

Online versus Face-to-Face Peer Team Reviews

Kathrin Figl, Christine Bauer, Jürgen Mangler, Renate Motschnig-Pitrik
Research Lab for Educational Technologies, University of Vienna,
Rathausstrasse 19/9, 1010 Vienna, Austria

PREPRINT VERSION

Kathrin Figl, Christine Bauer, Jürgen Mangler, & Renate Motschnig-Pitrik (2006). Online versus face-to-face peer team reviews. Proceedings of the 36th ASEE/IEEE Frontiers in Education Conference (FIE 2006). San Diego, CA, USA, 28-31 October, pp 7-12. DOI: 10.1109/FIE.2006.322469

The final authenticated version is available online at IEEE via <https://doi.org/10.1109/FIE.2006.322469>

Abstract

Peer-reviewing is gaining importance as didactic technique in computer science courses. Through reviewing their peers, students develop evaluation skills, increase their reflection ability, and develop awareness of their own work's quality. This paper presents an experimental study exploring communication and collaboration aspects of the peer-reviewing task. In particular, the study analyzes differences between the face-to-face and the online setting. Both settings were implemented and investigated with respect to communication and collaboration in and among teams as well as workload distribution. The results show that students highly appreciated many aspects of the online reviewing tool but found themselves constrained by the lack of discussion, which they experienced and valued in the face-to-face process. The paper discusses further results regarding team communication and collaboration and their implications on the specific didactical use of online and face-to-face peer-reviewing.

INTRODUCTION

Project-based teamwork and peer assessment are gaining importance as didactic techniques in computer science courses. Many studies and papers on peer assessment (e.g., [1], [2], [3], [4]) do not only elaborate that peer- and co-assessment foster fair grading but present many positive effects on both, the students' as well as the instructor's side.

Through reviewing their peers' work, students develop evaluation skills, increase their reflection ability, and develop awareness of their own work's quality. We tried to make use of these positive effects while focusing on teaming and communication aspects rather than on assessment.

THEORETICAL BACKGROUND

Peer Assessment

Peer assessment is defined as a scenario where students review artifacts as learning outcomes of other students on the basis of a set of criteria [1]. It is a form of innovative assessment, which is rather seen as a tool for learning than only as a tool for benchmarking knowledge at the end of the learning process [1]. In higher education peer assessment is widely applied both as formative as well as summative assessment.

According to [5], the term assessment refers to all activities undertaken by teachers and students that provide information

that can be used as feedback to alter subsequent teaching and learning activities. Under this definition, assessment encompasses, for instance, teacher observation, classroom discussion, and analysis of student work like assignments and tests [6]. The traditional distinction is between summative and formative assessment and is based on how assessment information is used.

Briefly put, summative assessment provides a summary judgment about the learning achieved after some period of instruction (e.g. by grading or scoring a test or paper) [6].

Formative assessment, on the other hand, is a feedback process that uses information about students' performance to close the gap between students' current learning state and the desired state via didactical actions. In other words, assessments become formative, when the information is used to adapt teaching and learning to meet students' needs [5], [6].

Peer Reviews In Software Development

In software development cycle, quality assurance plays a significant role. Usually the term "quality assurance" conjures an image of executing software to see whether it functions as intended [7].

An alternative form of quality control is to invite technically competent peers to examine your work in order to detect faults in software documents and code, and to find improvement opportunities: a peer review [8].

While traditional testing is limited to executable code, peer reviews can be applied to any software deliverable, design, or document [7]. Therefore, peer reviews have long been recognized as a powerful way to improve quality [8], [7].

Terminology

Having these considerations in mind, we favor the term peer review in our work for following reasons:

- In our course, practicing peer-reviewing as a means of quality assurance is seen as technical content rather than as a didactical technique.
- The deployment of peer reviews in the course aims to develop students' evaluation skills, which they will need in their professional lives.
- Students' peer review reports are not used for grading the reviewed work. Rather the reviewing activity is intended to foster learning for both, the reviewer and the reviewed.
- The peer reviews do not give summative judgments on students' works but give direction to the reviewed team and point to shortcomings that can be improved. The formative aspect is stressed.

Being aware that the purpose of peer reviews and peer assessments are different, we assume that the impacts on learning and teaming are similar. Therefore, we will use the term "peer review" throughout the subsequent sections.

Positive Effects of Peer-Reviewing

Studies reveal that peer reviews have many benefits on students' learning. They can, for instance, have following positive effects (cf. [2], [1]):

- Reviewing peers motivates reflection on a student's own performance and may increase the awareness of the quality of the student's own work.
- Since students know that peers will review their work, motivation is likely to rise. This situation can create an enhancing atmosphere of positive reciprocal stimulation and competition (for examples see [9], [10]).
- When reviewing their peers, students are given the opportunity to learn to know work contributed by other teams. In traditional course settings, students are often not interested in other students' contributions, as long as they get their own work right [4].
- Peer reviews help students to improve their own performances based on insights gained from their peers' comments [4], which leads to increased learning output.
- According to [9], students agree that seeing good and bad contributions fosters their learning. Furthermore, students report that they realize mistakes that they made in their own work when reviewing other students' work.

Online versus Face-to-Face Peer Reviews

Up to now, only few studies comparing traditional (pen and paper) and online peer reviews have been undertaken. These

concentrate on students' attitudes towards different modes and on effects of different modes on participation, on the number of comments, and on revision [11].

Reference [14] revealed that in face-to-face peer reviews more speech was produced and the group participated more often compared to a synchronous online version. In a study of [12], the online peer review could count more comments and revisions, but face-to-face interaction seemed to be more effective than online communication. Reference [13] found that students perceived specific types of tasks differently, e.g. commenting online was better evaluated than reading online.

Research in this field seems to consist of small puzzle pieces and it is difficult to draw general conclusions. This study aims to bring up some new insights.

RESEARCH QUESTIONS

The presented study aims at comparing face-to-face and online peer-reviewing. While most research on comparing face-to-face and online peer-reviews focuses on the amount of participation and the effects on comments and revision, this study concentrates on the analysis of collaboration aspects.

Specific research questions are: Do the online and the face-to-face version show differences in communication and discussion? How do collaboration within and among teams as well as workload distribution differ? Are there any differences in the perceived review quality and work efficiency?

STUDY

Design

During the winter term 2005/2006 students encountered a face-to-face peer review version in the beginning of the project as well as an online version in a later project phase.

For the peer reviews respectively two teams were assigned to review one another. In the face-to-face version the teams used paper review forms and printed out documents were provided for the students in class. They wrote comments about a partner team's project documents and noted shortcomings. Review results were discussed among partner teams and documents were revised accordingly. In a later project phase this peer-reviewing process was carried out online by a new combination of partner teams, using a web tool that was designed in accordance with the face-to-face version. Now the students had online access to the documents, which were made available by each team on the course platform. Figure 1 shows the peer-reviewing activities.

In both, the online and the face-to-face version the same amount of approximately six documents had to be reviewed.

The fact that teams had worked together in this course for different time periods before experiencing the face-to-face and the online peer review is negligible since this course's students already know each other very well and have already worked together in same and similar teams in other courses [15].

After students got to know both versions, differences were investigated with the use of an online questionnaire. This design

allowed for a direct comparison of the online and the face-to-face version by the students.

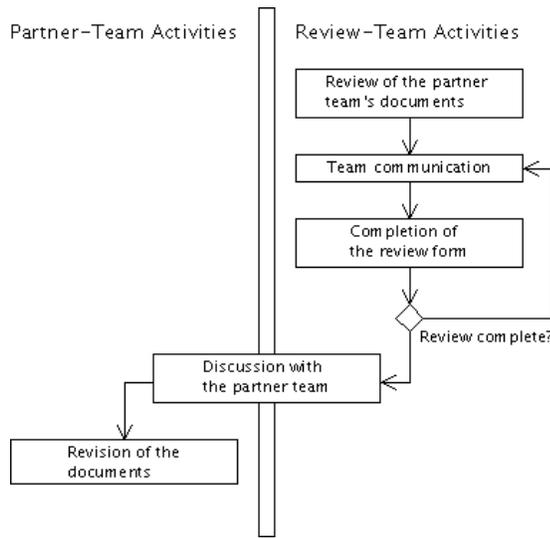


FIGURE 1
PEER-REVIEWING ACTIVITIES.

Course Description

The study was conducted in a blended learning course on "Project Management" for computer science students. This course is part of the Master program, which indicates that students had already received a Bachelor degree in computer science. In the course, students were assigned to create and plan software development projects, which they subsequently elaborated in small teams of three. Since quality assurance and

review processes were a significant part of this course's subject matter, peer-reviewing was practiced by teams.

Online-System

The review tool is loosely modeled after the Bugzilla Software [16] that has been written to track errors in software products for quality assurance in software projects. Following this approach and our desire to make the progress of all individual student projects visible to all members of the course, we created a simplified system that allows registering and managing the errors and deficiencies in a cooperative way.

When users decide to register a deficiency or to add a new comment, they see an interface as depicted in Figure 2. The form contains following input fields:

- **Date, Time – Regarding** – "Date" and "Time" can be set as well as (under the heading "Regarding") the student project where the error has been found.
- **Author** will be set automatically, as only logged-in users can add deficiencies. This field is immutable.
- **Category** is a drop down menu. Users can categorize the deficiencies according to categories defined by the administrator.
- The **Short description** of the problem that will be shown in the list.
- Name of the **Document, Chapter** and **Page** number
- **Long Description**
- **Additional Comments**

All deficiencies reported are listed as can be seen in Figure 3. The overview provides following information: the problem's category, the module (student problem) where it occurred, a link to the comments section of the problem, and a short description, which is clickable and links to a detailed description of the deficiency.

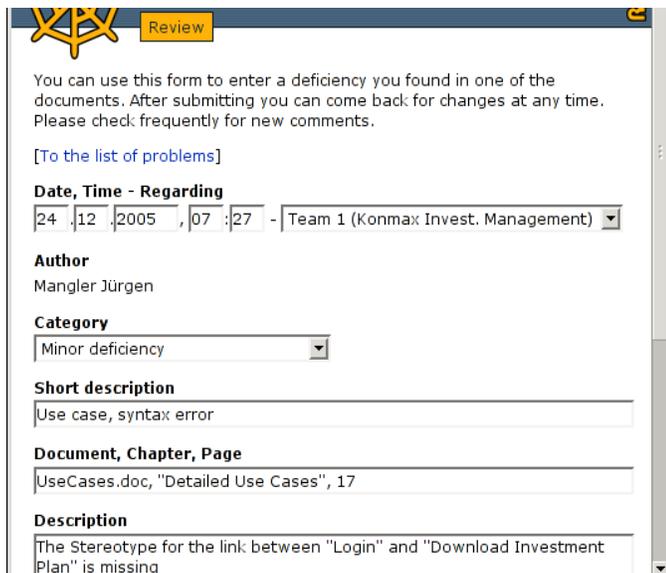


FIGURE 2
INTERFACE FOR REGISTERING DEFICIENCIES.

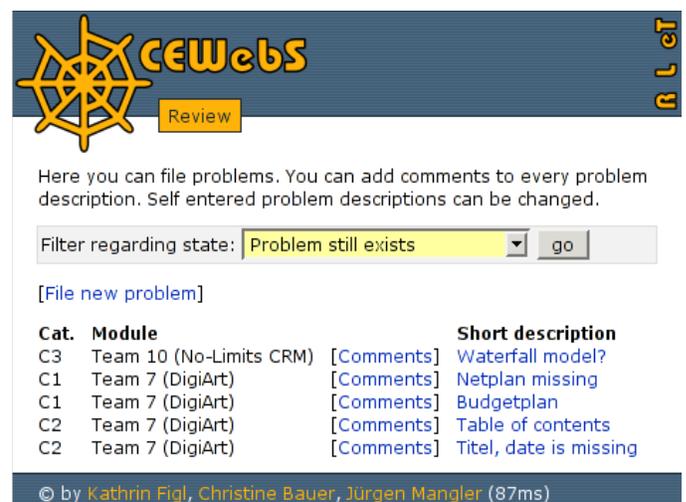


FIGURE 3
LIST OF REPORTED DEFICIENCIES.

The list is sorted by student projects and categories. The categories' ordering in the configuration affects the ordering in the output list. Since we considered structural changes as the most important problems, followed by specific errors and minor deficiencies, we offered following categories:

- **C3 – Rethink whole structure**
- **C2 – Problem that has to be corrected**
- **C1 – Minor deficiency**

An administrator can add an arbitrary number of problem states to the configuration. States in our configuration include:

- **Problem still exists.**
- **Problem has been solved.**
- **Duplicated** – the same problem already exists in the database.
- **Interesting but subjective** – since ideas are not always objective, we felt that the reviewer should have the option to set this state (whether initially or after a discussion).

The deficiencies listed can be filtered according to these problem states. The first state in the configuration is the one that is shown per default. Consequently, for our configuration in the default view all existing deficiencies are shown.

A user can edit the deficiencies he/she reported; the facilitator can change any deficiency. All new deficiencies default to Open (or in fact the first state in the configuration, meaning the error still exists), after first saving a comment, the user can also change the state (e.g. to "Duplicated").

Furthermore, this review tool includes the functionality to add comments to any problem. The comments will be shown in a flat list; every comment can make use of the simple WIKI syntax. The comment system provides means to communicate with the partner team, and close the problem after it is solved.

Face-to-Face Review Forms

For the face-to-face review, a paper review form structured in accordance with the online review form was used. Students had to fill in information on the reviewer team, the project reviewed, and the documents used. They had to give detailed descriptions of shortcomings found and to classify these in three categories of importance as explained above. Moreover an overall judgment if a further review was necessary as well as date and the reviewer team's signature had to be provided.

Questionnaire

For comparing the online and the face-to-face setting an online questionnaire was used. Students individually filled out the questionnaire during the last laboratory course unit. The questionnaire consisted of five parts: the online and presence version of the peer team review should be compared according to several activities, the workload distribution in teams, the work efficiency, and the review quality; furthermore the students should give suggestions for improvement of both versions. The majority of questions were open-ended with the

exception of five questions with a bipolar rating-scale for the preference between the two versions (cf. Figure 4).

In which version was the quality of the received feedback higher?

paper version	<input type="radio"/>	online version						
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FIGURE 4
 EXAMPLE OF QUESTIONNAIRE ITEM.

Analysis

Data was analyzed by qualitative content analysis [17] using four main categories for coding: "Preference for the online version", "preference for the face-to-face version", "indifferent", and "no coding possible". Answers were analyzed for each individual student; the team compositions were taken into account.

RESULTS

Differences in Activities

1. Review of the partner team's documents

Regarding differences in reviewing the documents, four students brought up arguments in favor of the online version, whereas four argued for the face-to-face version. Five students thought there were no differences between the two versions.

One of the arguments appreciating the online version was that particular documents could more easily be analyzed digitally in corresponding programs (e.g. MS-Project Files). For instance, students could search after key words and there was no paper chaos. On the online platform documents were sorted by milestones, and access to other teams' documents was provided for comparison. Furthermore, one student argued that the online version was better suited for teamwork.

Compared to the face-to-face version, where documents were printed out in one copy only, students appreciated that each document was available for every team member in the online version and that documents were always up-to-date on the platform. Moreover, students pointed out that there was no time limit in the online version, while in the face-to-face version a rather rigid time constraint was given due to the time slot of the course unit.

A main argument in favor of the face-to-face version was that the paper version of the documents was experienced to be more comfortable to read, because a computer display would be tiring for the eyes, too small for that kind of work and shortcomings would be recognized faster in the paper version. Furthermore, students brought up that it was easier to comment documents immediately and argued that handling paper documents was easier and faster, and that the paper version was more clearly arranged.

2. Completion of the review form

Regarding the completion of the review forms, five students preferred the online version due to the fact that they found it more easily and more comfortable to fill out and liked the

guided structure of the form. Furthermore, in the online version, there was unlimited place for describing shortcomings and an unlimited number of remarks possible. Other points raised were that the online version was regarded as faster because of touch-typing and since there was no difficulty of decoding handwriting. One student, however, judged the paper version to be faster, because of no "clicking through forms".

3. Team communication

Seven students out of three teams judged the face-to-face version to be more suited for discussion and communication, while five students out of three other teams thought communication was the same. They explained that face-to-face it would be "easier to discuss everything and to write comments together" and better, because it was more "direct" and more consultation took place within the team.

Two students of the same team reported that in the online version no discussion took place at all, others mentioned communication via email, voice over IP, or instant messaging.

4. Discussion with the partner team

Eight students out of three teams thought the face-to-face version was better suited for the discussion with the partner team about the review. Students mentioned that there was no possibility for discussing online and that discussion did not take place online. Other students wrote that online discussion had been limited to inserting comments and that a communication system like voice over IP or instant messaging should be included in the peer-reviewing tool. In the face-to face version, on the other hand, students found that a positive exchange of opinions had taken place and all shortcomings could have been discussed.

5. Revision of the documents

Concerning the revision of documents according to review results, most students gave a description on how they did it and explained that they overworked their documents. However, they were not responsive to the question on differences between the online and the face-to-face version.

On total, ten students reported that they overworked their documents according to the reviews, both in the face-to-face and the online version. Three students did not perceive any difference between the two versions and two students wrote that it worked out better face-to-face due to the fact that, in the online version, it was more difficult to ask the partner team when it was hard to understand what the noted shortcomings mean and how to exactly improve the documents.

Students' preferences are summarized in Table 1. The category "indifferent/the same" includes students who brought up arguments in favor of both review versions as well as students who did not perceive any differences.

Workload Distribution in Teams

Students described how they distributed work in their teams and what parts they did together. Four out of the 16 students meant that workload distribution was about the same in both versions. Slightly more students reported that, in both versions, each team

member read all documents instead of splitting them into parts and just reading a part. In accordance with the answers concerning the differences in activities, far more students mentioned that they discussed and agreed upon what to write in the review forms.

One rather noticeable difference could be identified in the answers: Whereas students filled out the review form together in the face-to-face version, in the online version it occurred more often that an individual student filled it out on the team's behalf.

TABLE 1
 DIFFERENCE IN ONLINE AND PRESENCE ACTIVITIES

Points	Online Version better	Indifferent/ The same	F-2-F Version better	No Coding possible	n
1. Review of the partner team's documents	4	5	4	3	16
2. Completion of the review form	5	5	0	5	15
3. Team communication	0	5	7	4	16
4. Discussion with the partner team	1	3	8	4	16
5. Revision of the documents	0	3	2	9	14

Work Efficiency and Review Quality

For determining whether students rated the online or the paper version better in the specific dimensions on the rating scale items, one-sample t-tests (n=16) with the reference value of 3.5 were calculated. Exact means, standard deviations, t-values, degrees of freedom, and probabilities can be found in Table 2. The value "1" stands for the paper version, value "6" for the online version.

According to the t-tests (detailed values are provided in Table 2), students found it (at the .05 level) significantly easier to express hints in the paper version. Analysis also shows a trend that it was easier to give helpful feedback in the paper version. Furthermore, the results indicate a slight trend for the paper version to take more time and for the online version to be filled out more easily.

Regarding the quality of feedback the online and the paper-version were judged equally, as can also be seen in Figure 5, showing all results.

TABLE 2
 RESULTS OF ONE-SAMPLE T-TESTS

	mean	sd	t	df	p
easier to fill out	4.19	1.47	1.87	15	0.08
takes more time to fill out	2.75	1.69	-1.77	15	0.10
higher quality of feedback	3.38	1.41	-0.36	15	0.73
easier to give helpful feedback	2.81	1.33	-2.07	15	0.06
easier to express hints	2.63	1.63	-2.15	15	0.05

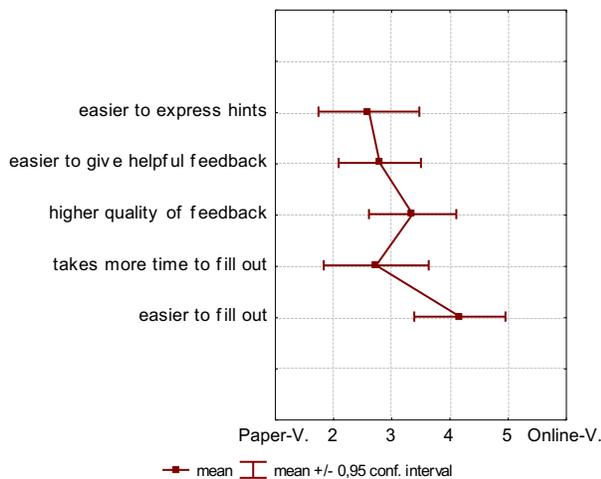


FIGURE 5
STUDENTS RATINGS OF ONLINE AND PAPER REVIEWS.

Furthermore, students gave explanations why they valued the face-to-face or online setting. Regarding the quality of reviews and the possibility to express hints, those students who were in favor of the face-to-face version, mentioned the possibility for direct communication with the partner team after reviewing as a main reason. Those students favoring the online version mentioned again that there was no time constraint and that the documents could be better analyzed in digital form (e.g. different views in project plans). Concerning the expenditure of time and the difficulty to fill out the forms, students raised similar arguments as in the activities section.

Suggestions for Improvement

The students gave seven suggestions for improving the face-to-face version of the peer review. Regarding the feedback forms they would rather prefer a questionnaire – similar to a checklist – that is more structured than the version used but still offers the possibility for comments. One student stated that printed out documents should be sorted chronologically, and another student proposed to have more time for the task.

For the online version 16 suggestions were provided. Ten students mentioned that the possibility of deleting an entry should be enabled in the online review form. Two students recommended to improve the structure in order that it is more clearly arranged (e.g. dividing feedback into different sections for each team). Three students indicated that they would like to have better possibilities to contact and communicate with the partner team. For both versions, one student mentioned that he would like to have a stronger focus on positive feedback rather than on shortcomings.

CONCLUSION

In this experimental study exploring communication and collaboration aspects of the peer-reviewing task, differences of activities in the face-to-face and online setting were analyzed.

The first research question addressed differences in team communication. Main results were that students preferred the face-to-face version for communication within their teams and with partner teams. There was less discussion with partner teams in the online version. This could be the reason why students found it significantly more difficult to express hints in the online version. For the completion of the review form, students preferred the online version. This finding is confirmed in both qualitative and quantitative analysis, indicating that filling out the online version was easier. Concerning the reviewing activity students' answers were inhomogeneous. While some preferred reading documents on paper, others appreciated the advantages of having the documents in digital form (e.g. search for keywords).

Results on collaboration and workload distribution reveal that in the face-to-face setting, students elaborated the reviews in teamwork while they worked individually on subtasks when reviewing online. Interestingly, the teams filled out the review forms in teamwork in the face-to-face version, while in the online version one student filled it out on the teams' behalf.

The third research question addressed the perceived review quality and work efficiency. While both scenarios were valued equally concerning the reviews' quality, results show differences in the work efficiency how this quality was achieved. Students perceived it as easier to give helpful feedback in the paper version although they experienced it as more time-consuming. On the other hand, students valued the online version for being easy to be filled out. Moreover, they appreciated that documents could be better analyzed digitally. For both the reviewing and the reviewed teams the possibility for direct communication during and after reviewing is a major argument favoring the face-to-face version.

Based on our findings three scenarios blending online and face-to-face activities seem appropriate:

- Online version enriched with synchronous communication tools (e.g. instant messaging, chat, voice over IP)
- Online version followed up by a face-to-face discussion with the partner team
- Computer-based face-to-face review (Teams work on the reviews in a face-to-face setting. But instead of using a paper version, they use the online tool on their PCs.)

Enhancing the online version with communication possibilities allows tapping the full potential of the online version and benefiting from rich discussions among teams. This research is an ongoing effort. Future research may investigate in depth the appropriateness of these scenarios.

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