.pdf

MARTÍNEZ-NAVARRO, G. (2017). Tecnologías y nuevas tendencias en educación: aprender jugando. El caso de Kahoot! *Opción: Revista de Ciencias Humanas y Sociales*(83), 252-277.

MONTUORI, L., ALCÁZAR-ORTEGA, M., BASTIDA-MOLINA, P., & VARGAS-SALGADO, C. (2020). Application of Artificial intelligence to high education: empowerment of flipped classroom with just-in-time teaching. *INNODOCT.* Valencia: UPV. doi:http://dx.doi.org/10.4995/INN2020.2020.11896

MONTUORI, L., ALCÁZAR-ORTEGA, M., VARGAS-SALGADO, C., & BASTIDA-MOLINA, P. (2020). Methodology for the implementation of e-learning class during the COVID-19. *INNODOCT* (págs. 155-163). Valencia: UPV. doi:10.4995/INN2020.2020.11877

SCLATER, N., PEASGOOD, A., & MULLAN, J. (2016). *Learning Analytics in Higher Education. A review of UK and international practice.* Bristol: JISC.

SRINIVASA, K. M. (2021). *Case Studies. In: A Beginner's Guide to Learning Analytics. Advances in Analytics for Learning and Teaching.* Springer. ISBN 978-3-030-70257-1. doi:10.1007/978-3-030-70258-8_10

VARGAS-SALGADO, C., BASTIDA-MOLINA, P., ALCÁZAR-ORTEGA, M., & MONTUORI, L. (2020). Metodología de docencia inversa online: herramintas utilizadas y aplicadas a la asignatura de redes eléctricas inteligentes durantae el aislamiento debido al estado de alarma producido por COVID-19. *IN-RED* (págs. 874-886). Valencia: UPV. doi:10.4995/INRED2020.2020.12025

WAHEED, H., HASSAN, S.-U., & ALJOHANI, N. R. (2018). A bibliometric perspective of learning analytics research landscape. *Behaviour & Information Technology, 37*, 941-957.

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