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# A gamified peer assessment model for on-line learning environments in a competitive context

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ABSTRACT

Peer Assessment (PA) offers a powerful solution that helps teachers in online learning environments to correct essays by distributing the workload among students. Nevertheless, the quality of the results in PA depends on good evaluations of reviewers. Thus, the main drawback for scaling up the use of PA is the presence of inadequate behaviours, such as being too harsh or too soft in the assessment, or even not offering a helpful feedback. This usually occurs due to the lack of motivation and engagement of students in the PA process. To deal with this problem, this paper proposes a gamified peer assessment model, where gamification elements are used to engage students in PA activities. Two experiments using the proposed model within an intelligent tutoring system called MeuTutor shows satisfactory outcomes. We verified that the average grade given by students to an essay are equivalent to those given by experts, but the time and costs to complete the assessments were largely reduced. Furthermore, the use of gamification helped to increase the amount of students' access to the system in 64.28%; increase in 10.53% the number of essays written and submitted; and improve the quantity and quality of assessments for each essay.



## 1. Introduction

In recent years, several countries have adapted their educational approaches to promote and support the use of technologies on both classroom courses and on-line learning courses. Currently, there are several technologies that support online learning, such as Intelligent Tutoring Systems (ITSs) Sleeman and Brown (1982), Virtual Learning Environments (VLE) (eg Moodle, SOLAR, TelEduc, Blackboard, Sakai), Computer-Supported Collaborative Learning (Miyake, 2007) and more recently, the Massive Open On-line Courses (MOOCs) (Wulf, Blohm, Leimeister, & Brenner, 2014) (eg EDX, Coursera, Udacity).

The recent increase in popularity of MOOC courses has made it accessible for anyone with an internet connection to enroll freely, university level courses (Piech et al., 2013). However, while new web technologies allow for scalable ways to deliver video lecture content, to implement social forums and to track student progress, we remain limited in our ability to evaluate and give feedback for complex and often open-ended student assignments such as mathematical proofs, design problems and essays (Piech et al., 2013). This is because these types of activities require manual correction by the teacher individually, which makes it an over-charging activity. With the increase in the students amount in these environments and, consequently, a greater number of activities being made every time, the correction by teachers would quickly become infeasible.

Facing this issue, Peer Assessment offers a promising solution to scale the grading of complex assignments in courses with tens or even hundreds of thousands of students (Piech et al., 2013). It is an educational arrangement where students judge peers performance quantitatively and/or qualitatively (Van Zundert, Sluijsmans, & Van Merriënboer, 2010). It stimulates students to reflect, discuss, and collaborate in their learning process (Topping, 1998) (Strijbos &

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Sluijsmans, 2010). Peer assessment is a process by which students or their peers attach grades or tests based on predefined benchmarks by professor (Sadler & Good, 2006). In peer assessment, students learn from each other by means of receiving and giving feedback. It is recommended because it reduces teacher's workload (Rubin & Turner, 2012), increases learning outcome (Murakami, Valvona, & Broudy, 2012). Due to its efficiency and active learning nature, peer assessment has been widely used in diverse fields (Falchikov, 1995) (Freeman, 1995).

Peer Assessment models have been used in various ways, improving teaching skills and even providing emotional benefits Sadler and Good (2006). This practice is used to save teachers time and improve students' understanding about the course materials as well as improve their meta cognitive skills (Malehorn, 1994). There are several peer assessment approaches published in the literature, such as formative approaches (Orsmond, Merry, & Callaghan, 2004), probabilistic models (Piech et al., 2013) and even models using Bayesian networks (Wang & Vassileva, 2003).

The effectiveness and quality of an assessment depends on how it is incorporated into the learning process (Schuwirth, 2004). However, students may not have enough knowledge to criticize peers work and conduct a fair evaluation (Wang, Liang, Liu, & Liu, 2014). To alleviate this problem, it was developed a peer assessment process that uses assigning multiple reviewers to an evaluation task, decreasing the bias (Tseng & Tsai, 2007). Thus, Peer Assessment become a collaborative evaluation process, where the quality of the final results depends on good evaluations of their reviewers. It values cooperation over competition and greater respect for the varied experiences and backgrounds of participants can occur (Boud, Cohen, & Sampson, 1999).

However, in some competitive on-line learning environment has the fact that when some students achieved the goal, all other students fail to reach that goal, only the best students will be victorious. As a result, students are not motivated to collaborate with the reviews of the activities. Students are used to being judged in terms of their own efforts and can resent others gaining credit for what they perceive as their own contributions, particularly within the context of a competitive course (Boud et al., 1999), i.e., there is a certain fear to evaluate other students.

The fact is that there is great reluctance to collaborate with those who are competing against. Facing that, this leads to the following question “How can we include Peer Assessment techniques in online educational environments in a competition context?”. This technique applied in this context is especially promising as destabilizing the passive role of the student, such that it take responsibility for their learning, seeking the improvement of the learning process through their active participation. However, a major problem when using it in the competitive context is the presence of inappropriate behaviour by students which decreases the learning and evaluation system (Kapp, 2012). The emergence of this type of behaviour occurs for various cognitive and emotional factors such as boredom, lack of motivation and the need to get results quickly. To solve this problem it is necessary to use techniques and models that have the ability to “engage” positively the emotional state/cognitive of the student, without necessarily increasing the deployment cost.

The paper proposes a gamified peer assessment model that uses gamification elements as a motivational aspect for students inside Peer Assessment process. Gamification is the use of mechanical, ideas and aesthetics games (context, fast feedback, competition, stages, achievements, points, et.), to engage people, motivate actions, promote learning and solving problems (Kapp, 2012). This term is commonly used to express the use of game elements (storyline, score, levels, quests, badges and rankings) in environments that are not games (educational environment) to motivate or influence people to perform a certain activity. The use of gamification applied in education is strongly presented in (de Sousa Borges, Durelli, Reis, & Isotani, 2014), as a motivational aspect to students. Some studies, such as (Pedro, Lopes, Prates, Vassileva, & Isotani, 2015) applied gamification in their environments and results indicate that the gamification implemented contributed to improve student performance in the case of boys.

Andrade, Mizoguchi, and Isotani (2016) points out that several positive effects of using gamification in learning environments has been found to date. The combined use of peer assessment techniques along with gamification makes the process most powerful and complete, avoiding and/or decreasing the presence of inappropriate behaviour by students. The gamification elements applied in the model positively influence the state of the student, encouraging them to participate in the proposed teaching-learning process through the rewards obtained (points, levels, trophies, among other).

The gamified peer assessment model proposed was applied in the MeuTutor educational environment, which is an intelligent tutoring system and aims to monitor the learning of students in a personalized way, ensuring quality in teaching and improving the performance of its members. The version chosen to be used was the MeuTutor-ENEM, which aims to help high school students prepare for the National High School Exam (ENEM). Thus, the environment offers courses related to high school subjects like Portuguese, mathematics, physics, among others. Our goal was evaluate the effectiveness of the use of our Gamified Peer Assessment model in the context of competition in the correction of essays.

We structured this document as follows: in section 2, we present the related works. In section 3, we present our proposal and the concepts created. Section 4 presents the planning and execution of an experiment, where we have applied the proposed model in the MeuTutor. Finally, section 5 summarizes the work, presenting the conclusions we reached, our limitations and some works planned for the future.

## 2. Related work

This section aims to discuss related work to the proposed work. We have seen that the use of peer assessment is frequently. Peer Assessment can be defined as a learning setting in which individuals evaluate or comment on the amount, level, value, quality, or success of the products or learning outcomes of the peers who learned in a similar context (Topping, 1998). The main goals to use Peer Assessment are “improve the quality of the learning process, sharpen critical abilities in students, and increase student autonomy” (Topping, 1998).

Several studies have reported that learners could receive a great deal of inspiration from peer assessment results (Chen, 2010), which could encourage their learning motivation (Jenkins, 2004), enhance their thinking capability (Prins, Sluijsmans, Kirschner, & Strijbos, 2005), facilitate their self-reflection and communication capabilities (Min, 2006) and improving learning achievements, motivations and problem-solving skills (Hwang, Hung, & Chen, 2014).

We can classify the works that use peer assessment into three groups. The first group includes those who use the peer assessment technique in a specific context, according to the specific needs of the task to be performed. In this case they are highly dependent of the context where was applied. The second group consists in the work that proposes tools that assist in the application of peer assessment in other tasks and contexts. These works proposes generic tools that do all the work necessary to apply peer assessment in a given context and/or task. The third group consists of works that proposes peer assessment models. In that case, they are