

INVESTIGATIONS ON THE USE OF STUDENT PEER REVIEW TO IMPROVE SUPERVISION OF CAPSTONE COURSES IN THE CIVIL ENGINEERING EDUCATION

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ABSTRACT

This paper investigates the use of peer-review as a supervising tool for students writing assignments for the capstone courses in their civil engineering education. The participants in the peer-reviews included a combination of bachelor and master students.

The reason for trying peer-review as a supervising tool was to activate the students' potential for learning through participating as both presenters and opponents in the peer-review process itself and to improve their work as an outcome. A potential for rationalisation of the supervisors' workload, was considered a possible secondary gaining. Experiences show that students run into many of the same obstacles and ask corresponding questions regarding their thesis. Through the peer-review process, the supervisors were able to advise everyone simultaneously, and everybody could gain from participating the discussions. The students participating in the peer reviews were separated into two different groups based on the topic of their assignments. This ensured relevant discussions and avoided students spending an unnecessary amount of time. The peer reviews were divided by category based on the report template. The results indicate that execution of well-directed peer review processes amongst the students might offer advantages that are not available through a "teacher" or other superior alone. These extra advantages are explained through several learning mechanisms. The students were found to be openminded towards participating in this "new" process, and to having high expectations for the outcome. After repeatedly participating eight sessions, their overall perception of outcome even outperformed their expectations.

Keywords: Student peer review, supervising, civil engineering education, survey, capstone courses

1 INTRODUCTION

Peer review is a well-known tool for research, acting both as quality control system for editors and even more important, as propulsion for progress and quality enhancement in research. It is thus an imperative part of any researchers' career development. One reason for the success of this tool, might be its democratic nature; feedback from persons at level presumably equal to one's own is easier to handle than coming from superiors. Additionally, switching between the roles as author and peer and thus between receiving and giving advices on improvement of written work, is probably the best education achievable on both roles.

The idea of introducing the peer review tool to students in their ordinary educational programme, is not new. However, nor is it commonly integrated as an obvious part of the engineering education. The initiative presented in this paper, is a structured approach to introducing peer review to students' efforts on their capstone courses both at bachelor and master levels, and on systematic measuring of the students' perceived gaining. All students participating, had their capstone course topics given from industrial panel partners within the RD&I-cooperation MEERC, initiated between the governmental road-building client organisation Nye Veier, and the University of Agder.

Like for researchers, the students included in these efforts were expected to gain through multiple mechanisms. This is easily supported by formerly published research. According to Topping [1], peer reviews can improve the effectiveness and quality of learning. The use of peer review was found to improve the students' oral presentation performance and presentation skills. Mulder et al. [2] concluded with three findings in their study about peer review in higher education. The first one was that students had high expectations prior to engaging in peer reviews, but the perceived value of the process was not

equally high. This was mainly due to contradictory feedback and variation in the quality of feedback from their peers. Secondly, the students learned most from the aspect of the process, hence the understanding of how learning takes place through peer review. Students indicated that giving feedback to others made them better at reviewing their own work. The third finding was an increase in the student's opinion about the competence of their peers and their ability to provide good feedback. The quality of the written work after the peer reviews was improved, both because of the feedback from other peers but also because the students were better at self-reflection.

Gielen et al. [3] identified from a literature review seven advantages from the peer review process, that teacher feedback lacks. Peer feedback can pressure the students to perform well because of the potential embarrassment from peers. This makes the students spend more time on their work, again increasing the quality of their work regardless of the outcome of their feedback. Students also understand the feedback given by peers better than from teachers because students "speak the same language," while teachers might have a more complex understanding of a subject. Peer feedback is quicker and improves the student's ability to understand feedback. The frequency of feedback can also increase with the use of peer feedback, and it is usually more individual feedback instead of teachers who give more general feedback. The last advantage is the student's honesty. Students tend to hide their weaknesses from their teachers, whereas they are more willing to show their difficulties to their peers.

This paper presents and discusses the perceived outcome from eight sequential peer review sessions organised throughout the capstone courses for 33 students mixed from the BSc and MSc level.

2 CASE STUDY

To identify the learning outcomes and other dividends from engaging in peer review, the supervision of 25 bachelors and 8 master students is used as a case study. To limit the time spent for the individual student, they were distributed into two parallel sessions. All students participating in each session, worked with related topics. Consequently, all had potential to contribute both on the formal requirements like methodology and the thematic works of all others.

Eight peer review sessions were sequentially arranged during the semester, each focusing on successive chapters from the assignment thesis template. The template followed a traditional IMRAD-like structure. One adjustment was emphasizing "theoretical background" as a separate section, comprising results from the execution of a limited literature review. A survey was executed amongst the students after each peer review. The students were asked to answer questions regarding preparation, implementation, interpretation of feedback and their total benefit from each peer review. Every survey also had a free-text option where the students could provide feedback. The different topics for each peer review session can be seen in Table 1. By following the structure of the thesis template, the students were guided towards a steady progress on their final thesis.

Most of the students pursued their thesis in teams of 2-4 individuals, however some was also working alone. For simplicity, they are all referred to as "groups" below, whether having one or multiple members. Each group had to prepare a presentation prior to the peer review session, and to present it orally to the plenary. All students were requested to actively take part in the presentation. Each group also had the role as prepared opponent to one presentation given during each session. A simple yet compulsory template was supplied for the presentation, to support all presentations to be at relatively equal level. Prior to the oral presentation, the completed template was forwarded to the group of appointed opponents. By allowing the opponents to prepare, the expectation was that opponents could formulate better and more detailed feedback. But the process and expectations were meant to also create mental stress, encouraging all students to be generally well prepared for and actively participating each peer review session. The combination of opponents towards presenters were designed carefully so that all should meet new reviewers at each sequential peer review, intending to avoid the creation of alliances. Each group was given 10 minutes to present their work and 5 minutes for the organised feedback. Following the prepared opposition, a plenary discussion opened for all to give feedback. To support and develop the process, there was a small closing session to each presentation, where the supervisors also had the chance to comment both on the presentation and on a meta perspective to the process itself. This was meant primarily to help developing the students' perception of the peer review process, and thus the supervisors acted mostly as moderators to the process. To support the learning outcome from accessing the peer review process, all students were requested to participate all presentations within their session.

3 METHOD

This paper is based on the feedback from eight surveys, distributed directly after each sequential peer review session. The scope of the surveys was to identify students' perceived dividends generated from engaging in peer reviews. The students were asked to give score on a scale of five levels on the perceived outcome ("very poorly" to "very useful"), on questions regarding preparation, implementation, feedback from both fellow students and supervisors, and the total benefit from participating each peer review session. Every survey also had a free-text comment option where the students could write feedback to the organisers (supervisors). There were four supervisors present at every peer review. The surveys were distributed through the learning management platform Canvas and were available for two weeks from the day they had the peer review. The survey regarding the first peer review (number 0) stands out, as it included questions regarding the student's pre-expectations, while all other surveys (peer review numbers 1 through 7) were identical.

4 RESULTS & DISCUSSION

The schedule and topic for each peer review session were chosen in a tactical way by the supervisors and can be seen in Table 1. This guided the students towards a steady progress on their final thesis and gave a hint on where they ought to be in the process.

Table 1. Information about the peer reviews and response rate from the surveys

Peer review number	Date	Subject	Response rate
0	16-Jan-18	Thesis and preliminary schedule	57,6 %
1	23-Jan-18	Introduction and research question	66,7 %
2	6-Feb-18	Research question and project schedule	72,7 %
3	20-Feb-18	Method	81,8 %
4	6-Mar-18	Theory	69,7 %
5	10-Apr-18	Results	48,5 %
6	24-Apr-18	Discussion	27,3 %
7	8-May-18	Conclusion and report structure	18,2 %

The results from the survey regarding peer review number 0 shows that 63% had high or very high expectations when asked about the anticipated dividends from engaging in the peer reviews. Based on an assumption that few students had even heard about the concept peer review prior to the presentation given initially in the semester, this relatively high score is taken as a proof of the students being positive and open towards trying this new "tool". The positive attitude demonstrated through the relatively high score is in accordance with the findings of Mulder et al. [2]. Whether the students in Mulder et al.'s investigation had better knowledge about the peer review tool prior to participation than ours, remains unknown. Mulder et al. experienced that the students' outcome after participation was perceived lower than the expectations. The share of our students scoring high on perceived outcome ("useful" or "very useful") was even higher than the share having high pre-expectations, for seven of the eight sequential peer review sessions. Consequently, the perceived outcome after participation was inclining compared to the pre-expectation, in contradiction to the declining experience found by Mulder et al. Mulder et al. mainly explains the decrease in perceived outcome to be the result of "contradictory feedback and variation in the quality of feedback". Without having detailed knowledge on Mulder et al.'s requirements to the students, it is not possible to conclude on the explanation for the more positive outcome in our students' perception. However, we generally received positive comments on the requirements that guided our presentations. Being strictly guided on the topics and level of details for each presentation was perceived positive amongst the students. This might also have higher quality on the opposition, therefore. 95% had high or very high dividends at this sequentially first session, from presenting their thesis for their peers. 74% found the feedback useful.

Figure 1 shows the results from the questions where the students had to score their own preparation and evaluate their performance. From the upper figure the results indicate that the students felt relatively well prepared with 75% or more of the students stating they were somewhat or well prepared for all the peer reviews except for peer review number 5. This session was about the results from their work. All

groups might not have clarified their results at the time of the peer review, explaining the dip in preparedness. The figure below indicates that 65% of the students felt good or very good about their ability to present their work in seven of the eight sessions. There is a certain element of obvious causality in the correlation between high degree of preparedness and high score on mastering. However, it is nice to support this causality with quantification, and it is certainly in accordance with Topping’s conclusion that peer reviews can improve the effectiveness and quality of learning and that the use of peer review was found to improve the students’ oral presentation performance and presentation skills [1].

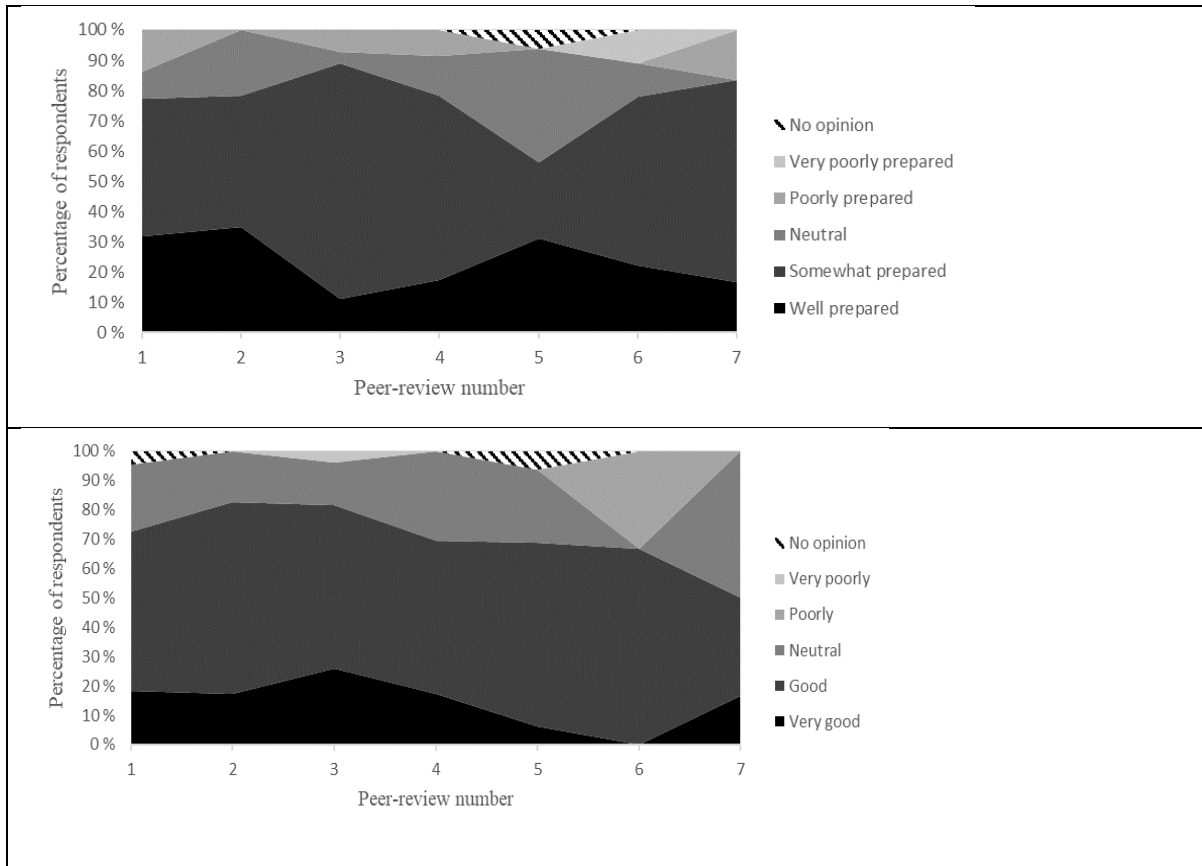


Figure 1. Upper: "How well prepared were you prior to the peer review?". Lower: "How well were you able to present your work?"

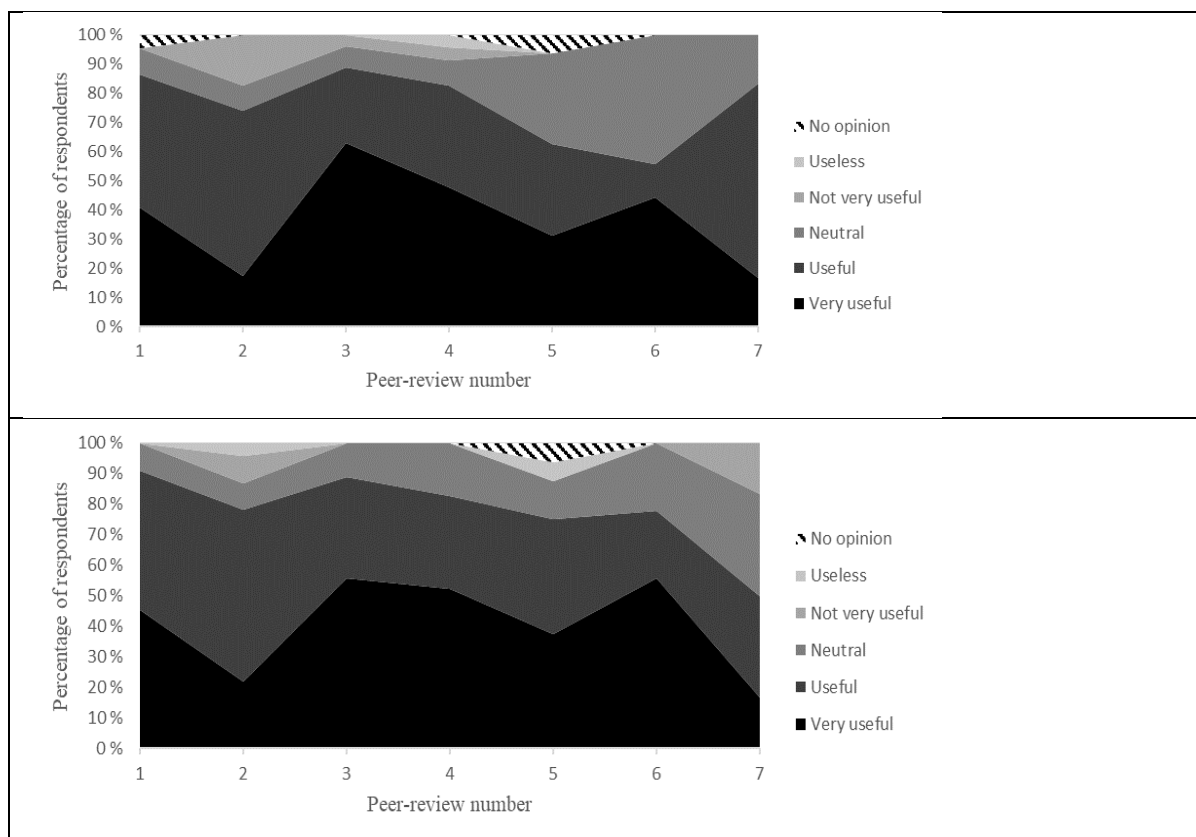


Figure 2. Upper: "How useful did you find the feedback?". Lower: "Overall impression. How useful did you find the peer review?"

Figure 2 upper part shows the students' perception of the usefulness of the feedback they received for each specific topic, while the lower part states the overall perception of the process so far. There seems to be high level of correlation between those. This might be caused by the students not clearly separating between the two. More interesting is the result that peer review session number three, focusing on method, where the students are less prepared, is the one perceived as giving the most useful outcome. This might be explained by this being the part where students struggle the most. Hence, the feeling of not mastering the topic also give the feeling of shortcoming. This is supported by comments given by the students, that they were unsure about the scope and requirements of the method section. Even if the students felt little prepared, they might have gained from struggling with planning how to present the topic they mastered weakly. Experiencing then support from the plenary during the presentation (caused by the common feeling of shortcoming), might trigger the perception of positive outcome. This is well in correspondence with Gielen et al. [3], who found that peer feedback can pressure the students to perform well because of the potential embarrassment from peers. This makes the students spend more time on their work, again increasing the quality of their work regardless of the outcome of their feedback. Additionally, this was also the topic where the students had most to gain from involving in and learning from the plenary discussion. Again, this corresponds well to Gielen et al. [3], who found an advantage in the student's honesty; Students tend to hide their weaknesses from their teachers, whereas they are more willing to show their difficulties to their peers. And that students understand the feedback given by peers better than from teachers because students "speak the same language," while teachers might have a more complex understanding of a subject.

By using peer review as a supervising tool, the students did not only get feedback from their supervisors but also from their peers. The students were trained in oral presentation and to formulate their work to others. Since the students must have an oral presentation as a final exam of their thesis, this gave them a rehearsal in presenting and prepared them for their final exam. Opposing their peers improved the student's ability to be critical and to provide feedback. These findings corresponds well with Mulder et al. [2], who found that student's work after the peer reviews was improved, both because of the feedback from other peers but also because the students were better at self-reflection.

There were some aspects of the peer reviews the students did not find productive, which may explain the variation in satisfaction. The written comments from the students indicated that the time spent on presentations and feedback varied too much and that the supervisors could be better at keeping to the schedule. Some students also meant that they could have been separated into even smaller groups so that the time spent on giving feedback would be reduced. Findings from Gielen et al. [3] also indicate that students found it as a “waste of time” and boring, and 53-87% did not want to use peer feedback in future assignments. The pronounced decline in perceived outcome from our last peer review session (no 7) might be an indication of “waste of time”. This was shortly before submission deadline, and the students were stressed upon the deadline. Only a few students participated, and the perceived outcome was low – possibly caused or at least strengthened by the low number of participants. Though Gielen et al. [3] found that the frequency of feedback can be increased through the use of peer review, there is clearly a limit; Eight peer review sessions during one semester, the last one shortly before submission date, might have been just one too many.

5 CONCLUSIONS

- Despite having little knowledge about the peer review process prior to the introduction given initially in this project, the students had high expectations to the outcome of participation. The perceived outcome after execution was even higher, for seven of the eight sequential peer review sessions. The positive experience is partly explained by the strict direction requested for the process, securing preparedness and a levelled standard on both presentations and feedback.
- The students report to be least prepared for the topic they master the least. However, this is also the topic where they report to gain the most from participating the peer review process. It is indicated that though they feel little prepared, this might foremost be caused by the feeling of lack of mastering. The gaining from participation might both be due to struggling with the difficult topics and participating a well-directed discussion amongst a peer of equally levelled participants.
- Overall, the students scored the peer review process high. It is concluded that peer review is a valuable tool for students, offering advantageous feedback and processes additional to what a “teacher” (or other superior) can offer. Major factors explaining this, might be that students more easily reveals their weaknesses to equally levelled students than to superiors, and gain from discussions in “their own language”, strengthened by the strict formal requirements and directions given for the process. Thus, students seem to embrace the same qualities of the peers, as researchers do.

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