Learning Analytics for Smart Classrooms

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Cèlia Llurba
https://orcid.org/0000-0003-1192-8579
University Rovira i Virgili, Spain

Ramon Palau
https://orcid.org/0000-0002-9843-3116
University Rovira i Virgili, Spain

Jordi Mogas
https://orcid.org/0000-0003-3385-5534
University Rovira i Virgili, Spain

INTRODUCTION

Big data and LA are poised to transform personalized learning once again (Shemshack, & Spector, 2020) which can help students to increase motivation and engagement.

The modern digital era, which includes LA, has not changed this fundamental aspect of a teacher day in a class because teachers' target has always been to enhance learning by getting answers to tailored questions, scoring attendance on a sheet of paper and comparing this with test scores supported by triage (Dollinger et al., 2019); although teachers have always used different types of data about students, data analysis tools are useful for having more information and presumably much faster (Naujokaitiene et al., 2020).

In recent years, when researching and conducting studies on this topic, it has been found that the tools provided the teacher with improbable data such as: predictive analytics to help determine which students are at-risk (Joksimovic, Kovanovic, & Dawson, 2019; Larrabee et al., 2019); to use the student's past data and current data to determine what is likely to happen next, such as identifying underperforming students; and prescriptive analytics to provide teachers with data which can then use to make actionable decisions, as providing alternative suggestions to make teaching more effective (Admiraal, Vermeulen, & Bulterman-Bos, 2020). These examples have been taken to improve the work of the teacher in the classroom. Saving time and data that teacher can also easily store. Even though Naidu et al. (2017) affirm the model will be effective in making traditional classrooms to SC equipped with LA. Taking into account the definition of SC, which is according to Cebrián, Palau, & Mogas (2020), an educational space endowed with digital devices and learning software, sensor networks, gathering data and offering insights to help decision making for better and faster learning, to provide more convenient teaching and learning conditions for educators and students. Therefore, LA are intimately linked to SC, which integrates in an unobtrusive manner the sensor and communication technology, and artificial intelligence (AI), among others, into the classroom (Aguilar et al., 2018) collecting data to improve the learning process and the student's academic performance.

The overarching aim of this review is to know the benefits of data analysis, main features, claiming if the practice has been carried out, and which contributions or experiences about LA and SC are already made. Even though systematic review focuses on LA for supporting study success, there have been a

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number of research focused on LA (Atif et al., 2013), on practices (Sclater, Peasgood, & Mullan, 2016) and policies (Gasevi et al., 2019). But, according to Ifenthaler, & Yau (2020), the success of LA in improving student learning has not yet been systematically and empirically demonstrated. Yet not much is known about the practice. It is important to note that many of the implementations described in these papers studied the importance of using LA in SC at different educational levels in higher education, such as high schools or at Universities. Nevertheless, there remains a significant gap in the research concerning LA adoption in high schools (Joksimovic et al., 2019), and almost no practice found in elementary schools.

BACKGROUND

Material and Method

Following the steps used by Vangrieken et al. (2015) were determined to meet the criteria for inclusion of the work in the final set to be reviewed. The first step was the initial search, in the results of the present review the authors searched for several keywords, specifically five combinations of keywords, which were: "LA and SC", "LA and teaching", "LA and learning", "LA and learning processes" and finally "LA and smart school". The keywords were linked obtaining more precise results that improve the search. Also in this phase of the systematic review only included papers published in the last five years, filtered years to 2016 – 2020 to review papers which have been related to the topic for their search. English and Spanish were the selected languages.

The filtering criteria used during the second step of searching was to remove by title; the keywords and titles of each initial search result were reviewed and those that appeared related to the term were included. The third search step was an attentive read of the abstract of each article to determine the main underlying focus.

The fourth step consisted of downloading all these articles to Mendeley. The downloaded literature was indexed based on full text pdf files; thereafter the review search string was applied on the indexed literature. Each article that met the inclusion criteria was read in its entirety a second time to validate the article's decision in the final data set.

Table 1. Number of reviewed articles selected from two scientific databases

Database	LA	LA & SC	LA & TEACHING	LA & LEARNING	LA & LEARNING PROCESSES	LA & SC	Total
Scopus	459	24	10	19	3	1	57
Web of Science	546	5	13	7	3	1	31
Total	**1005**	**29**	**23**	**26**	**8**	**2**	**88**

The results grouped by studies according to the term used, as shown in Table 1, which started among two of the main scientific databases in educational science, with only one keyword, which was LA, therefore came out with 1005 articles. Papers met in the research field and were examined in detail; the results grouped by studies according to the term used, a combination of keywords were made: 29 of them use classroom, 23 teaching, 26 learning, 8 learning processes, and 2 smart schools as the main term in the paper. A total of 88 articles were selected from the scientific data-bases.