Student Perceptions of Value of Peer and Instructor Feedback in Capstone Design Review Meetings

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Many capstone design courses have recently incorporated some form of peer feedback in review meetings and presentations. In one instance, the course instructor and students participate in informal, design review meetings, taking turns asking questions and providing feedback. We investigated student perceptions of the effectiveness of instructor and peer feedback in helping achieve both the course learning outcomes and the students' own design project objectives. Students participated in two formats of the review meeting: one in which the instructor alone was in attendance and providing feedback (instructor-only review) and one in which both the instructor and another team of students attended and provided feedback (mixed review). Survey results indicate that the instructor's feedback was perceived as being slightly more helpful than the feedback received in the mixed review format in helping students address learning outcomes related to requirements, safety, and project management, as well as in helping them achieve their design objectives. Nevertheless, a majority of students expressed that, if they had to choose only one meeting format, the mixed review format was overall more helpful as it combined feedback from both the instructor and their peers. Implications for the sequencing of the different types of meetings are discussed.

Keywords: peer feedback, instructor feedback, student perceptions

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Introduction

Design reviews in capstone design courses serve the purpose of allowing instructors and other stakeholders to evaluate student design progress, often at important milestones. More recently, implementations in which student peers are invited to attend and provide feedback at design review meetings have also been reported. In this paper we follow up on one such reported instance and focus on student perceptions of the value of feedback provided by peers and the course instructor with regards to meeting course learning and project objectives.

Background

Formal design reviews in capstone design courses are a common summative evaluation tool that takes the form of an oral examination, usually at the end of the project as a whole or at the conclusion of important milestones. In the traditional format, design reviews are attended by the team whose progress is being reviewed, as well as the course instructor, the team's faculty advisor, and external evaluation committee members such as industry experts and representatives of the client company (if applicable).

In addition to summative feedback, capstone design teams benefit from regular formative feedback throughout the design process. The education literature defines formative feedback as "*information communicated to the learner that is intended to modify his or her thinking or behavior for the purpose of improved learning*" (p.154)[1]. We have previously reported on a management engineering capstone design program that implemented a form of regular biweekly design review meetings - termed progress update meetings - as a venue through which teams could report on their progress and receive *formative* feedback in a context that was less formal than typical summative design reviews[2,3].

The broader education literature has long lauded the value of peer feedback and peer review to student learning[4]. In engineering education in particular, there have been multiple reported instances of incorporating some form of peer review in capstone design courses[5,6], though seldom in design review meetings. Based on previous findings that supported the significant benefits of peer review in addition to instructor review, beginning in 2013, progress update meetings in our management engineering capstone design courses began incorporating a significant peer review component [2,3]. These meetings were formatted in such a way that allowed a team's progress to be reviewed by both the instructor (and sometimes the faculty advisor) and one additional team. Broad surveying of students revealed that overall students found the format helpful, with the addition of peer review supporting supplementary goals

such as improving project communication, and inter-team collaboration and sharing of ideas[3]. One disadvantage of those surveys, however, was that surveyed students had only experienced the mixed review format of progress update meetings (i.e., the simultaneous review from both the instructor and their peers). In the mixed review format, the instructor would normally provide their questions and comments only after the students had had a chance to do the same. Therefore, surveyed students had not experienced the instructor-only review format, in which the meeting time was devoted to the instructor's review, making a fair comparison between formats difficult. In this paper we report on a capstone design course offering that was designed in such a way to allow a more systematic comparison of instructor-only and mixed reviews in progress update meetings.

Method

The management engineering capstone design program is composed of a series of two courses that students take in their final year. The investigation was conducted in the Spring 2015 offering of the first capstone design course of this series. The course's learning outcomes are formulating a design problem; developing a list of design requirements/specifications; generating and evaluating feasible solutions; addressing safety, regulatory, sustainability, and ethics requirements; developing a feasible design project plan and managing risks; communicating the design project accurately and effectively; and working effectively in teams.

The class of fifty-five students formed fourteen teams, all but one composed of four members. Each team participated in three biweekly progress update meetings. One meeting was of the instructor-only review format, whereas the other two incorporated instructor as well as peer review (i.e., mixed review format). At the beginning of each mixed-review meeting, students were familiarized with the peer-review format and encouraged to ask questions and provide feedback to their peers throughout the meeting. They were not, however, given specific areas on which to focus their review. For six of the teams, their first meeting was of the instructor-only review type, with the second and third meetings being in the mixed review format. For the remaining eight teams, the first and third meetings were in the mixed review format, whereas the second meeting only utilized instructor review. The reason for this schedule design was two-fold. First, it allowed all teams to experience both formats, in order to more fairly compare peer and instructor review. Second, it minimized order effects that might arise from the sequence in which the two formats were experienced by the students. The schedule design and the reasoning behind it were discussed with the students at the beginning of the term, as well as with the university's research ethics office to ensure compliance.

At the completion of the second progress update meeting, but before the third, students were invited to complete an anonymous survey. At a high level, the objective of the survey was to gauge student perceptions of the quality and relevance of feedback provided by their peers and the instructor. One important conceptual issue that had to be addressed was with respect to the intended aim of the feedback students receive in progress update meetings. From the point of view of the instructor, good feedback helped students meet the learning outcomes of the course. On the other hand, students may have viewed good feedback as primarily relevant to them meeting their own objectives to deliver a successful design at the end. Therefore, in the survey, these two goals were decoupled. The first section of the survey focused on the former, asking students to rate the helpfulness of each meeting format in achieving each of the seven *course* learning outcomes, using a three-point scale (not helpful, somewhat helpful, and very helpful). In two open-ended follow-up questions students were asked to comment on aspects of each meeting format that were helpful or unhelpful in achieving learning outcomes. The second section of the survey mirrored the first, only this time students were asked to rate and comment on the helpfulness of each meeting format in achieving the design project objectives that the *team* had articulated as part of their design project plan. In the third and final section of the survey students were asked about which format they preferred overall and why.

The survey was completed by 47 students (85.5% participation rate), which was due to a generous award of 1% bonus to the final course mark of each student that completed the survey. To maintain confidentiality, the survey was managed in such a way that while the instructor had access to the anonymized responses (well after the completion of the course), the awarding of bonus points was done through a course assistant.

Results

Part 1: Achieving course learning outcomes

Figure 1 summarizes student feedback on the extent to which each meeting format helped students achieve course learning outcomes. We note that while both formats were perceived to have contributed to the achievement of learning outcomes to a good degree, some differences also emerged. In particular, students reported that the instructor-only review was more effective than the mixed-review in helping them come up with the design requirements and specifications, including requirements stemming from safety, regulatory, sustainability, and ethical considerations, as well as in helping them better manage their project. On the other hand, the mixed-review format was more

effective in helping them come up with or improve on their design concepts.

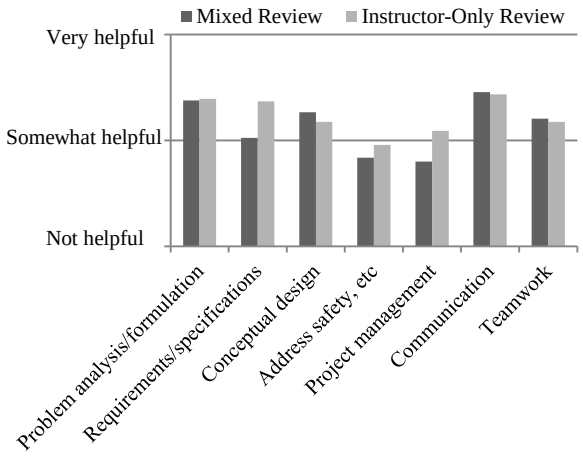

Figure 1: Perceived effectiveness of each meeting format in achieving course learning outcomes

The answers to the open ended questions provided further detail. Students expressed that having their peers attend and critique their presentation helped them improve how they communicated their project. Presenting to a new audience in every meeting helped them identify what aspects of their presentation audiences found confusing:

"Peer-review was a great way of getting a brand new perspective on our project. It was also a big helping in understanding where people would get confused in our introduction of the problem."

In addition, students appreciated listening to their peers' feedback and also observing the challenges and successes of other teams:

"Most peers have a background in the area that our project is on therefore it's interesting to hear if they think we've overlooked an aspect of the problem. Also incredibly interesting to see how their project is progressing and how they're tackling problems in their own group."

In contrast, the instructor's feedback main benefit lay in its directness and relatability to course content and deliverables:

"Helpful was extent of attention and level of feedback that could be generated individually. Also helpful compared to peer review is a professor's better understanding of a design project, its objectives, related course content and its applicability."

Overall, there was general agreement among respondents that the best schedule of progress update meetings was that experienced by Stream A, whose first meeting was with the instructor alone, before moving to the mixed review format in the second meeting. The reasoning provided was that the instructor's review was helpful in orienting the students to the general format of progress update meetings, as well as helping them improve on an initial iteration of their presentation, problem analysis and requirements specification and the overall project scope. In the subsequent meeting, the added feedback of peers helped with the refinement of the problem and the identification of alternative design solutions:

"It was good that we did the peer-review when we had investigated potential solutions... that was useful"

Part 2: Achieving team design objectives

Figure 1 summarizes student feedback on the extent to which each meeting format helped teams achieve their own design project objectives.

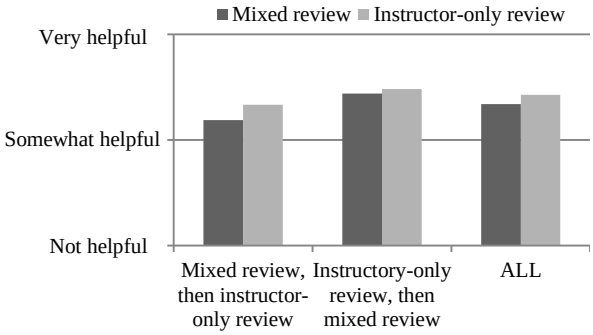

Figure 2: Perceived effectiveness of each meeting format in achieving team project objectives

Overall, both formats were found to be helpful to some extent. Teams that experienced the mixed review format before the instructor-only format reported that they found the instructor-only review more helpful than the mixed review; this result is in line with results from the first section of the survey, reinforcing the finding that students drew the most benefit out of both formats when the instructor-only meeting was scheduled before the mixed review meeting.

It is important to note that student responses to the open ended questions in this section of the survey revealed that they may have misunderstood the intention of the question. Our belief was that they would distinguish between the instructor's goals with regards to achieving learning outcomes and their own goals with regards to achieving a successful design. Unfortunately, asking about the later in terms of "design project objectives" was likely not very clear or effective.

Part 3: Format preference

Figure 3 summarizes student responses to the question of which meeting format they preferred. In the previous sections it was observed that overall, students perceived that the instructor-only review format was (marginally) more effective in helping them achieve the course learning outcomes and their own design project

objectives. That sentiment was reiterated by about 30% of respondents in their answers to the open-ended question in this section of the survey:

"[Instructor-only meetings provide] more direct feedback, more relevant feedback (after all, the "marking" would be done by the instructor), and less time spent explaining the company/background to additional teams."

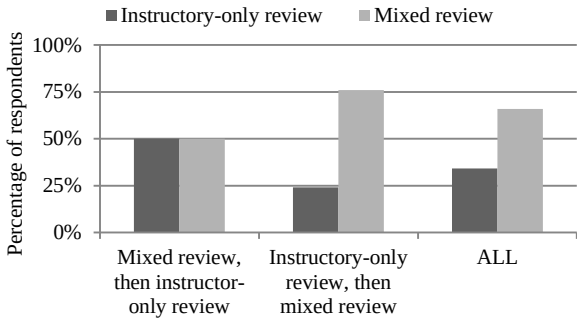

Figure 3: Student's format preference

Overall, however, it appears that if they had to choose just one format, a majority of students would prefer the mixed review one:

"Peer-review combined both the instructor's feedback, along with the students. It is very important to have other students give their perspective on our idea as potential users of the system, but it is also very important for the instructor to inform us if our idea can be successfully achieved."

While the question format forced students to choose one of the two meeting types, in their comments a few elaborated that they actually liked both formats, and that they appreciated being exposed to both:

"Although I voted for one, I preferred the mix."

Conclusions and future work

In this preliminary study we obtained student perceptions on helpfulness of feedback provided by instructor-only formats and mixed review formats. It was useful to view the students' perceptions of helpfulness with the dual perspective of achieving their own design project objectives, as well as the intended course learning outcomes.

Preliminary results suggest that the instructor-only review format was perceived as being slightly more helpful than the mixed review format in addressing the learning outcomes related to requirements and specifications, safety, and project management. A possible explanation for this is that the instructor is generally more expert and experienced in these areas than students. Similarly, students also perceived that the instructor's review was more helpful in the achievement of their design project objectives. Yet, overall students expressed a strong preference for the mixed-review format, as a 'best of both worlds' option.

This paper has summarized the preliminary results of a multi-stage project that is investigating the implications of peer review in capstone design courses. characterization and comparison of the feedback provided by peers and instructors. A separate publication[7] summarizes our initial efforts in defining a theoretical framework for that characterization, with future work to focus on the application of the framework on archived records of actual peer and instructor feedback.

It may be useful in determining whether an optimized structure for review types and frequency during the conduct of a design project course could be defined based on student perceptions and course experience. At least according to our survey results, while a typical review meeting should be in the mixed-review format, there is a strong indication that the effectiveness of subsequent mixed review meetings is enhanced when 'primed' by an introductory meeting in the instructor-only format.

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