AC 2012-4574: STUDENT PERCEPTION OF THE EFFECTIVENESS OF FACULTY MENTORING ON CAPSTONE PROJECTS

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Students Perception of the Effectiveness of Faculty Mentoring on Capstone Projects

Introduction

Most construction engineering and management (CEM) related undergraduate programs require senior level students to complete a comprehensive capstone experience prior to graduation. Such experiences are usually structured in a manner that requires student teams to design construction operations for realistic projects. Often, the goal is for teams to mirror standard industry practices during the development of bid-level cost estimates, project schedules, etc. and thereby provide students the opportunity to demonstrate and integrate the myriad of skills and knowledge learned over the course of the undergraduate curriculum.

To facilitate learning and improve student performance faculty mentoring of the capstone projects is often used. Faculty members frequently have actual industry experience that allows them to effectively guide students through the complex process of operational planning and design. As a result, students gain insight into actual industry practices.

Faculty mentoring of capstone projects is used extensively within the construction management program at the University of North Carolina at Charlotte (UNC Charlotte). This paper describes the overall structure of the capstone course and projects, outlines the role and expectations for faculty mentors, and provides an assessment of the impact and effectiveness of the faculty mentoring on student performance and project outcomes. Capstone students were surveyed at the completion of the course and asked to rate the effectiveness of their faculty mentor. An analysis of the results appears to indicate a correlation between the quality of the faculty mentoring received and student satisfaction and performance on the final project. Based on the feedback received, it appears that effective faculty mentoring is a worthwhile and key component in improving student learning and performance on capstone projects.

Capstone Course Structure

The CM capstone course at UNC Charlotte is a one semester, two credit hour course taken during the student's last semester before graduation. At the start of the semester, students form self-selected teams of three students each, select a construction project of interest, and identify a faculty mentor for their team. The types of projects can be chosen from any sector of the industry and are usually found through the search of Internet plan rooms and other online resources. Teams must be able to obtain a complete set of the contract documents for the project and selected projects must have sufficient scope and complexity to require at least 360 man hours of work per team over the course of the semester. Both the course instructor and the faculty mentor aid the team in scoping the proposed project.

Once the project has been identified, the team is required to prepare and submit a formal written proposal for their project. The proposal includes a detailed description of the construction project, outlines the proposed team structure with each individual's primary responsibilities or role (i.e. estimator, scheduler, etc.), outlines the semester's proposed deliverables, and provides a work breakdown structure and schedule of the semester's activities. Both the course instructor and faculty mentor must approve the proposal before the team can commence work on the capstone project. Minimum project deliverables include:

- Completed contractor bid package
- Construction methods and means analysis
- Cost estimate
- CPM schedule
- Risk assessment report
- Preliminary safety plan
- Permitting and regulatory requirements evaluation

End-of-semester project results are disseminated through a comprehensive technical written report describing the methodologies and results of their operational analysis, a 30-minute oral presentation to the collective CM faculty, and the presentation of a poster at the annual college-wide Senior Design Expo which is open to the general public. To help keep teams on-track and to aid in the completion of the final technical report, four interim reports are required over the course of the semester. Each interim report has a specific topic designed to reflect comparable sections in the final report and include the following:

Interim Report No.1 – a detailed work breakdown structure and quantity takeoff for the project including documentation, evidence and discussion that demonstrate that the work breakdown structure and quantity takeoff is comprehensive and complete.

Interim Report No. 2 – a narrative description of the grand plan for constructing the project identifying the key or primary operations and activities required. The discussion includes an outline of the overall sequencing of the work, description of the general site logistics and physical layout of plant and equipment, and discussion of any necessary temporary structures and/or special safety operations required.

Interim Report No. 3 – a narrative identifying four to six critical activities or operations on the project that are expected to have a significant impact on the cost, schedule, and/or quality of the completed project. The report then requires the team to perform a complete operational design of one of the critical activities including a detailed quantity takeoff, a means and methods analysis encompassing the proper selection of equipment, materials, and labor, calculation of crew production rates, calculation of activity durations, and development of a first order cost estimate.

Interim Report No. 4 – a narrative identifying and discussing the risks associated with the four to six critical activities identified in Interim Report No. 3 (or those highlighted in response to instructor feedback on the report). The report includes discussion on the types of things that could go wrong with or negatively impact these critical activities, the potential impact on cost and/or schedule due to the risks, and the mitigation methods that could be used to reduce or protect against the expected risks.

All written reports are required to be reviewed and approved by the faculty mentor prior to submittal to the course instructor for grading. All written reports are graded for both technical content and English grammar and spelling. Templates and grading rubrics have been prepared for all reports and are posted at the beginning of the semester for student reference and use. Final grades for the class are determined as follows:

Project Proposal	10%
Interim Reports	10%
Technical Analysis	30%
Final Written Report	30%
Poster Presentation	5%
Oral Presentation	5%
Peer Evaluation/Teamwork	10%

Individual final grades are adjusted according to feedback received from peer evaluations, faculty evaluation of the technical adequacy of the individual's work and contribution, and evaluation of the individual's oral presentation skills. Therefore, it is common for team members to receive different grades for the course. In addition, assuming that the quality of work is equal, projects demonstrating a higher level of technical complexity, requiring more independent research, and/or exhibiting more ingenuity or creativity receive higher grades than other less ambitious projects.

Faculty Mentoring Requirements

Each capstone team is required to identify a faculty mentor to work with during the course of the semester. Within the Department of Engineering Technology and Construction Management (ETCM) faculty mentoring is considered a collective responsibility of all faculty members. As a result, each faculty member typically mentors one to three capstone projects each semester. In addition, faculty members lend their expertise to other capstone teams as well. Over time, students have begun to recognize the preferred faculty mentors and as a result these faculty mentors are often overloaded with requests from teams to mentor their projects. As a consequence, the course instructor is often required to assign less preferred faculty members as mentors in order to balance the faculty workload. The CM faculty workload for the last two semesters is illustrated in Table 1.

Table 1: CM Faculty Mentor Workload (2 Semesters)

Faculty ID	No. of Projects	No. of Students
A	4	10
B	1	3
C	3	7
D	3	8
E	2	6
F	1	3
G	3	9
H	2	6
Total	19	52

Studies have indicated that faculty mentors should be assigned projects for which they bring considerable relevant technical expertise [Somerton, et. al., 2003]. As a result, teams are encouraged to align their projects with a particular faculty member's expertise. For example, if a team has selected a commercial project they should attempt to find a faculty member with a

commercial background. Unfortunately, this is not always possible as the mix of student selected projects does not always mirror the available technical expertise. If there is a high concentration of a particular type of project in a given semester, say commercial, then there will not likely be enough faculty members with that expertise to accommodate all of the projects. In those cases, it is important that the students have access to those with the relevant technical expertise outside for the formal faculty mentoring relationship [Somerton, et. al., 2003].

Effective mentoring of capstone projects requires faculty members to shift their role from a traditional lecture or consulting role to a coaching role [Taylor, et. al., 2000]. A successful coaching role encompasses three main responsibilities:

1) Mentor: providing support by showing the way. Being there, aware and helpful.
2) Mediator: a buffer between external reviewers and consultants.
3) Manager (facilitator): guiding the team in both team processes and the design process.

Our mentoring program has been designed to reflect this coaching role. As a result, faculty mentors are not required to formally grade any portion of a team's work. Rather, their function is to guide and facilitate the team's efforts. Teams are required to meet with their faculty mentors on at least a weekly basis and are strongly encouraged to establish a set time each week for accomplishing this. Faculty mentors are expected to review and comment on all draft written reports prior to submittal for formal grading and teams are required to incorporate any comments into their final submittals. In addition, faculty mentor signatures are required on all interim reports as verification that they have been given the opportunity to review the report.

The course requires a mid-semester review of all capstone projects. The format of the review is a business conference room style meeting between the project team, course instructor, faculty mentor, and other available CM faculty members. Each team is given 30-minutes to discuss the status of their projects and to receive constructive feedback from the faculty members. At this point in the semester, teams are expected to have completed their work breakdown structure and overall construction scheme for the project. The mid-semester review is not a graded exercise although teams are given an indication of where their project currently stands grade wise.

At the end of the semester, faculty members are expected to participate in evaluating capstone teams' oral presentations. These are formal 20-minute presentations of the team's results followed by a 10-minute question and answer period with the collective faculty members. In addition, faculty mentors are expected to attend the end-of-semester Senior Design expo and assist with the evaluation of their teams' technical poster presentations. Faculty mentors provide formal feedback to the course instructor concerning both the oral and poster presentations.

These expectations are in aligned with identified best practices for faculty mentoring which include [Watkins, 2011]:

1) Regularly scheduled group meetings,
2) Individual group member queries,
3) Signature approval of reports,
4) Mid-term and end-of-semester reviews, and

5) Review of draft written reports.

Faculty mentors are faced with the difficult challenge of balancing their role as a coach with that of the overall success of the project [Watkins, 2009]. The temptation is to intervene and provide too much technical or team management assistance, particularly if a team is under performing. Often, faculty members perceive the outcome of a project as a reflection on their own performance and therefore want to ensure that all teams have a successful outcome. However, it is important to remember that is ultimately the students' responsibility to do the work not the faculty member's. Unfortunately, not all projects or team will be successful and it is critical that teams be allowed to succeed or fail on their own merits.

Survey Methodology

In order to gauge student perception of the effectiveness of faculty mentoring of capstone projects within the program, students were surveyed at the end of the Spring and Fall 2011 semesters. The survey instrument was developed and distributed using SurveyShare®. The survey was administered as part of the end-of-semester peer evaluation and all students in the course were required to complete the survey. Students responded to each question using a 5-point Likert scale with 5 = strongly agree and 1 = strongly disagree [Likert, 1932]. The survey questions used where as follows:

- Enter your faculty mentor's name:
- My faculty mentor has made themselves available to meet with my team on a weekly basis.
- My faculty mentor has provided quality technical advice and assistance on my project.
- My faculty mentor has provided constructive feedback on project management issues such as team dynamics, scheduling and allocation of work, etc.
- My faculty mentor has provided constructive feedback and comments on my written reports and other course assignments.
- My faculty mentor is enthusiastic about mentoring my project.
- Overall, my faculty mentor has had a positive and beneficial impact on my project.
- Indicate any additional comments or concerns you may have concerning the capstone course.

A total of 52 students from 19 project teams responded to the survey. It is important to note that the survey questions have not been formally validated. In addition, the survey was not completely anonymous as the course instructor was able to match particular student responses with the appropriate faculty mentor.

Survey Results and Discussion

Aggregated responses from the survey are shown in Table 2:

Table 2: Student Perceptions of Capstone Faculty Mentoring Effectiveness

Survey Question	Likert Average	Range of Responses
My faculty mentor has made themselves available to meet with my team on a weekly basis.	4.33	Min = 2.0 Max = 5.0
My faculty mentor has provided quality technical advice and assistance on my project.	4.09	Min = 2.0 Max = 5.0
My faculty mentor has provided constructive feedback on project management issues such as team dynamics, scheduling and allocation of work, etc.	4.11	Min = 2.0 Max = 5.0
My faculty mentor has provided constructive feedback and comments on my written reports and other course assignments.	4.29	Min = 2.0 Max = 5.0
My faculty mentor is enthusiastic about mentoring my project.	4.40	Min = 3.0 Max = 5.0
Overall, my faculty mentor has had a positive and beneficial impact on my project.	4.27	Min = 2.0 Max = 5.0

Overall, students appear to have positive perceptions concerning their interactions with their faculty mentors. However, it is interesting to note that student ratings were the lowest on the two items many would consider to be the primary functions of faculty mentors, namely providing both technical advice and assistance with team dynamics. Without further research, it is not possible to determine exactly why students rated these lower than other areas and that would be an interesting area to explore. Despite the added faculty mentoring expectations, it appears that faculty members are enthusiastic about mentoring student projects.

If the data is broken down by individual faculty mentor, the results show a significant range in student perception of individual faculty, as shown in Table 3.

Table 3: Individual Faculty Mentor Ratings

Faculty ID	Aggregate Rating
A	4.75
B	4.72
C	4.78
D	4.46
E	4.27
F	3.22
G	3.50
H	3.33
Average	4.25

Clearly, students perceive some faculty mentors as being more effective and beneficial than others. This is further evidenced by the fact that teams tend to gravitate towards certain faculty when selecting their mentors. This is also reflected in the additional comments provided by some students. Many commented on the positive impact that their faculty mentor had on their team and project while a couple expressed disappointment in their mentor's performance. It should not be

a surprise that some faculty mentors are perceived more favorably than others as some faculty are more actively engaged in the process than others.

Several dual major students had taken a previous capstone course (with a similar mentoring system) and were able to compare directly their faculty mentoring experiences between the courses. In both cases, the students reported that their project outcome and course experience was significantly impacted by the quality of the faculty mentoring received.

As illustrated in Table 4, there appears to be little correlation between a faculty's mentoring workload and their student evaluation rating score. It is likely that the quality of the faculty mentoring experience is a function of the priority and value placed on the relationship by both the faculty member and the student team. If parties sense a value to student learning and project success from the mentoring process then they will become more committed to expending the necessary time and effort, regardless of their capstone project workload. It is not uncommon for some student teams (and faculty) not to appreciate the value of the mentoring process and to treat it as merely a perfunctory meeting requirement. Obviously, in such cases the impact of the faculty mentoring experience is going to be less than desired. Although there may be little correlation between mentoring workload and aggregate ratings, this does not imply that faculty workload should not be a consideration. When done correctly, faculty mentoring requires a substantial time commitment and care needs to be taken to ensure that mentoring does not become an excessive burden for faculty.

Table 4: Individual Faculty Mentor Workload vs. Ratings

Faculty ID	No. of Projects	Aggregate Rating
A	4	4.75
B	1	4.72
C	3	4.78
D	3	4.46
E	2	4.27
F	1	3.22
G	3	3.50
H	2	3.33
Average	2.37	4.25

Conclusion

In general, it appears that the construction management program at UNC Charlotte has an effective capstone project faculty mentoring program. Based on student perceptions, it appears that despite the added demands and expectations faculty members are enthusiastic about mentoring capstone projects. Based on comments received, it appears that students perceive the benefits of quality faculty mentoring and are able to differentiate the better faculty mentors. One surprising result was that student ratings were the lowest on faculty mentors' effectiveness in providing both technical advice and assistance with team dynamics. Without further research, it is not possible to determine exactly why students rated these lower than other areas and that would be an interesting area for additional research.

There is a perceived value to student learning and project success from effective faculty mentoring of capstone projects. Therefore, if they have not already done so, other CEM programs should be encouraged to establish formal faculty mentoring programs for their capstone projects. Efforts should be made to move the mentoring beyond the role of merely monitoring student progress or performance to one of coaching that contributes real value to student learning. Faculty are the professional experts; the challenge becomes how to use mentoring effectively to impart some of that knowledge and experience to students.

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