Student Evaluation of Capstone Advisors

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Abstract

Many universities employ their standard teaching evaluation survey tool to obtain feedback on capstone team advisors, despite the many reasons that the teaching survey tool is ill-suited for that task. Expectations of advisors vary significantly from program to program, but rarely do the advising tasks match those of a teaching role. Improving this feedback loop for advisors, with a tool appropriate for the advisor expectations, is an important part of ensuring that all capstone students have a high-quality experience. This paper describes a project in which one engineering college standardized advisor expectations and developed and implemented a new advisor evaluation survey. Results of this student survey were analyzed using AI, providing advisor-level feedback as well as insight to college administrators for overall areas for improvement.

Introduction

Teaching evaluations are a very standard part of monitoring the efficacy of university instructors and provide instructors with valuable feedback for improving their own performance and the experience of students.[1] The instruments to evaluate standard academic courses, however well designed and validated they may be for that task, do not typically serve well to evaluate how the advisors of senior design (capstone) project teams perform their duties. Yet the same course evaluation instrument is often applied to capstone project advisors by default, since capstone is typically listed and registered as an academic course.

The idea of the modern capstone project largely emerged in the 1980's, rapidly accelerating in adoption through the end of the millennium and reaching a current day estimated saturation of around 75% of US engineering programs.[2] The research basis surrounding capstone projects has similarly accelerated in recent decades, as pedagogical scholars worked to understand best practices in this emerging space. One can find a number of publications covering the administration of capstone courses, managing team dynamics, even effective team advising, but very little on appropriate methods of or instruments for evaluating the advisor. Given the range of expectations for such advisors at different schools, this may not be surprising. But closing this feedback loop for advisors is an important part of ensuring that all capstone students have a high-quality experience.

This paper describes a project in which one engineering college set out to create this feedback loop for capstone advisors. This college, one of five colleges in a small private undergraduate

institution in Ohio, runs a capstone program in which all faculty are expected to advise one or two projects (some multidisciplinary). The college comprises six majors in three departments. Mechanical engineering (ME) is a single-major department; civil engineering (CE) and engineering education (EngEd) are administered by the Civil and Environmental Engineering Department; electrical engineering (EE), computer engineering (CpE), and computer science (CS) are combined in the ECCS Department.

The authors, along with an ad hoc committee within the college, first internally codified a list of expectations of capstone advisors in the college, and compared these with published expectations from a variety of university programs. Employing these resources, a capstone advisor feedback tool was developed which was tailored to the expectations of our program. Results of this feedback are discussed.

Standard Course Evaluation Tools

Capstone represents a very important part of engineering education, especially given the current emphasis on industry readiness in graduates,[3] and it is thus important to do well. This role is very different than traditional teaching. The advisor is not delivering specific technical content; the advisor is often not even a technical expert in the project topic. The advisor's chief role is to guide students as they follow the design process. It is more like mentoring or coaching[4] than instructing. Yet until recently, the university's standard course evaluation tool was the only instrument used for capstone advisor feedback. And our school is not alone in using a standard course evaluation tool for capstone.[5]

Some questions on a typical course survey tool are appropriate. For example, the following statements accompanied by a five-point agree/disagree Likert scale:

- Learning outcomes were clearly explained at outset of course.
- Instructor provided timely feedback on work submitted.

Others, by contrast, seem ill-suited for evaluating the performance of a capstone advisor:

- Instructor was well-prepared for class.
- Instructor demonstrated expertise and knowledge of the subject matter.
- Instructor's overall teaching of the course was effective.

In addition, because all of our ME/EE/CpE/CS students enroll in a common capstone course, the student feedback from this course evaluation is all combined and routed to the capstone coordinator. The questions graded by Likert scale reflect only the composite sentiment of all students in all projects with all advisors. Even on the open comment portions, it is impossible to know which advisor that a student is praising or cursing unless the student identifies him or her.

The capstone course was only unified college-wide in 2015. Before this time, each advisor had his/her own section of the capstone course. This could have provided some level of direct feedback to the proper advisor, but these capstone courses were entirely excluded from the course survey process due to low enrollment and the consequent likelihood that student feedback could be tied to a particular student.

Advisor Expectations

The expectations of advisors – labeled in some programs as "mentors" or "coaches" – vary significantly from program to program. Faculty in some universities have the advising responsibility for many different teams; others may only advise one or two teams. Some programs assign advising roles only to faculty with design expertise or experience; in other programs the advising role is expected of all engineering and computer science faculty. Some advisors are expected to spend multiple hours each week meeting with a project team and providing technical guidance;[6] others may only be expected to occasionally meet with the group to monitor and evaluate progress.[7]

For context, then, this is a two-semester capstone in the senior year for all students in the college. Most teams have 4-5 students, though one or two large projects may have up to 8 students. Some projects will contain students from more than one discipline (roughly 1/3 this year). Projects come from a variety of sources: 25-50% from external sponsors, with the remainder from external design challenges or competitions, student ideas, faculty projects, or other entities on campus. Each team works on a unique project.

Advising one or two capstone projects is a standard expectation of all faculty in the college. An advisor's chief responsibility is to ensure that the appropriate design process is being followed. The project may have some connection to the advisor's technical field, but it often does not. In the latter cases, teams must solicit technical expertise from other faculty in the college.

Some projects have more than one advisor, for two reasons. First-year faculty are often paired with a veteran advisor to learn the advising process. Multidisciplinary teams may (but do not always) have an advisor from each represented department.

This capstone advisor evaluation project was piloted by the ME and ECCS (EE/CpE/CS) departments, with the goal to expand it to the whole college. As a first step in generating an evaluation survey for students to provide feedback on their capstone advisors, a list of advisor expectations (responsibilities) was created. An ad hoc Capstone Committee from ME and ECCS department faculty handled this task. That list of responsibilities is shown in Appendix A.

Capstone advisor responsibilities are found in literature for a wide range of engineering programs. For instance, California State University at Chico,[7] East Carolina University,[8] Ohio State University Multidisciplinary Capstone,[6] Bucknell University,[9] and Brigham Young University.[4] The degree of overlap in these lists is high.

Evaluation of Capstone Advisors

Some authors have noted difficulties inherent in evaluating capstone advisors. One paper aiming to describe a functional taxonomy for capstone teaching/advising declines to "evaluate effectiveness or identify best practices for capstone teaching" because of its complex and context-dependent nature. "[A] best practice effective in one context may be disastrous in another."[10] Thus rather than attempting to create a tool evaluating generalized characteristics of a "good advisor," our survey simply asks the students how well the advisor met the expectations for the position.

As noted in the introduction, the authors could find few references to evaluation methods for capstone advisors at other schools. One university has looked to the open comment section of its senior exit survey for indication of capstone-related issues.[11] They have no questions, however, specifically asking about capstone advising. The same university, as part of a two-year study aiming to improve their capstone advising practice, gave students a survey before and after (the following year) a number of changes were implemented.[7] The five questions on that survey were as follows, evaluated on a five-point Likert scale:

- I have a clear understanding of the role of a senior project faculty advisor.
- I have generally been pleased with the support provided by the faculty advisor of our project.
- The faculty advisor was clearly interested in our project and did whatever he/she could to help ensure its success.
- With a few exceptions, we met weekly or at least every other week with our faculty advisor.
- The faculty advisor contributed greatly to the success of our project.

New Evaluation Survey Tool

The evaluation survey for this paper is shown in Appendix B. This was first administered at the end of the 2023-24 academic year. Because the survey results for each faculty member come from a small number of students, the results so far have been directed to department chairs, not to individual faculty members. The general nature of the capstone team feedback can be communicated through the chairs to faculty in their annual review meetings.

Key questions from this survey are listed below. Students evaluated these statements using a five-point Likert scale. Following these questions, students were given the opportunity for open comment on the strengths of their capstone advisor as well as areas for improvement.

Your capstone advisor(s)…

1. Attended a weekly status review meeting with your team.
2. Held your team accountable to following the design process appropriate for your project? ("Agile" for CS projects, "Frame-Ideate-Create-Analyze-Communicate" for others.)
3. Encouraged professional and regular communication with your client.
4. Regularly encouraged consistent team progress toward project completion.
5. Reviewed team purchase requests and documentation before approving purchases. (Leave blank if your team made no purchases.)
6. Approved appropriate purchase requests in a timely manner. (Leave blank if your team made no purchases.)
7. Encouraged professional and positive relationships among team members.
8. Provided timely review of and feedback on assignments.
9. Assisted the team and client in defining and maintaining a realistic project scope.

Results

Seventy-nine (79) of the 84 ME and ECCS capstone students surveyed (94%) responded to the poll. Results for all nineteen faculty from the Likert-scale questions are shown in Figure 1. Overall, the results communicate that advisors are performing their responsibilities well. Advisors appear to be dutiful in attending weekly capstone meetings. There is some room for improvement, however, in the rest of the categories. Some advisors were apparently negligent in reviewing team purchase requests and providing timely feedback on reports and other graded work (9% disagree or strongly disagree with the "timely" assertion, 8% neither agree nor disagree). Encouraging regular and professional communication with the project client (16% N/D/SD), and helping the team define and maintain a realistic project scope (15% N/D/SD) could also be improved.

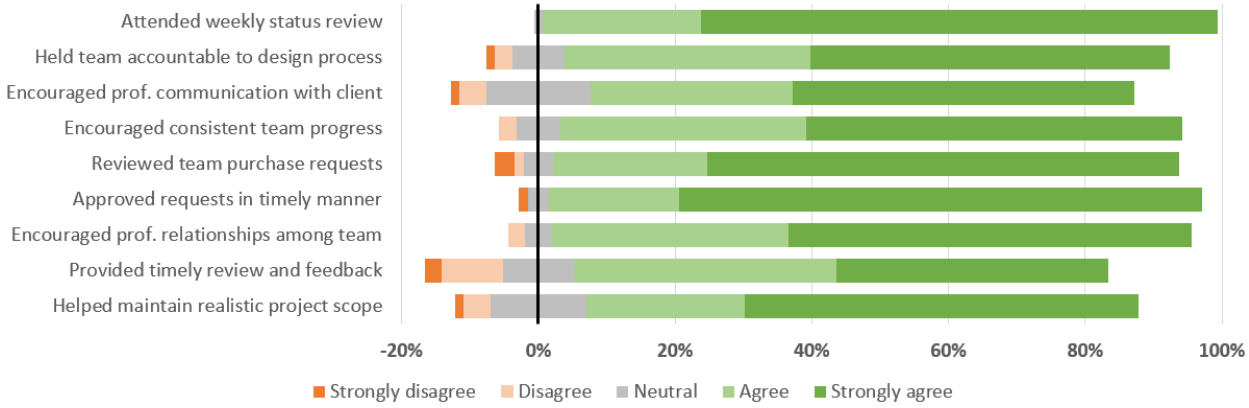

Figure 1. Cumulative responses to capstone advisor survey (N=79)

Figures 2 and 3 below show Likert responses for two separate faculty, F02 and F08. F02 reliably attends the weekly meetings, promptly approves purchase requests, and does well encouraging professional and positive relationships among team members. The results show room for improvement on all the rest of the metrics, however, showing the chair or capstone coordinator an opportunity for providing specific help in these areas. F08 did well overall, but should be encouraged to improve his or her timeliness in reviewing team submissions.

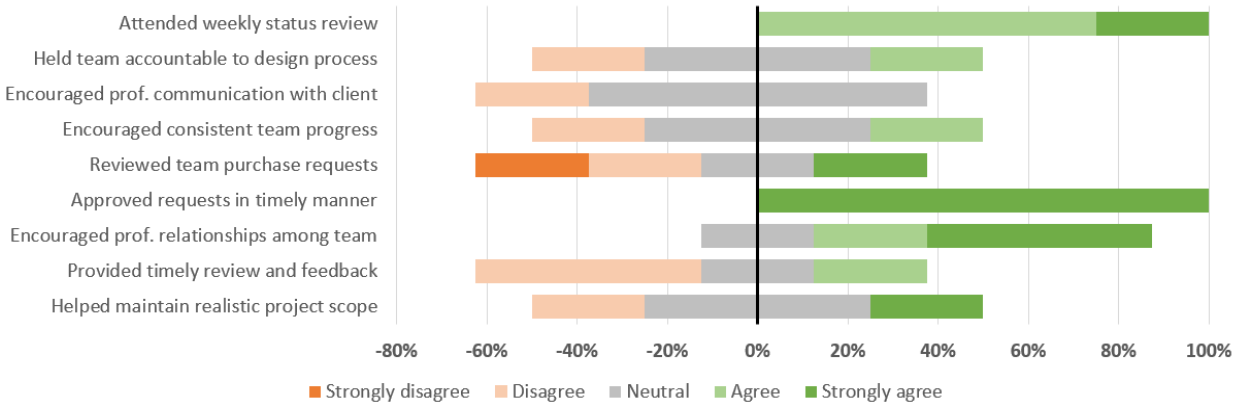

Figure 2. Capstone advisor survey results for F02

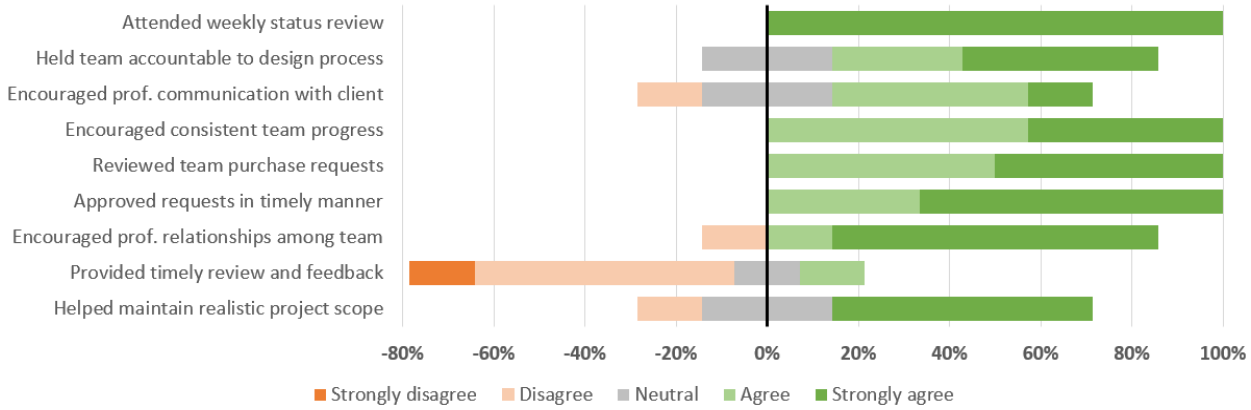

Figure 3. Capstone advisor survey results for F08

Answers to the free response questions on advisor strengths and areas for improvement were submitted to ChatGPT for analysis and summary. The data was first anonymized by replacing student and faculty names with a random-ordered research ID, changing gendered pronouns to "they," and redacting identifying comments that could not otherwise be removed.

The prompt given to ChatGPT was as follows: "Assume the role of an experienced higher education administrator. You are reviewing student feedback, provided about their faculty advisor supervising their senior design project. You are given a table containing three columns. That data table is attached. The first column lists the faculty advisors using an anonymous identification code. The second column lists student feedback on the advisor strengths. The third column lists student feedback on the advisor areas for improvement. Summarize the data

provided in the table, providing me with the following: 1) A short summary of the feedback for each advisor. 2) A short summary of the overall feedback, considering all advisors in aggregate 3) A list of faculty members who may require additional follow up from their supervisor and a summary of why that follow up is needed."

A sample of the ChatGPT output is shown below for the qualitative "summary of feedback for each advisor." These ChatGPT summaries were compared with the actual student responses and found to be generally on target.

- **F02**
  Strengths: Supportive, attended meetings, and proactive.
  Areas for Improvement: Better communication and holding the team accountable.
- **F03**
  Strengths: Accessible, provided useful feedback.
  Areas for Improvement: Could check in more regularly with the team.
- **F06**
  Strengths: Managed team issues well and offered strong student autonomy.
  Areas for Improvement: No major areas identified; positive overall feedback.
- **F07**
  Strengths: Understanding and flexible with student needs.
  Areas for Improvement: Could have had higher expectations and pushed students harder.

The overall qualitative feedback summary was as follows:

> In general, students appreciated their advisors' subject-matter expertise, accessibility, and support throughout the capstone projects. Strengths included timely assistance with technical issues and strong interpersonal relationships. However, across many advisors, the most common areas for improvement related to timely feedback, stronger enforcement of deadlines, and holding students accountable to ensure team success.

ChatGPT identified the following list of advisors requiring follow-up:

- **F01**: Needs improvement in timely grading and keeping students on schedule.
- **F02**: Requires better communication and team accountability measures.
- **F08**: Delayed feedback was a concern, especially over an extended period.
- **F11**: Feedback on reports was not timely, which affected the project flow.
- **F15**: Issues with making last-minute changes and communication difficulties.
- **F17**: Lacked guidance on project design, which is a critical advisory role.

Any discussion on the student evaluation of teaching should include a qualifying disclaimer acknowledging the limitations of such evaluation.[12,13] Various biases can significantly skew results, including instructor gender, race, and even perceived attractiveness. Students also tend to rate instructors in elective or "easier" courses more favorably, as well as instructors in courses

in which students are expecting a higher grade. Also often questioned is whether the evaluations truly measure teaching effectiveness vs. students' own satisfaction or the instructor's personality.

No evaluation tool can completely alleviate these concerns. A number of these survey questions, however, can be answered fairly objectively, such as the Likert-scale response to "Your capstone advisor attended a weekly status review meeting with your team." Bias could certainly affect the answer to that very straightforward question for one or more students on a team, but probably would not sway everyone's response.

This survey tool is also used only for the capstone course, which would tend to provide a normative effect, as opposed to a tool given for a range of "easier" and "harder" courses. On the other hand, some capstone projects are easier than others, and some advisors will tend to grade more leniently than others. Regardless of the survey's validity, administrators must always be careful when assigning weight to the results. But there is definitely value in feedback, both for advisors and for the whole capstone program. One already-cited college witnessed a remarkable improvement in both student and faculty satisfaction with its capstone program after soliciting and responding to student critique.[7]

Conclusion

Because the standard course evaluation tool is poorly matched to the responsibilities of capstone advisors, a different instrument should be used for that purpose. The survey proposed here asks the students to compare their advisor's performance with each of the advisor responsibilities, then provides them the opportunity to give general comments on advisor strengths and areas for improvement. Though the sample size is small for each advisor, the results can still be used to help advisors better meet their teams' needs. The cumulative results can be used by the capstone coordinator to identify areas where additional training for college faculty may be helpful.

One downside of the current implementation is that advisors only receive feedback once a year, at the end of each capstone project. The survey could also be offered at the end of fall semester; but there is some concern that this may sour the team-advisor relationship for advisors receiving a poor evaluation, potentially affecting team performance and grades in spring term.

The BYU study notes the importance of providing training and regular feedback for capstone advisors, whom they term "coaches." "Coaches desire and need feedback on their coaching performance *during* the experience in order to more effectively coach their team."[4] Their team/coach interaction is provided by a faculty member in the Organizational Behavior area. Though it may not always be prudent to provide midterm feedback results to advisors, regular short training sessions may help raise the performance level of all advisors.

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Appendix A

Capstone Advisor Responsibilities

The advisor is *not* responsible for project success. But attention to his or her role of monitoring student progress, encouraging an attitude of urgency for the project, and holding students accountable to deadlines and deliverables can significantly increase a team's likelihood of success.

- Attend and advise students in weekly status-review meetings.
- Hold the student team accountable for their responsibilities, including:
    - Following the design process appropriate for the project.
        - CS projects: "Agile" process.
        - Other projects: ENGR 1041/1051 design process.
    - Weekly email reports.
    - Communication with the client (professional, sufficiently regular).
    - Consistent progress toward project completion.
    - Application of engineering and/or computer science principles.
    - Team documentation.
- Review team purchase requests and budget documentation, and approve appropriate expenses.
- Encourage professional, functional, positive relationships among team members.
- Timely review and feedback on assignments.
- Assisting the team in defining a realistic project scope.
    - Helping prevent "scope creep" (in either direction) as necessary
- Participate in Project Review Boards for other teams.

Appendix B

Capstone Advisor Survey Spring 2024

This survey was implemented in Qualtrics. The question format was modified here for efficiency of space.

1. Who is your capstone advisor? [Dropdown menu]
2. Do you have a second capstone advisor? Yes / No
3. Who is your second capstone advisor? [Dropdown menu]

Questions 4-12 were evaluated on a 5-point Likert scale:
Strongly agree, agree, neutral, disagree, strongly disagree.

Your capstone advisor(s)…

4. Attended a weekly status review meeting with your team.
5. Held your team accountable to following the design process appropriate for your project? ("Agile" for CS projects, "Frame-Ideate-Create-Analyze-Communicate" for others.)
6. Encouraged professional and regular communication with your client.
7. Regularly encouraged consistent team progress toward project completion.
8. Reviewed team purchase requests and documentation before approving purchases. (Leave blank if your team made no purchases.)
9. Approved appropriate purchase requests in a timely manner. (Leave blank if your team made no purchases.)
10. Encouraged professional and positive relationships among team members.
11. Provided timely review of and feedback on assignments.
12. Assisted the team and client in defining and maintaining a realistic project scope.

Questions 13 and 14 offered a text box for free response.

13. What were the strengths of your capstone advisor?

14. In what areas do you see room for improvement in the advising role?