A Complete Validated Learning Analytics Framework: Designing Issues from Data Preparation Perspective

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ABSTRACT

With the rapid growth of online education in recent years, Learning Analytics (LA) has gained increasing attention from researchers and educational institutions as an area which can improve the overall effectiveness of learning experiences. However, the lack of guidelines on what should be taken into consideration during application of LA hinders its full adoption. Therefore, this article investigates the issues that should be considered when approaching the design of LA experiences from the data preparation perspective. The obtained results highlight a validated LA framework of twenty-two designing issues that should be considered by various stakeholders in different contexts as well as a set of guidelines which can enhance designing LA experiences.

KEYWORDS

Analysis, Adaptive Learning, E-Learning Assessment, Effectiveness, Learning Analytics, Smart Learning Environment

1. INTRODUCTION

Recent advances in technology have created new opportunities in education to improve teaching methods and learning quality, resulting in better learning outcomes. Consequently, learning environments have evolved over time from the classic learning with blackboard in classrooms to the distance and open courses in smart learning environments. Koper (2015) defined smart learning environments as environments which are considerably improved using technology to enhance learning. Traditional assessments of the learning process can be incongruent with the use of these new smart environments, hence new methods to evaluate learners and the learning process are needed.

Learning analytics (LA) has emerged as a very promising area with techniques to effectively use the data generated by learners while learning to improve the learning process. It focuses on techniques and methods for extracting useful information from data in all different educational contexts. LA application in education are expected to provide institutions with opportunities to support student...
progression, detect at risk students and provide personalized learning experiences (Renties, Cross, & Zdrahal, 2016; Tempelaar, Renties & Giesbers, 2015).

Serious concerns however are associated with LA application (Ifenthaler & Tracey, 2016; Pardo & Siemens 2014). Prinsloo & Slade (2013) stated that not many educational institutions have succeeded to fully address the ethical implications of LA due to their policy frameworks. Ferguson and Clow (2016) highlighted that gathering evidence about the success and failure of LA is difficult, since researchers and workplace educators often find themselves stopped by a payment procedure when they try to access important scientific papers. Therefore, the main research question that this study aims to answer is “what are the issues that different stakeholders should consider when approaching the design of learning analytics experiences?”

To answer this research question, an LA framework of designing issues was developed based on two steps. The first step was to identify as many issues as possible for different stakeholders based on three stages from the data preparation perspective. The second step was to validate the proposed framework by a group of international experts. This framework aims to guide researchers and practitioners about the issues to consider for a better design of LA experiences from the data preparation perspective.

The rest of this paper is organized as follows. Section 2 presents a literature review about learning analytics. Section 3 presents the developed LA framework while section 4 validates it. Finally, section 5 presents a set of recommendations for a better design of learning analytics experiences and concludes the paper with potential future directions based on this study.

2. LITERATURE REVIEW

LA is rooted in data science, artificial intelligence, practices of recommender systems, online marketing and business intelligence. Siemens (2010) defined LA as “the use of intelligent data, learner-produced data, and analysis models to discover information and social connections, and to predict and advise on learning.” Fournier, Kop and Sitlia (2011) considered LA as “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.” Van Barneveld, Arnold and Campbell (2012) defined LA as “the use of analytic techniques to help target instructional, curricular, and support resources to support the achievement of specific learning goals.” LA approaches typically rely on data obtained from learners’ interactions with Information and Communication Technologies (ICTs), such as learning management systems and social media (Gašević, Dawson, Rogers & Gasevic, 2016). Powell & MacNeill (2012) identified five potential purposes of LA which are: (1) Provide learners feedback about their learning progress compared to their colleagues; (2) Identify at risk students; (3) Help instructors to plan interventions when needed; (4) Enhance the designed courses; and, (5) Support decision making when it comes to administrative tasks. Furthermore, while the most used method to model learners is questionnaires, Tili, Essalmi, Jemni, Kinshuk and Chen (2016) proposed a new approach which uses LA to implicitly model learners in computer based learning environments.

Despite the importance of LA and its adoption in different institutions, it still faces some serious challenges and considerations (Pardo & Siemens, 2014). For instance, ethical issues have been addressed in varying degrees within LA area from the outset of a range of contemporary practices which use learner-level data to predict results and apply interventions (Willis, Slade & Prinsloo, 2016; Prinsloo & Slade, 2013). According to Richards and King (2014), current legal and ethical guidelines have not caught up with innovations in the extraction of knowledge emerging from the vast datasets being collected by institutions. Ifenthaler (2015) stated that institutions need to address privacy and ethics issues related to LA. Locke, Ovando, and Montecinos (2016) mentioned that ethical practices of review in institutions tend to be varied and not easily categorizable. Richards and King (2014) further stated that there is a need to establish LA principles and best practices to guide the stakeholders rather than forcing learners to share their personal data with little in return. Willis,
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