Using Learning Analytics to improve teamwork assessment

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ABSTRACT

Acquiring the teamwork competency is fundamental nowadays, in order to guarantee a correct working performance for individuals. This means that a great deal of importance is being given to this activity in educational circles. Nevertheless, evaluating the development of teamwork individually is not simple, given that on many occasions there is no objective evidence to study. Information and Communication Technologies applied to educational contexts enable access to information that can help in this analysis. However, it is still complex due to the large amount of information that needs to be considered. This study proposes indicators based on the interaction between learning agents (student–student and active–passive). The exploration of these indicators contributes to the assessment of the individual development within the teamwork context. The analysis carried out in this study demonstrates that there is a direct relation between these interactions and final grading corresponding to individual assessment of teamwork activities by teachers. Additionally, a Learning Analytics system is introduced as support for the challenging task that teachers face in evaluating and monitoring individual progress within teamwork. The information provided by the Learning Analytics system and timely information extraction allow preventing problems, carrying out corrective measures and making decisions to improve the learning process of teamwork.

1. Introduction

It is widely accepted that students should build their own knowledge in an active manner (Alexander, 2006). The cooperative model proposes that learning is produced more successfully when small groups of students share information and debate it together. Doing so in groups allows them to build mental models and, therefore, knowledge (Leidner & Jarvenpaa, 1995; Vogel, Davison, & Shroff, 2001). The teamwork competency (hereafter referred to as TWC) is highly valued by organizations that need cooperation between their members in order to achieve their objectives (Iglesias-Pradas, Ruiz-de-Azcárate, & Agudo-Peregrina, 2015). The

General Secretary of the United Nations includes the TWC amongst its Core Competencies that "... refer to the combination of skills, attributes and behaviour required of all staff, regardless of their level or function" (UN, 2014).

In educational circles, based on the implementation of the European Higher Education Area (EHEA), the large majority of universities include the TWC in its study programs and, therefore, should do the teamwork assessment to verify the extent to which such competency is acquired by means of evidence. Qualification Accreditation Programs like ABET (Accreditation Board for Engineering and Technology) (ABET, 2013) ask for this type of evidence within the internal evaluations of universities and, in particular, the Spanish quality agencies (national and regional) request it within their revision programs to verify qualifications (ANECA, 2014). Similarly, the Horizon report for Higher Education (Horizon, 2014) says that "Many educators are discovering that online platforms can be used in order to provide the solution to problems in groups, and to develop communication skills whilst the students' knowledge is increased". Helfand (2013) demonstrates how a progressive collaborative learning system in Higher

Education can produce graduates with communication skills, quantitative reasoning and teamwork. However, in order to carry out monitoring and a subsequent evaluation, evidence is needed. The development of teamwork leaves evidence of three types: individual (participation, cooperation, monitoring, leadership, efficiency, etc.), group (mission and objectives, standards, map of responsibilities, etc.) and results (Perez Martinez, Garcia Martin, & Sierra Alonso, 2014).

In organizational environments, group evidence and its identification are usually measured, and its knowledge and structure are used in the professional accreditation concerning the TWC (Baker, Day, & Salas, 2006; Salas, Bowers, & Edens, 2001; Salas, Tannenbaum, Cohen, & Latham, 2013). However, in higher education, the result is fundamentally evaluated (based on final work), because it provides a clear evidence that is suitable for comparisons and can be measured. Nevertheless, as Barkley, Cross, and Yhowellmajor (2007) indicate "...in collaborative learning two things need to be assessed: the students' command of the subject content and their participation in the group processes. The majority of teachers want to know to what extent the students have learnt the subject content related with the subject in question. Teachers that choose collaborative learning also believe that it is important to grade the team processes".

In this sense, the majority of students that start their studies at Spanish universities begin with a substantial lack of knowledge in terms of TWC development. According to the Fidalgo's study (Fidalgo, Leris, Sein-Echaluce, & García-Peñalvo, 2013) more than 65% of the students begin their higher education studies without (or hardly) having used teamwork tools and procedures. Fidalgo et al. (2013) demonstrate that 80% of university students that are starting out have never been evaluated in the TWC and, for the rest, only 20% have had the TWC assessed during the development of teamwork. All of this indicates that, in the context of the study, students reach university without having experience with the TWC, or without having had the development of their TWC monitored or evaluated. However, this lack of training concerning the phases of development in the acquisition of the TWC leads, on many occasions, to what some authors demonstrate in evidence: students work individually and only come together in order to compile the results obtained (Sancho-Thomas, Fuentes-Fernández, & Fernández-Manjón, 2009), reducing the interaction between peers to the greatest extent (Vik, 2001).

Furthermore, the effectiveness of the teamwork is not only measured by the results or group evidence, but also by the quality of the performance of the team members; in this way, Strom, Strom, and Moore (1999) state that "One of the most perplexing tasks for teachers is to identify the teamwork skills acquired by individuals" and that "Teachers know that group success depends on individual accountability".

Unfortunately, teamwork assessment methods, both for the results obtained and the group evidence, do not normally really measure the acquisition of the TWC by each individual. Most commonly, the monitoring and assessment of TWC development is carried out by student opinion surveys, in order to observe students' perceptions or peer evaluations to measure the individual evidence (Poblete & García Olalla, 2014). These methods highlight the relevance of mutual assessment among team members. Therefore, team members should be up-to-date with the tasks that each individual should undertake, as well as with group milestones and tasks. This translates into an improvement of the individual perception of the effectiveness of teamwork (Fransen, Kirschner, & Erkens, 2011).

On the other hand, this assessment should also take into consideration the behaviour of the leader, who has a great impact on the group performance and on the development of the teamwork (Huang, Kahai, & Jestice, 2010). Hambley, O'Neill, and Kline (2007) note the importance of the leaders when it comes to establishing the means of communication used for virtual groups in order to achieve a communication and collaboration that is more effective, in turn increasing their constructive interactions and cohesion, which in addition can ultimately affect the team performance.

Therefore, in order to evaluate TWC performance it is not enough to have evidence of aspects like cooperation or leadership, but it is also necessary to perform a total monitoring of the evidence collected about the performance of each and every one of the team members. Nevertheless, this is very difficult to achieve using traditional methods (Salas, Sims, & Burke, 2005). In order to carry out the monitoring and individual evaluation in a teamwork context, various tools have been developed: surveys that measure the perception of students (Battles & King, 2010; Perez Martinez et al., 2014), self-evaluation questionnaires and peer evaluation (Strom et al., 1999; De los Rios Carmenado, Figueroa Rodríguez, & Gómez Gajardo, 2012) and rubrics, closely related with peer evaluation. Those tools are used for the formative assessment (during the process) and for the summative assessment (at the end of the process), and thus allow monitoring of the competency so as to improve the learning process (Martínez-Figueira, Tellado-González, & Raposo-Rivas, 2013). With regard to the tools used to monitor the teamwork, recording the debates of each group stands when virtual debates are used (Gu, Shao, Guo, & Lim, 2015).

However, monitoring methods, despite being widely used, present drawbacks in terms of their validity as assessment methods, because they are exclusively based on the perception of students (lacking in objectivity) or because they lead to difficult and cumbersome analysis procedures, like measuring the participation of each one of the team members (as in recording of debates).

Therefore, objective evidence about the participation of each member during the development of the teamwork needs to be collected. Nevertheless, teaching staff usually face great difficulties in order to follow the different phases of the development of the teamwork, due to the impossibility of carrying out direct individual monitoring and access to every objective evidence due to time limitations. This constraint prevents decision making throughout the process, which would enable timely solving of learning anomalies and improvement of learning. It is therefore necessary to have individual and group evidence that allow teaching staff to identify the skills related with teamwork of group members during its execution, and to give students feedback about their strengths and shortcomings, as well to detect problems, like delays and failure to assume individual responsibilities.

The CTMTC method (*Comprehensive Training Model of the Teamwork Competence*) (Leris, Fidalgo, & Sein-Echaluce, 2014), integrates tools that are present in the different Learning Management Systems (LMS) and facilitate registration of user interactions, as well as an easier access to teamwork evidence. This method works with the following kinds of evidence (Fidalgo et al., 2013):

- Final result of the work. In an online format (commonly on Wikis).
- Group evidence corresponding to the different phases of work (mission and objectives, time frame, map of responsibilities, organization of information). On Wikis and Dropbox.
- Individual evidence (active participation, responsibility, leadership, cooperation, etc.). On forums.

However, the CTMTC method and other similar ones, on their own, are not completely effective. The reason is that monitoring individual evidence in the teamwork and evaluating its performance requires a great deal of time for the teaching staff (the effort