A Web-Based Platform for Peer Assessment in Technology Enhanced Learning: Student Module Prototype

Gabriel Badea, Elvira Popescu
Computers and Information Technology Department
University of Craiova
Craiova, Romania
gabriel.badea@yahoo.com, popescu_elvira@software.ucv.ro

***Abstract* – Peer assessment is widely used in educational settings as an alternative evaluation approach. It brings various benefits to the students, increasing engagement and interactivity and fostering critical thinking and reflection. Several platforms for managing the peer review process have been proposed in the literature, but most of them are confined to a particular domain or course and have various limitations related to reliability, reviewer allocation, reputation and training of reviewers or instructor support. In an attempt to address these challenges, we propose an innovative general-purpose peer assessment platform, called LearnEval. In this paper we focus on the student module part of the system, describing its functionalities, pedagogical rationale and implementation details.**

Keywords – technology-enhanced assessment; peer evaluation; educational platform

I. INTRODUCTION

Peer assessment, also known in the literature as *peer evaluation* or *peer review*, represents the process through which students evaluate the quality of the work submitted by their peers and provide formative or summative feedback and sometimes grades [2]. Traditionally, the process was done using pen on paper, which can be very intensive and time-consuming, especially in classes with a high number of enrolled students [2]. In recent years, the process has known a large growth as more and more systems supporting peer review have emerged [1, 5, 9].

As reported in the literature, peer review reduces many administrative tasks, offering solutions for the free ride risk and for the assignment of grades to group work where some of the students contribute more than others [4]. Furthermore, the process has been shown to foster critical thinking and reflection [3]; learners could benefit from the timely feedback and be exposed to different ideas, offering new perspectives, not the exclusive one provided by the teacher.

Nevertheless, peer review can also have drawbacks and pitfalls. The process is prone to bias, but some measures can be taken to counteract the problem such as ensuring anonymity. Furthermore, some peers might feel insecure in their abilities in assessing peers, but calibration and training offer a good solution to the problem [9].

Currently, the landscape of peer assessment systems is quite heterogeneous, including platforms such as: CrowdGrader [1], WebPA [4], CaptainTeach [5], SocialX [7], Mechanical TA [9]. The main limitations of the state-of-the-art systems refer to reliability issues, lack of an automatic mechanism to identify and report rogue reviews, limited support for the instructor, potentially unfair allocation of solutions to reviewers, lack of training for students as evaluators, and limited analyses of peer assessment data and review quality. Furthermore, most systems have been designed to support peer evaluation in a given domain or have been purpose-built for a specific course.

In this context, what we propose is an innovative, fully-fledged and general-purpose peer assessment platform, called LearnEval. The system aims to support a wide range of functionalities and instructional scenarios, seeking to address some of the main challenges of existing tools. A prototype of the system has already been developed and tested in a pilot study. In this paper we focus on a part of the LearnEval system, namely the student module, which includes an automatic score-computing mechanism and a reputation system for addressing reliability issues, as well as an open learner model and advanced reporting system with suggestive graphical visualizations.

The rest of the paper is structured as follows. Section II presents a brief overview of related platforms and approaches for integrating the peer assessment process, outlining the novelty of our system. Section III describes the LearnEval student module in terms of functionalities, architecture and implementation. Section IV draws some conclusions and outlines future research directions.

II. RELATED WORK

One of the most mature peer assessment platforms is WebPA [4], which tries to solve the problem of assigning individual grades to each student in a group. It can be used on any type of assignment and it allows the teacher to configure different parameters such as the team size, number of teams, assessment criteria and assessment settings. Another interesting approach is proposed by CaptainTeach system [5], which applies peer review to multiple stages within assignments in progress. The

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approach could solve the cases where a student misunderstood a programming problem and peer review could aid the student to get back on track before the deadline.

SocialX [7] is an exercise sharing tool which integrates a reputation system designed for increasing the students' motivation and interaction between them. This system models several traits of a student such as involvement, usefulness to others, competency on the topic, ability to judge others' solutions and critical thinking. Similarly, CrowdGrader [1] relies on a reputation system that gives more weight to the grades assigned by students who have a high grading accuracy. Each student is stimulated by receiving a crowd-grade that reflects both the quality of the submissions and the quality of the work as a reviewer.

Some systems rely on a combination of peer and expert evaluations. For example, Mechanical TA [9] is an automated peer review platform that involves human teaching assistants (TAs) to assure the quality of the reviews. The TAs evaluate the reviews done by students that did not provide proficiency in reviewing and spot check the reviews submitted by the more proficient students.

One of the challenges faced by existing peer assessment systems refers to the reviewer assignment, which is generally performed randomly. An exception is the OASYS2 platform [8], where the assignment is based on reviewers' ability: three students of varied reviewing skills are assigned for each solution. Further issues that need to be addressed include automatic mechanisms for identifying and reporting rogue reviews, as well as improving the reliability and training of the reviewers. A potential solution is the integration of a calibration phase that precedes the peer assessment process, as proposed in [9]. In this phase, students' reviews are compared to reviews done by experts in order to assess their evaluation skills.

To sum up, based on the literature survey as well as our own experience with peer assessment [6], we extract a set of features that should be provided by an ideal peer evaluation system: support for a highly configurable peer assessment workflow, automatic reviewer allocation based on different fairness criteria, reputation system for addressing reliability issues, automatic score-computing mechanism to reduce the grading workload, algorithm for identifying ambiguous peer reviews, calibration mechanism for training the students before the peer review process starts, open learner model and advanced reporting system with suggestive graphical visualizations. Starting from these requirements, we aim to develop a comprehensive, general-purpose peer assessment platform, which addresses the limitations of the current systems. An initial version of this platform (called LearnEval) has already been implemented; in what follows we describe the student module part of the system.

III. LEARNEVAL PROTOTYPE - STUDENT MODULE

The peer assessment workflow supported by the LearnEval system can be briefly depicted by the following steps:

- The teacher creates the assignments associated to a course. An assignment has several properties such as title, content, submission deadline, review deadline, number of reviewers assigned per solution and review criteria.
- Students submit solutions to the assignments.
- After the submission deadline is reached, the solutions are assigned to reviewers based on the allocation mechanism specified by the teacher. Various approaches are available, such as: automatically by the system based on the reviewing skills of the students, randomly by the system or manually by the teacher.
- Students review their peers' work by assigning grades and providing feedback for each of the review criteria. A grade and a confidence factor are assigned to each solution based on its reviews and the skill level of its reviewers.
- Students can visualize the reviews and grades received, as well as various statistics.

A. Main System Functionalities

1) View Assignments

This module allows the student to visualize the list of assignments, including the submission and review deadlines. The learner can download the assignment and submit a solution to it, as long as the deadline has not yet passed.

2) Review Solutions

This module provides the student with the list of solutions assigned for evaluation. A review can be submitted by assigning a grade and providing feedback for each of the evaluation criteria. The grade is on a scale from 1 to 10 and there are constraints regarding the minimum length of the feedback, to encourage students to provide a detailed evaluation.

3) My Solutions

This module allows the student to visualize the grades and reviews received for her/his submissions, as illustrated in Fig. 1. The mark assigned to a solution is computed based on the evaluations received both from the peers and from the teacher (in case the teacher graded it), as follows:

$$Mark = hrsMark * wm1 + mrsMark * wm2 + lrsMark * wm3 + tMark * wm4 \quad (1)$$

where *hrsMark* represents the average mark given by students with high reviewing skill (HRS), *mrsMark* represents the average mark given by students with medium reviewing skill (MRS), *lrsMark* represents the average mark given by students with low reviewing skill (LRS), and *tMark* represents the mark given by the teacher. Students are split into different reviewing skill levels based on a *reviewing score*, as described below (subsection 5). The weights are configured by the course instructor, such that $wm1 + wm2 + wm3 + wm4 = 1$.

In addition, a confidence factor is computed for each grade, to indicate the level of trust for that grade, depending on the reviewing skills of the evaluator students: the higher the skill level, the higher the confidence. The metric is

intuitively displayed as a dot that takes different colors, ranging from green in case of high confidence to yellow in case of medium confidence and red in case of low confidence (see Fig. 1).

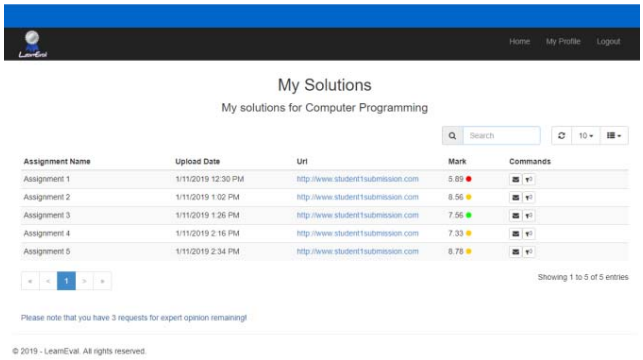

Figure 1. LearnEval - My Solutions page

The students have the possibility to leave a back-review for each evaluation received. This way, the learners can assess the utility of the review and whether it changed their perspective on the solution. The students also have the option to request an expert opinion (i.e., ask for teacher evaluation), when they are not satisfied with the reviews received from peers. The number of such requests is limited in order to prevent abusing this feature and reduce the burden on the instructor. Nevertheless, if after evaluation the request is deemed motivated by the teacher, the student is granted an additional expert request token.

4) My Reviews

This module is dedicated to the visualization of the reviews performed by the student, together with the back-reviews received. The learner can also access the reviews done by other peers for the same solution, providing opportunities for comparisons and new perspectives and promoting critical thinking.

5) My Scores

A reputation system based on the *involvement*, *competence* and *reviewing abilities* of the student is proposed. The *involvement* depends on the number of solutions, reviews and back-reviews submitted by the student before the deadline. The *competence* score of the student is computed based on the grades received for each assignment, both from the teacher and the peers. The *reviewing* score depends on the back-reviews received from peers and teacher and on the agreement of the student's reviews with the final mark assigned to the reviewed solutions. Learners can visualize a detailed breakdown of their scores and an open learner model feature is provided.

6) Statistics

The system also offers relevant statistics and suggestive graphical visualizations regarding students' activity. For example, the student can see the evolution of the grades throughout the semester, monitoring her/his progress. The learner can also easily compare the different grades received for the same solution and pinpoint the strengths and weaknesses based on the various criteria breakdown. Further statistics refer to the number of reviews or back-reviews received for each submission.

7) Notifications

This module allows students to receive messages for various events of interest, such as: assignment created/modified, submission or review deadline approaching, review/back-review received, grade assigned.

B. Architecture and Implementation

LearnEval web application was developed in C# using ASP.NET MVC 5 framework backed by an SQL Server database. The client side of the application is implemented using JavaScript and libraries such as jQuery and Knockout. The platform has a friendly and responsive user interface, being easily accessible from mobile devices.

IV. CONCLUSION

The paper proposed a web-based peer assessment system, called LearnEval. The student module part of the platform was described, outlining the main functionalities and their pedagogical rationale. The prototype was successfully used in a pilot study, in the context of a Multimedia Technologies in E-Learning project, at the University of Craiova; the results of the study will be reported in a forthcoming paper. As future work, we plan to conduct additional, larger scale validations of LearnEval, which will focus also on other functionalities of the platform, such as the instructor module or the automatic reviewer allocation mechanism.

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