



## Applying social learning analytics to message boards in online distance learning: A case study



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### ABSTRACT

Social learning analytics introduces tools and methods that help improving the learning process by providing useful information about the actors and their activity in the learning system. This study examines the relation between SNA parameters and student outcomes, between network parameters and global course performance, and it shows how visualizations of social learning analytics can help observing the visible and invisible interactions occurring in online distance education.

The findings from our empirical study show that future research should further investigate whether there are conditions under which social network parameters are reliable predictors of academic performance, but also advises against relying exclusively in social network parameters for predictive purposes. The findings also show that data visualization is a useful tool for social learning analytics, and how it may provide additional information about actors and their behaviors for decision making in online distance learning.

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### 1. Introduction: context of the study

Despite all the advantages of ICT-supported distance learning, virtual classrooms add a whole new set of challenges for instructors and course designers; apart from the necessity of technological training and the reduced availability of time to adapt learning contents (Pang, Reinking, Hutchison, & Ramey, 2011), as classes become more decentralized and the number of students is potentially unlimited maybe the biggest of these challenges is the difficulty for teachers to keep track of students' progress and activity in the course.

Compared to traditional, in-classroom learning, student tracking in ICT-supported distance learning is complicated by the impossibility to directly observe the different interactions that take place in the classroom. This problem has several implications: first, without the existence of physical cues, it is not easy for teachers to determine the level of engagement and understanding of individual students and student groups (Reffay & Chanier, 2003); second, as learning strategies shift toward student-centred, self-directed

learning, there is a change in the role of teachers from deliverers of instructional content and knowledge to facilitators or guides (Dawson, 2008); and third, instructors lack the information to observe the social dynamics of the class, which would allow them to act on the most influencing or the disconnected students, depending on their needs.

Regardless of these difficulties, in more recent systems some of the information required by teachers to perform student tracking is stored – with varying degrees of accessibility – in the systems' databases. Until recently, raw data of student activity and the course information and contents displayed in the learning system generally co-existed separately, in part due to the burdensome task of filtering and presenting only the relevant information about the learning process to the different agents (Macfadyen & Dawson, 2012).

In this context, learning analytics emerges as a link between educational data and learning. While there is no agreement on a standard definition of learning analytics, a broad conceptualization of the term defines learning analytics as “the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs” (Long & Siemens, 2011, p. 34). More specifically, ongoing literature has emphasized that learning analytics should include the different activities from the

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above definition, but also that in the end learning analytics should be oriented toward decision making (Siemens et al., 2011), at the many different levels across educational institutions.

### 1.1. Classroom interactions in online distance learning

To overcome the lack of physical contact in online learning and facilitate communication in the classroom, learning systems have built-in synchronous and asynchronous capabilities in order to construct social learning. Communication tools allow teachers to observe only one side – the most visible one – of the dynamics of the course: the exchange of messages among active students; from there, teachers can assess and infer whether or not the different concepts and lessons are being understood, as well as the discourse construction, and then decide on when to intervene to help and support the students in the learning process.

However, many of the passive interactions – i.e. lurking – which occur in the system may pass unnoticed to instructors. As a consequence, it is extremely difficult for teachers to detect the involvement of the students who are not actively engaging in conversations. Moreover, in a given virtual classroom, the students may have very different learning styles, and sometimes the lack of active engagement does not mean a lack of involvement, or that learning is not happening (Wise & Hausknecht, 2013). For instance, some students may expand their learning by searching for external resources on the topic, and they may decide not to share them with the rest of the class; and other kind of students may act like learning witnesses or “invisible students” (Beaudoin, 2002) and rely on content shared by others. Therefore, sometimes it is very hard for instructors to determine whether learning is actually happening, be it for individual students or the class as a whole. Without that information, the decisions made on how to direct the class may rely purely in intuition or experience and, even having that information, teachers may not know if the social dynamics occurring in the classroom are the most appropriate. This is where learning analytics may provide the necessary information to make informed decisions to improve the learning process.

### 1.2. Research objectives

In this study, we are interested in observing the emerging visible and invisible social network structures from student and teacher interactions in online classrooms and their relation to student performance. More particularly, this study examines the relation between the parameters of both social networks and classroom and student performance. Furthermore, we want to explore the potential of social network visualizations to observe student and teacher behaviors. These objectives lead us to the following research questions:

- RQ1. Are social network parameters of the different actors related to student outcomes in online learning?
- RQ2. Are global social network parameters related to overall class performance?
- RQ3. Can visualizations from social network analysis provide additional information about visible and invisible interactions in online classrooms that help improving the learning process?

We will try to answer these questions by performing a case study with data from a one-semester online course. The research paper is then structured as follows: the next section offers a review on the literature of social learning analytics and the use of visualizations for learning analytics; then, the methodology of the case study is explained, followed by an analysis of the results from the study; the final sections will present a discussion of results and the conclusions extracted from this research.

## 2. Visual learning analytics and social learning analytics

### 2.1. Social learning analytics

Buckingham-Shum and Ferguson (2012) define five levels of social analytics, differentiating between inherent social analytics and socialized analytics. According to these authors, the former may be divided into social learning analytics – derived from the analysis of interpersonal relationships – and discourse analytics – focused on language-based constructed knowledge. The objective of this study is to examine how the interpersonal relations may affect learning in online distance education; therefore, discourse-centric learning analytics falls out of the scope of this research and we will focus solely on social learning analytics instead.

Social learning analytics refers to the application of Social Network Analysis (SNA) theory to learning processes, with the purpose of understanding, explaining and improving them. SNA considers each actor as a *node* of the whole network, while the different relationships between them are conceptualized as lines connecting the nodes and known as *edges* or *ties*; edges can in turn be *undirected* – that is, the edges are not oriented and the edge  $(a, b)$  is equal to the edge  $(b, a)$ , with  $a$  and  $b$  being network nodes – or *directed* – when the edges are oriented. Edges can also have different *weights* depending, for example, on the strength or the number of interactions between two nodes.

The application of SNA to educational contexts is not a novelty. Earlier studies in face-to-face and CSCL (Computer Supported Collaborative Learning) have already used SNA as a means to observe and understand learning construction and course dynamics from a social standpoint (e.g. Nurmela, Lehtinen, & Palonen, 1999). For example, SNA has been widely used in both settings to extract relevant indicators of participation, as a proxy for academic performance. Nevertheless, the main problem is that studies applying SNA to education have focused mainly on small groups in collaborative learning contexts.

More recently, with the increasing offer of courses delivered exclusively online, and especially with the emergence of MOOCs (Massive Online Open Courses), a new interest has raised in evaluating the suitability of SNA as a tool to perform social learning analytics not only in collaborative learning settings, but also as a means to observe the social learning occurring in classes with a high number of geographically distant and previously disconnected students. SNA has then been used for student role analysis (Aviv, Erlich, & Ravid, 2003) and role assignment (Capuano, Laria, Mazzoni, Pierri, & Mangione, 2011), detection of structured and unstructured communities (Aviv, Erlich, Ravid, & Geva, 2003), categorization of central/peripheral agents and expert status in virtual communities of practice (Chang & Hsieh, 2012; Nistor et al., 2015), prediction of sense of community (Dawson, 2008), detection and tracking of relevant topics (Tobarra, Robles-Gómez, Ros, Hernández, & Caminero, 2014), identification of at-risk students (Macfadyen & Dawson, 2010) or prediction of final student performance (Romero, López, Luna, & Ventura, 2013).

Regarding the latter, the main interest lies on investigating the relation between SNA parameters – typically, centrality parameters such as degree, betweenness and closeness centrality (Freeman, 1978) – and student outcomes, usually measured as final grade. This line of research has its origin on results from prior studies on the relation between participation or engagement and academic performance in online learning and CSCL. Although there is some consensus on the idea that participation – i.e. number of messages posted to the course message board – is associated to higher student engagement and academic achievement (Romero et al., 2013), prior studies show contradictory and mixed results in this regard, as Huang, Lin, and Huang (2012) point out.

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