Using LearnEval Peer Assessment Platform in Project-Based Learning Settings: A First Experience Report

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***Abstract*—Through project-based learning (PBL) students achieve higher levels of knowledge by developing challenging and complex projects over long periods of time. Adding a peer assessment component has the potential to increase students' engagement and critical thinking skills. In this paper we provide an experience report on the use of peer evaluation in a PBL scenario in a higher education context. A pilot study involving 41 undergraduate students enrolled in a Multimedia Technologies in E-Learning course is presented. A novel peer assessment platform called LearnEval is used by the students to evaluate the project deliverables of their peers. The unfolding and findings of the study are discussed and a detailed analysis of students' activity, as monitored and reported by LearnEval, is included in the paper. The results are encouraging, as students had a generally positive experience with the peer assessment process and the support platform. Nevertheless, increasing the quality of the reviews provided by the students is an important area for improvement.**

Keywords—peer review, project-based learning, experience report, pilot study

I. Introduction

Project-based learning (PBL) is an instructional approach where learning is organized around projects [10]. The projects consist in general of intricate, challenging tasks, where students work independently over long periods of time and provide deliverables at different milestones. On the other hand, peer review represents the process in which students evaluate the work of their colleagues and provide formative feedback, and in some cases summative assessment in the form of grades [4]. The various benefits of the process for both teachers and students are well-documented in the literature [7, 8]. Therefore, joint application of a PBL approach and peer assessment has the potential to increase the students' involvement and allow them to reach higher levels in Bloom's taxonomy [3]. The current paper provides an experience report on the use of peer evaluation in a PBL scenario, in a higher education context. A dedicated peer assessment platform is used, called LearnEval [1, 2]; hence, the paper also presents a first experimental evaluation of the system, in a real world pilot study.

LearnEval platform provides various affordances for both teachers and students, as described in [2] and [1] respectively. Thus, one of the main functionalities for the instructor represents the capability to tailor the peer assessment process based on the context and the requirements of the course. The teacher experience is also enhanced by features such as: course management, student enrollment, creation and editing of assignments, monitoring of student activity, automatic notifications, suggestive graphical visualizations of course data, and detailed learner model including involvement, competence and reviewing skills [2]. Similarly, the student module includes several functionalities, such as: upload of assignment solutions, submission of reviews for peers' work, access to reviews received and provision of back-reviews, visualization of grades (automatic score-computing mechanism), possibility to ask for teacher evaluation, automatic notifications, visualization of personal scores, various statistics and charts (open learner model) [1].

Several other initiatives for using peer assessment in PBL settings have been presented in the literature [6, 5, 7, 11]. The current report is based on a pilot study involving 41 undergraduate students in Multimedia Systems Engineering program from the University of Craiova, Romania; the students were enrolled in a Multimedia Technologies in E-Learning course during the first semester of 2018-2019 academic year. Our study is distinguished by the use of a novel peer assessment platform; students' activity in LearnEval is explored in detail, relying on the analytics dashboards offered by the system. In addition, the quality of the reviews is investigated and students' subjective learning experience is gauged by means of an opinion survey; hence, a more comprehensive experience report is provided.

The rest of the paper is structured as follows. Section II presents an overview of related experimental studies on peer assessment. Section III outlines the context of our study, describing the course, participants, project tasks and peer evaluation scenario. Section IV presents the unfolding and results of the study, analyzing the peer assessment activity of the students in LearnEval. Section V draws some conclusions and future work directions for improving the peer assessment scenario and platform.

II. Related Work

In what follows we present an overview of experimental studies on the application of peer assessment in education, especially in PBL settings.

Paper [7] reports the experience of peer review on a full-semester project in a Web Design course where 37 master and 26 bachelor students were enrolled. The project consisted in developing a web application in the form of a personal blog. The peer review process was applied to the programming activities. Students had between 3 and 4 days to review their peers. Students were allowed to revise their work based on the feedback received from peers before submitting it for teacher evaluation. The findings show that the project results were improved when using peer review

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compared with the previous year when the process was not applied. The possibility to provide revision was deemed helpful, as it allowed students to receive higher grades. Strong correlations were found between the overall student's rating based on peer reviews and the exam score, as well as between the teacher's evaluations and the students' reviews. An anonymous survey showed that the students found the methodology useful, especially the revision phase.

A somewhat similar approach is presented in [8], where peer review is applied in an undergraduate ecology course, at University of Otago, New Zealand. The study involved 50 second year students writing a research proposal as a grant application, prior to do the research project. The reviewing process was applied to the research proposal. Students wrote a "rebuttal" for every feedback point received from the peer reviews before re-drafting and submitting again. The rebuttal required students to consider each peer comment and provide a rationale why the feedback is accepted, partially accepted or rejected. The large majority of the rebuttal comments were accepted and the research proposals were re-written accordingly. There were 25 research proposals and 25 rebuttals. When it comes to the assessment process, each research proposal was sent to 2 students and 2 teaching staff for anonymous evaluation. The peer reviews and teacher reviews appeared notably similar in structure and impact, changes accepted or rejected. The findings suggest that students expressed a strong desire to help and be constructive.

A dedicated online tool, Designing for Learning and Portfolio (D4L+P), was used to support the T5 (tasks, tools, tutorials, topic resources, and teamwork) method of teaching and learning as reported in [11]. The tool was applied in a PBL approach to enhance students' reviewing abilities. The participants were 25 students (grade 10, ages 15-16) enrolled in an enrichment classroom program, 15 teachers and 5 experts. One of the objectives was to compare the students' reflections as reviewers of the projects using the D4L+P program with the reflections of teachers and experts in PBL. The results show that students and experts had similar patterns of offering feedback, while the teachers' patterns emphasized reinforcing feedback.

The pedagogical benefits of peer feedback for facilitating PBL are examined also in [6]. The peer review process is applied in an online instructional design master's level course implemented using Moodle LMS. The study involved 21 students geographically dispersed, enrolled in a public university in USA. Most of the students were K-12 school teachers, although there were involved also college instructors, technology coordinators and technical writers. The paper examines the graduate students' participation and perceptions of peer feedback activity that supports PBL. The results showed that the students' participation was high and the peer feedback can be applied in an online learning environment to support PBL. Furthermore, the students were supportive of peers' work and they posed questions that provided an incentive for critical thinking for their colleagues.

A more complex analysis of the review data is performed in [9], where it is studied the potential of peer assessment process in 4 university-level hybrid courses involving undergraduate students and 4 online courses involving MBA students. The experiment took place from spring to fall 2014 and the topics referred to Global business environment and Corporate strategy. The courses involved a sample of 272 students, from which 156 took a hybrid course and 116 took an online course. Canvas LMS was used for managing the peer assessment process. Each student assessed between 3 and 5 peers on two assignments: i) an interim discursive assignment in the form of a paper regarding an aspect of the class content and ii) a summary creative assignment in the form of 7 image-slides, conveying the most significant ideas students had studied throughout the course. The review was guided by a rubric developed based on Bloom's taxonomy. Several measures were applied for analyzing the data, such as: cross-sectional data profile students' views before and after the experiment, frequency analyses, mean comparisons, and t-tests. The measures show that in the beginning students have strong and positive agreement with the potential of peer reviewing, but the post-experience exhibits weaker support for the value of the process. Furthermore, the results suggest that peer assessment is not promoting student engagement as it is reported in other papers.

A different approach is used in [5], where online peer assessment (OPA) is applied in a one-semester Experimental Physics PBL course to enhance students' professional skills in LED design. The participants were 73 junior students from the Department of Physics, National Changhua University of Education, Taiwan. The students were divided in two groups: OPA group (with OPA) and traditional group (without OPA). Regarding the peer assessment process, two roles were defined: the teacher who had control over the OPA process and mechanisms, and the students who had the possibility to upload homework, evaluate each other and provide feedback about peers' projects. Three sessions of peer assessment were conducted and the findings show that OPA group achieved better results than the traditional group in concept clarification and enhancement of LED design skills in well-structured problem solving. There was no significant difference between the two groups for the enhancement of LED design skills in ill-structured problem solving. Regarding the students' perception about the effect of peer assessment, the OPA group benefited from enhanced inquiry learning and reflective thinking. The majority of the students found the two-stage LED simulation of PBL course challenging, helpful and interesting.

Our study adds to the literature by presenting an experience report on applying peer assessment in a PBL scenario. The novelty consists in the use of a dedicated support platform built by our research team, called LearnEval [1, 2]. A detailed report of students' activity is provided, starting from the analytics dashboards offered by the system; students' perspective is also analyzed, based on an opinion survey.

III. Context of Study

We applied the peer assessment platform LearnEval in the context of PBL, in a pilot study involving 41 undergraduate students enrolled in Multimedia Systems Engineering bachelor program at the University of Craiova, Romania. The study took place during the first semester of 2018-2019 academic year, in a Multimedia Technologies in E-Learning project taught to 4th year students. An interactive Informatics lesson for high school level had to be developed individually by every student and implemented as a website integrating multimedia content (such as images, audio and video tutorials, animations, educational games and simulations, assessment tests). Throughout the semester,

three presentations were held by each student: two intermediary and one final. The first and the second presentations required students to provide the overall structure and layout of the application, create the hierarchy of the web pages, integrate learning content and style the pages; thus, from the perspective of programming and implementation, it involved writing HTML5 and CSS3 code. The third presentation required students to add interactivity to the website, by integrating animations, simulations, assessment tests or educational games; thus, JavaScript programming language was exhaustively used by the students.

The development of the educational website was supplemented by a peer assessment scenario, supported by LearnEval. The three deliverables for the project were used to create three peer review sessions. After each presentation, the student had to upload his/her solution into LearnEval in the form of an archive with the project artifacts or to supply a link where the artifacts can be found (e.g., Dropbox or Google Drive). After the submission deadline was reached, each solution was automatically allocated to three reviewers with various assessment skills (one high, one medium and one low). We decided to use the same review criteria for the three presentations as they covered the main aspects necessary to be delivered: functionality, implementation & pedagogical quality and aesthetics. A review was both summative and formative: the student had to assign grades on a scale from 1 to 10 and offer feedback for each review criterion. We decided to set a one-week period for submitting solutions, followed by a period of two weeks for reviewing peers' work. Therefore, students had enough time to analyze the solutions assigned to review and provide insightful feedback and grades. After the review deadline was reached, each solution was automatically assigned a grade and a confidence factor based on the peer evaluations (according to the formula presented in [1]).

As mentioned before, the peer assessment scenario was managed using LearnEval platform. The system can ease the work of both teacher and students and provide highly desirable functionality. The teacher used LearnEval to create the course and assignments, configure the number of reviewers per submission, specify the review criteria, set up the submission and review deadlines, visualize the submitted solutions and reviews, and visualize course statistics and student scores; furthermore, the platform offered a way for monitoring the activity of each learner. The students used LearnEval to submit the project deliverables, review the work of peers, access the reviews received and provide back reviews and visualize various scores and statistics. Some of these LearnEval functionalities are illustrated in the next section.

IV. Unfolding and Results of the Study

In what follows, we provide an overview of the PBL activity taking place throughout the semester. We start by briefly discussing the projects developed by the learners; next, we analyze the peer assessment activity of the students in LearnEval. We also investigate the quality of the reviews provided by the learners, as well as their subjective satisfaction with the platform and the peer evaluation process.

Overall, the quality of the projects submitted by the students was satisfactory and most of the learners succeeded to provide fully functional websites at the end of the semester. The range of topics was very wide and covered lessons such as arrays, directed and undirected graphs, sorting algorithms, or backtracking. In what follows, we illustrate one of the best projects developed, on the topic of *binary trees*. An excerpt from the lesson is depicted in Fig. 1, showing the removal of a node from a binary tree. The user interface is very intuitive and offers both graphical and textual information regarding the steps involved in the process.

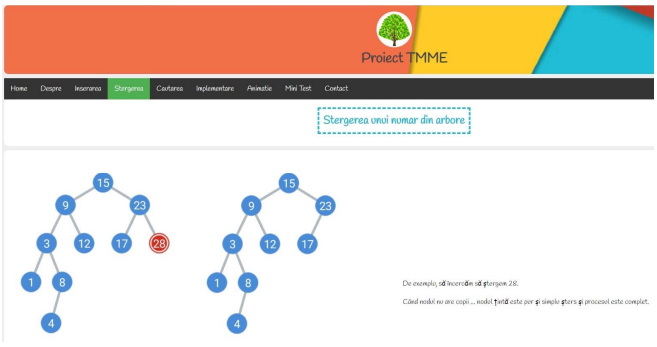

Fig. 1. Student project on binary trees - illustration of the node removal process

The student project also contains a helpful educational animation that illustrates the creation of a binary tree, addition and deletion of nodes from the tree, searching for a node with a specific value, or printing the binary tree (Fig. 2).

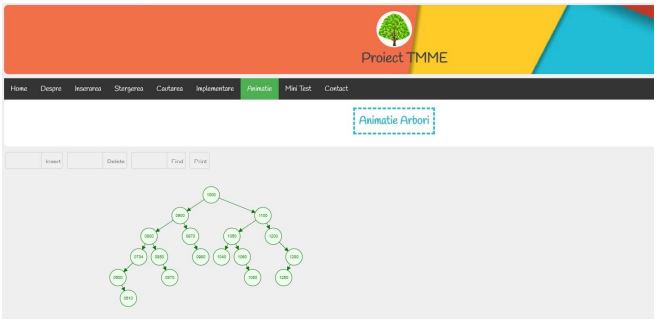

Fig. 2. Student project on binary trees - capture of an educational animation

Next we report on students' activity in the LearnEval system, relying on the Statistics module provided by the platform.

The student engagement with the peer assessment system was satisfactory, with a total of 93 project deliverables submitted: 33 for the first milestone, 27 for the second milestone and 33 for the third milestone (as illustrated in Fig. 3). Students were also highly involved in assessing their peers' work, with a total of 218 reviews submitted: 86 for the first milestone, 52 for the second milestone and 80 for the third milestone. The lower number of solutions and reviews for the second milestone could be explained by the corresponding time of the semester, which was just before the winter holidays.

An *involvement score* for each student was computed by LearnEval, based on the number of solutions, reviews and back-reviews submitted [2]. As can be seen in Fig. 4, few students had a low involvement score: 7 students (17%) had a score below 5 and only 3 students (7%) did not provide

any solutions or reviews (i.e., score 1). By contrast, 19 students (46%) had an involvement score above 8, being highly engaged in the peer assessment activities.

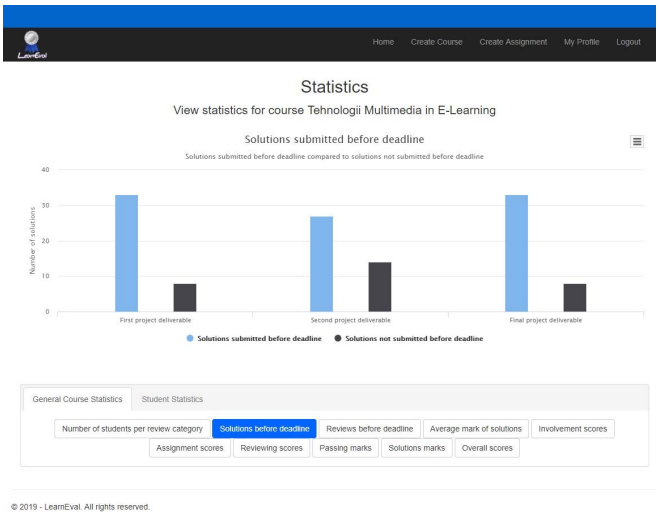

Fig. 3. Chart with the number of solutions submitted before deadline compared with the number of solutions not submitted before deadline

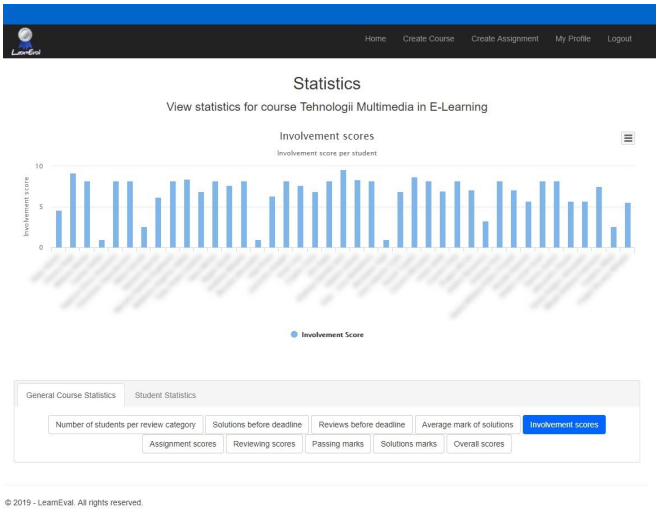

Fig. 4. Chart with students' involvement scores (students' names are blurred)

As far as the quality of the solutions provided by the students is concerned, the scores were quite high, with 8 students achieving a mark greater than 9 (Fig. 5). No student had an average score of the submitted solutions lower than 5.

The average score values obtained by the whole class are: 8.49 for the first milestone, 8.66 for the second milestone and 8.06 for the third milestone, respectively (the evolution of the scores is presented in Fig. 6). The slightly lower value for the last milestone could be explained by the higher complexity of the task, which required more advanced JavaScript programming skills.

In addition, a *reviewing score* for each student was computed based 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 [2]. Most students had a high reviewing score: only 9 students (22%) had a score below 8 and only 5 students (12%) did not provide any reviews and had a score of 1 (Fig. 7).

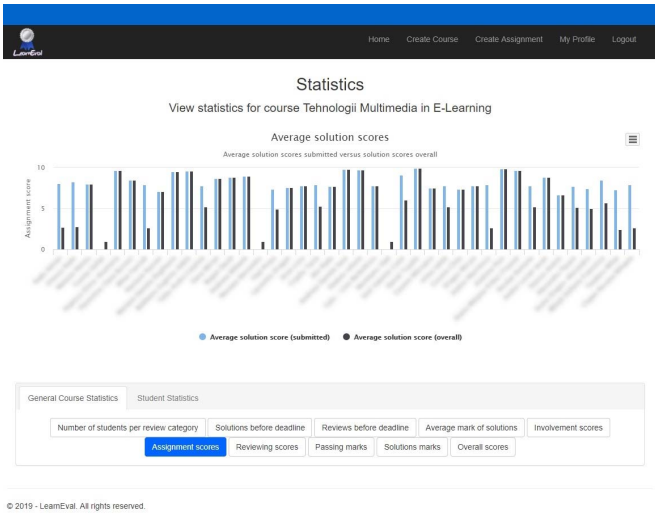

Fig. 5. Chart with the scores obtained by the students for the submitted solutions versus the overall average score calculated taking into account also the missed milestones (i.e., solutions not submitted, graded with 1) (students' names are blurred)

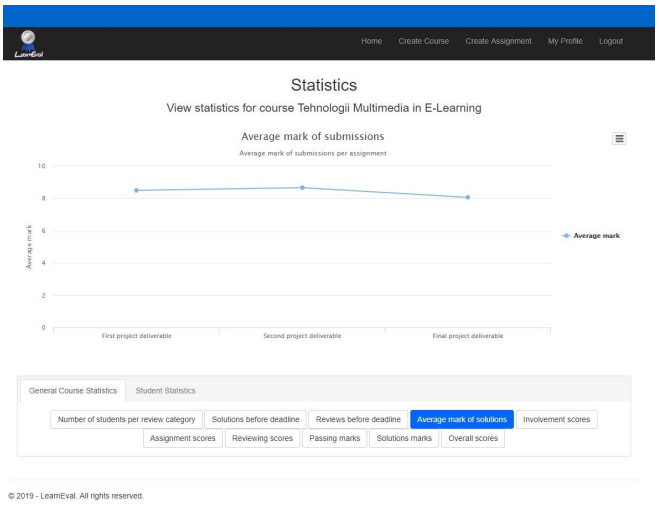

Fig. 6. Evolution of class average solution scores

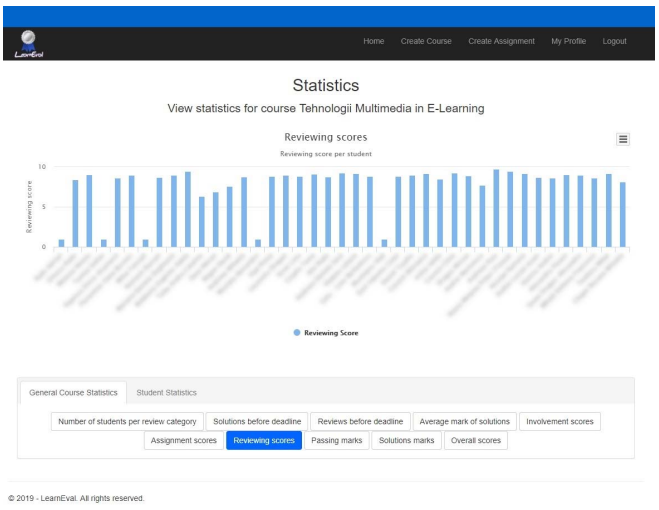

Fig. 7. Chart with students' reviewing scores (students' names are blurred)

While the reviewing scores indicate overall good reviewing skills, a closer look at the actual feedback comments written by the students (in addition to the grades) provides a different perspective. A total of 654 comments

were given by the students (i.e., one comment for each review criterion, yielding 3 comments per review). Examining the length of the feedback, 175 comments had at least 50 characters (27%), 68 comments had at least 100 characters (10%), 28 comments had at least 200 characters (4%), and 11 comments had at least 400 characters (1.7%). Noteworthy, all the comments with over 400 characters were written by the same student (who achieved also the highest overall score). As far as the content is concerned, the very short comments are of the type *"very good", "perfect!", "works well", "good quality", "not very complex", "it is ok", "good implementation", "code is ok", "incomplete",* which do not offer much information and usefulness to the author of the solution under review. By contrast, some students provide very specific and helpful comments, such as: *"The code has many errors, there are errors in every page. The page Formarecursiva.html has 2 body elements, while the page PermutariElemente.html does not have a closing body element. The CSS code is almost inexistent and it is very inconsistently used, in some places it is defined internally while in others it is defined inline."* It is therefore important for the teachers to strongly encourage students to provide detailed feedback to their peers, in addition to the mark for each criterion.

Finally, at the end of the semester, the students were asked to fill in an opinion survey regarding their experience with the peer evaluation process and LearnEval platform; 38 students completed this questionnaire. In what follows we report on a subset of the survey items, which are most relevant for our study. Thus, the majority of the students (81.6%) liked the idea of evaluating peers' projects, at least to a moderate degree. A similar percentage of learners (79%) also liked the idea of being evaluated by their peers, at least to a moderate degree. Most of the students were satisfied with the peer evaluation settings used in the project: number of assessment criteria (86.8%), time allotted for submitting the solutions (71.1%), time allotted for submitting the reviews (71.1%), and anonymity settings (double blind review) (81.6%). Finally, as far as usability is concerned, most LearnEval functionalities were considered easy or very easy to use by the students; overall, the platform was successfully used by the learners, although some minor issues and bugs were found.

V. Conclusion

The paper described our pilot study experience of using LearnEval peer assessment system in a PBL scenario. 41 students used the platform to evaluate peers' projects in a Multimedia Technologies in E-Learning course. An analysis of learners' activity was provided, in terms of project quality, involvement and reviewing skills, as well as subjective learning experience.

The results were generally positive, with students being engaged and satisfied with the platform. However, some of the feedback offered to the peers was short and superficial; hence, improving the quality of the peer evaluation comments is an important issue. A potential solution would be to provide the students with a more detailed description of the review criteria and examples of relevant and useful reviews. The instructor could also encourage students to give high quality feedback by further outlining the benefits of the peer assessment process at the beginning of the project activity. In addition, the teacher could make use of the back review feature provided by LearnEval to give students continuous feedback on their reviewing activity throughout the semester. Developing additional mechanisms to boost students' engagement and motivation to provide high quality reviews is a future research direction. Finally, we plan to extend the use of LearnEval platform to different courses and instructional scenarios and perform more in-depth analyses of the collected data.

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