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VARIOUS FORMS OF EXECUTING PEER REVIEWS IN CIVIL ENGINEERING EDUCATION

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ABSTRACT
This paper investigates the students' perceived outcomes of different types of peer review. The purpose is to evaluate the students' learning outcomes through surveys after attending the various peer review sessions. The motivation for using peer reviews for the engineering students is to engage the students as presenters and opponents. This could improve the students' ability to be critical of their work and to give and receive feedback. The three different peer review concepts investigated in this paper are i) supervised peer review with one or more university employees, ii) unsupervised peer review where the students will execute the session on their own, and iii) written peer review where the students will be organised in pairs with another group and only give and receive written feedback.
The results from the surveys can identify the learning outcomes and other dividends from the different ways of using peer review as a part of the supervising on the academic work. The findings could help improve the ways of supervising students in their academic work, and also whether the different ways of executing the peer reviews differ much in the students' learning outcomes.

Keywords: Peer review, civil engineering, survey, supervision

1 INTRODUCTION
There is evidence that peer review could have significant benefits for both students and university staff members in higher education. Mulder et al. [1] concluded that facilitating student peer review could help university staff members to provide more detailed and timed feedback to students. This was especially true in large classes, which is a common occurrence in higher education. A further finding was that participating in student peer review helps students to gain a deeper understanding of course material and assessment requirements. However, students often doubt the credibility of their peer's feedback. Zacharias' [2] findings were that students value the feedback from teachers high, and are insecure about the feedback from peers. Not only do the students doubt the credibility of the feedback provided by their peers, but according to Cheng et al. [3], the students also lack confidence in their abilities to critique the work of others. One of the conclusions of Mulder et al. [1] was that implementing peer review in higher education could help students develop important skills of self-assessment.
This paper will be a continuation of the paper from *the International Conference on Engineering and Product Design Education* in 2020: "Investigations on the use of student peer review to improve supervision of capstone courses in the civil engineering education" [4]. This paper concluded that the students had high expectations of the outcome of participating in peer reviews, but that the perceived outcome was even higher. It was also found that peer review is a valuable tool for students. However, the research had supervised peer review with four university employees present at all the sessions. Even though this resulted in a more efficient way of supervising many bachelor and master's students at the same time, the students in [4] had the same supervisors and were working on the same research project. Therefore, the purpose of this paper is to invite all the students writing their bachelor and master's thesis in civil engineering and only have the persons responsible for the courses present at the peer reviews. Thus, this will result in more work for the university staff. By investigating the students' feedback on three different ways of conducting peer review we hope to answer the following key question:

- How do students evaluate different executions of peer reviews, and how useful do they rate the feedback?

2 CASES

The students participating in this investigation on peer reviews are in their final semester in the bachelor programme or master's programme in civil and structural engineering at the University of Agder in Norway. The capstone course for the bachelor programme is 20 ECTS and 30 ECTS for the master's programme. The semester started 5th January 2022 and the students have until May 2022 to finish their projects. The bachelor students are writing in groups consisting of 3-4 students, while the master's students can write alone or in groups of 2-3 students. An overview of the total number of students writing their bachelor and master's thesis is given in Table 1. Most students chose a project in cooperation with the local industry, meaning that the students have one supervisor from the industry and one supervisor from the university. The projects result in a thesis following an IMRaD (Introduction, Methods, Results and Discussion) template and an oral defence. Both the bachelor and master's students use the same template.

At the beginning of the semester the students had a start-up workshop where general information about writing a thesis was given, and an explanation of the template. The scheme of the peer review was given during this workshop, where the students had to sign up for all three peer reviews on the workshop held at the beginning of the semester. A total of 22 bachelor students and 9 master's students signed up to participate in the peer review sessions (Table 1). The peer reviews covered topics from different chapters from the template. The students have experience with using the template in previous courses. They have also had supervised peer review previously in their study and know the purpose and process of peer reviews. Hence, the students received these peer reviews as additional guidance on their academic work.

Table 1. Overview of participants in the study

Study programme	Total number of students registered	Participating in peer review
BSc	54	22
MSc	41	9

2.1 Execution of peer review

The three different peer review concepts are i) supervised peer review with one or more university employees, ii) unsupervised peer review where the students will execute the session on their own, and iii) written peer review where the students will be organized in pairs with another group and only give and receive written feedback. The first peer review topic was the *research question and project plan*, the second peer review was about *methods*, and the last peer review concerned their *theoretical background*. The bachelor and master's students had separate peer review sessions.

Overview of presenters and opponents was given to the students 2-3 days ahead of the peer reviews along with information about the sessions. The students were contacted via e-mail 2-3 days before the peer review. The following information was given:

- Contact information to the participants
- Schedule with presenters and opponents including the title of their thesis
- The topic of the peer review
- Purpose of the peer review
- Expectations and guidelines for the presenters and opponents

2.2 Supervised peer review

The feedback in the supervised peer review was given orally by the opponent, peers, and lecturer. Even though the university had opened after the pandemic, we considered it more including for everyone to conduct it digitally using *Zoom*. The opponents received the presentations before the session to prepare feedback in advance.

All participants were present throughout the session. The presenters had 15 minutes to present their research questions and progress plan. The opponent started giving feedback, followed by feedback from other peers and the lecturer.

The topic of the supervised peer review was the research question and the progress plan for their projects. The research question and the progress plan must be approved at the beginning of February. This is a requirement for examination [5, 6].

2.3 Unsupervised peer review

Unsupervised peer review was also conducted using Zoom. The lecturers started the session but left after the introduction. The unsupervised peer review was conducted in the same way supervised peer review but without lecturers present. The topic of the unsupervised peer review was methods. According to National Guidelines for engineering studies [7], the students should be able to use relevant methods for research and development work. Hence, this topic was chosen for the unsupervised peer review.

2.4 Written peer review

The students sent their work to their other peers by e-mail. This was limited to three pages to reduce the workload. The opponents had one week to give written feedback before sending it to the lecturers for final feedback. Written feedback was given as comments in the Word or pdf document. The total timeline of the written peer review was two weeks.

The topic for the written peer review was the theoretical background. A scientific theory section should be included in a thesis [7] and the students should be able to anchor their work in research [5].

3 METHODS

Students were asked to answer one survey after each peer review session. After the supervised peer review sessions, a joint survey was sent to the bachelor and master's students. This contained five multiple-choice questions and one free-text comment option. This was distributed on the 25th January and was available for the students until the next peer review sessions on the 8th February. The second survey was distributed on the 8th February after the unsupervised peer review sessions and contained 8 questions where one was a free-text comment option. To be able to see the difference between the bachelor and master's students two identical surveys were sent: one for the bachelor students and one for the master's students. The same was done after the written peer review. This final survey consisted of a total of 11 multiple choice questions and one free-text comment option. These surveys were distributed 10th March and closed on the 14th March and had one activation. If the students answered that they did not participate in the written peer review an extra question would appear asking why they did not participate. All surveys were distributed by E-mail and made with SurveyXact.

The students were asked to evaluate on a scale of 1 to 5 where 1 meant very poorly, unsatisfied, useless and 5 meant well, very satisfied, and very useful, on questions concerning their preparations, presentation of their work, feedback, and overall satisfaction. The five multiple-choice questions from the first survey were identical to the next surveys. These were analysed by calculating an average and the standard deviation. The standard deviation was calculated to show the variation in the students' opinions.

4 RESULTS AND DISCUSSION

An overview of the surveys is shown in Table 2 below, containing information about education degree, distribution date, number of questions and response rate. The first survey was sent to both bachelor and master's students. Regarding unsupervised peer review and written peer review, we decided to send different surveys. Consequently, we could see if there is any difference between the students with different educational degrees.

Table 2. Data about the surveys

	Education degree	Date	No. of questions	Response rate
Supervised peer review	BSc and MSc	25-Jan-22	6	68%
Unsupervised peer review	BSc	8-Feb-22	8	64%
	MSc	8-Feb-22	8	67%
Written peer review	BSc	10-Mar-22	12	45%
	MSc	10-Mar-22	12	56%

Students rate their preparedness as relatively high. In response to "How well prepared were you for the peer review?", the bachelor students rated their preparedness consequently higher than the master's students on all three peer reviews (Table 3). It is worth mentioning the standard deviation on the written peer review for the master's students. This is owed to severe differences in answers; with two students rating 1 very poorly prepared and two students rating 5 well prepared. A possible explanation for these

results could be in line with Gielen et al. [8] observed advantages from the peer review session. Firstly, when participating in peer reviews the students would spend more time on their work, which can improve the quality of the work. Secondly, the risk of embarrassment from peers could also pressure the students to perform better. Furthermore, when the students were asked how much time they spent on preparing the three pages for the written peer review, the bachelor students would spend more time than the master's students. Interestingly though, the bachelor students would spend less time giving feedback to others than the master's students.

Table 3. Average results from the surveys with standard deviation in parenthesis

	Supervised peer review	Unsupervised peer review		Written peer review	
	BSc & MSc	BSc	MSc	BSc	MSc
How well prepared were you for the peer review?	3.81 (0.60)	3.86 (1.17)	3.50 (0.84)	3.89 (0.78)	3.00 (2.31)
How well did you present your work?	4.19 (0.60)	3.29 (1.20)	4.17 (0.75)	4.00 (1.00)	3.67 (1.15)
How useful was the feedback from peers?	4.00 (1.00)	2.36 (0.84)	4.00 (0.00)	2.78 (1.09)	4.00 (1.00)
How useful was the feedback from the university staff?	4.76 (0.44)	-	-	4.89 (0.33)	4.33 (1.15)
How satisfied are you with the peer review?	4.24 (0.54)	2.64 (1.22)	4.00 (0.63)	3.67 (0.71)	4.00 (1.15)

It is apparent from Table 3 that the students found the feedback from the university staff more useful than the feedback from peers. These results are consistent with data obtained in "Teacher and student attitudes toward teacher feedback" [2]. Students often tend to blindly trust the feedback from the teachers and assume that it is the correct way of solving a problem.

The most striking result to emerge from Table 3 is the low scores from the bachelor students on unsupervised peer review. This discrepancy could be attributed to the lack of confidence in their ability to critique the work of their peers in line with the findings of Cheng et al. [3]. The students approached the authors after the unsupervised peer review with several questions they wanted to be answered. The same thing happened to Zacharias [2]; when the students were told to comment on each other's work they would often ask the teacher to verify if the comments were true. In the free-text comment option, one student wrote: 'I think it would work better with the university staff members present who knows the formalities of the thesis. A lot of my peers threw out opinions which sometimes turned out to be wrong. This confuses us and makes us insecure on how to execute our work correctly.' This was further corroborated by another student: 'It was hard to know if the feedback from our peers was good. It was a lot of assumptions from my peers which is difficult to relate to. However, an all-right peer review.' These results are consistent with those of Mulder et al. [1] findings which showed that one-third of the interviewed students worried that they did not have adequate experience and they were also concerned that their reviewers were not experienced enough. The master's students, however, seemed to find all the different peer reviews useful and were also satisfied with the unsupervised peer review. This could confirm the insecurities of the bachelor students and prove that master's students are more self-driven and independent in their work.

However, the scores from the supervised peer review are rated quite high on all five questions, including the feedback from peers. In the free-text comment option, there are no comments about the lack of competence in their peer. One of the comments was: 'Peer review gives good guidance in your task, and a lot of the discussions regard all of us. There is probably a correlation between participation, preparedness, and results. I would like to see more students participate in the peer reviews.' It seems to us that having university staff members present could remove some of the insecurity in feedback.

According to Van Berg et al. [9], one role of the teacher in the peer review process is to facilitate an arena where the students feel safe in assessing the work of their fellow students. This, in turn, could explain the differences between the supervised and unsupervised peer review sessions.

5 CONCLUSIONS

This paper investigated the students' feedback on three different ways of conducting peer review, and sought to answer the question:

- How do students evaluate different executions of peer reviews, and how useful do they rate the feedback?

The students evaluated the supervised peer review as very useful. However, the score from the unsupervised peer review varied between the bachelor students and the master's students. The master's students rated this equally to the supervised peer review, while the bachelor students had trouble conducting this peer review. They had doubts regarding their peers' feedback and needed validation afterwards from the teachers. Furthermore, the students rated the feedback given by university members as very useful which could indicate that they trust this feedback more than their peers' feedback. On the other hand, it seems like the educational degree plays a role in the evaluation scores. The master's students seem to find all the three different conduction of peer review useful, managed to give constructive feedback to their peers and were also satisfied with the peer reviews.

Although the current study is based on a small sample of participants, the findings suggest that the bachelor students could need a closer follow-up from the university staff, because of the lack of trust in their peer's feedback. Overall, the students rated the conduction of the peer reviews as useful but came with strong recommendations in the surveys that supervisors or teachers should be present at all peer reviews to avoid confusion and mixed feedback.

6 FURTHER RESEARCH

Further research should be carried out to establish if the written peer review would improve if the feedback also was explained orally. Van Berg et al. [9] investigated the use of written and oral feedback in higher education, finding that to obtain the most complete feedback a combination of both feedback types is essential, where the written feedback can be orally explained and discussed. Another aspect would also be to research the students' experiences and learning outcomes when giving feedback and reviewing others' work. Gaynor studied the quality of written peer feedback, the importance of assessments and student perceptions [10], concluding that the students perceive reviewing and giving feedback to their fellow students as more useful than receiving feedback on their work, as well as believing that it improved their understanding of the assignment.

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