The Role of the Faculty Advisor in the Capstone Design Experience: The Importance of Technical Expertise

Craig W. Somerton, Brian S. Thompson, and Craig Gunn
Department of Mechanical Engineering, Michigan State University

Introduction

The capstone design experience in the mechanical engineering program at Michigan State University is achieved through the Mechanical Engineering Design Projects course: ME 481. This course utilizes industrially sponsored design projects for which the company makes both a financial investment ($3500) and a personnel investment (a staff engineer is assigned to the project.) Each team of four students works on the project for the semester under the supervision of a faculty member. About 160 students enroll in the course each year, requiring the acquisition of nearly forty design projects by the course coordinator. In an academic year about thirteen faculty are assigned to supervise these projects. The course coordinator is responsible for the specific assignment of a faculty advisor to a design project. Among the faculty, there has been considerable discussion concerning how the faculty advisors should be assigned to project teams and what role their technical area of expertise should play in this assignment. This role is the focus of the paper. This paper continues with a discussion on the bearing that faculty advisor technical expertise has on the design project. The results of a student survey and industrial sponsor survey on this issue are then presented and discussed. Final remarks conclude the paper.

Comments on the Faculty Advisor's Technical Expertise for Design Project Teams

It would seem obvious that faculty should be assigned design projects in their technical area of expertise. Indeed most faculty at research universities feel very uncomfortable when asked to work outside their narrow technical area of expertise. The difficulty in making the assignments in this fashion lies in the eclectic nature the design projects and the composition of the faculty. As a typical mechanical engineering faculty, our department is composed of fifty percent of members whose expertise is in the mechanical systems area and fifty percent of members whose expertise is in the thermal/fluids science area. Because the projects are solicited from industry, and the decision as to what projects to use is dictated by an assessment as to the most positive learning experience for the students, there is rarely an exact balance between the technical areas of the projects for the semester and those of the faculty members assigned to be advisors for the semester. So it is a normal occurrence that some faculty advisors are assigned design projects that are outside their technical area of expertise because all faculty in the department are supposed to participate in this class during a two-year period.

What should be done under these circumstances? In our department, the faculty has agreed that the capstone design course is the responsibility of all faculty members and that all faculty members should be available to provide assistance to the student design teams. It is also understood that the role of the faculty advisor is not to be the technical expert on the project but rather to guide

the student design team and facilitate their learning experience. This frequently requires the students to be directed to academic colleagues with different areas of expertise. Also, some faculty advisors who have been assigned a project in their technical area of expertise are, on occasion, abused by the industrial sponsor, because they are treated as free consultants by the sponsor. Being an academic mentor requires a delicate balance.

Surveys on Faculty Advisor Role

Student design teams were surveyed during the spring semester of 2002 to assess how the technical expertise of the faculty advisor had affected this learning. The survey is shown in Figure 1. Forty-six of the eighty students in the class responded, and only one of the twenty design teams had no responses (Project 5). Industrial sponsors have also been surveyed to gather their perspective concerning the technical expertise of the faculty advisor and its impact on the design project. Their survey is shown in Fig. 2. Unfortunately, only eight of the twenty industrial sponsors responded to the request for information.

Results of the student survey are shown in Table 1. On this table the authors have also provided their assessment as to the level of relevant technical expertise the faculty advisor brought to the design project. Comparing the authors' assessment with the student design team's assessment on the level of relevant technical expertise of the faculty advisor, we see good agreement, though the students seem to overrate the advisor's level of relevant technical expertise. For the twenty projects, the authors would propose that the faculty advisor had considerable relevant technical expertise in nine projects, some expertise in six projects, and little expertise in five projects. Of the nineteen teams responding, fifteen teams utilized the technical talents of other faculty members on the project, including nine teams with faculty advisors that had considerable relevant technical expertise. Clearly, both students and faculty have bought into departmental participation in the capstone design course, regardless of the formal teaching assignment.

Upon examining these results, it would seem that Advisor A performed unsatisfactorily as a faculty advisor, and this would appear not to be due to his/her level of relevant technical expertise because the rating involving the non-technical component was also quite low. Though the department does not formally assess faculty advisor performance, it is clear that this survey could be used to identify advisors who need to improve their performance. Because of this poor overall performance, Advisor A will not be included in the following discussion dealing with technical expertise.

Of the nine projects for which the authors assessed the advisor's relevant technical expertise to be considerable, the students' overall rating of the faculty advisor was 2.6. Of the remaining eight projects for which the authors assessed the advisor's relevant technical expertise to be some or little (recall we are excluding Advisor A from this analysis), the students' overall rating of the faculty advisor was 2.5. These results would indicate that a lack of relevant technical expertise by the faculty advisor can certainly be overcome in order to provide a successful learning experience for the students.

Figure 1 Student Survey on the Role of Faculty Advisors

Faculty-Advisor Survey by Student-Team Members

Name of Faculty Advisor: _____

What level of technical expertise did your faculty advisor bring to the project?

3	**2**	**1**	**0**
Considerable	**Some**	**Little**	**None**

How much technical assistance did you receive from your faculty advisor?

3	**2**	**1**	**0**
Considerable	**Some**	**Little**	**None**

Did you seek out other faculty for technical assistance on your project?

Yes	**No**

Name(s) of faculty: _____

Please rate your faculty advisors role in guiding and mentoring your design team in non-technical areas

3	**2**	**1**	**0**
Excellent	**Good**	**Fair**	**Poor**

Did your faculty advisor enhance your design experience?

Yes	**No**

Were the results of your design project enhanced by your faculty advisor?

3	**2**	**1**	**0**
Greatly	**Somewhat**	**Little**	**None**

What is your overall rating of your faculty advisor?

3	**2**	**1**	**0**
Excellent	**Good**	**Fair**	**Poor**

Please share with us any other comments you might have concerning the role of the faculty advisor in your ME 481 experience:

Figure 2 Industrial-Sponsor Survey on the Role of Faculty Advisors

Faculty-Advisor Survey by Industrial Sponsor

Project: Faculty Advisor:

In your opinion what level of technical expertise did the faculty advisor bring to this specific design project?

3	2	1	0
Considerable	**Some**	**Little**	**None**

What was the contribution of the faculty advisor to the project through his/her technical expertise?

3	2	1	0
Considerable	**Some**	**Little**	**None**

What was the contribution of the faculty advisor to the project other than through his/her technical expertise?

3	2	1	0
Considerable	**Some**	**Little**	**None**

What is your overall appraisal of the success of the project?

3	2	1	0
Excellent	**Good**	**Fair**	**Poor**

Table 1 Results of Student Surveys

Advisor	Project	Authors' assessment of faculty advisor's relevant technical expertise.	What level of technical expertise did your faculty advisor bring to the project?	How much technical assistance did you receive from your faculty advisor?	Did you seek out other faculty for technical assistance on your project?	Please rate your faculty advisor's role in guiding and mentoring your design team in non-technical areas	Did your faculty advisor enhance your design experience? (Yes/No)	Were the results of your design project enhanced by your faculty advisor?	What is your overall rating of your faculty advisor?
A	1	1	1.5	1.5	No	1.0	1/1	1.5	0.5
A	2	2	2.0	1.5	No	2.0	1/1	2.5	2.0
B	3	3	2.7	2.3	Yes	2.7	3/0	2.7	3.0
B	4	3	3.0	3.0	Yes	3.0	3/0	3.0	3.0
B	5	2	NR	NR	NR	NR	NR	NR	NR
C	6	3	2.5	1.5	Yes	3.0	2/0	2.0	2.5
C	7	2	3.0	2.5	Yes	3.0	2/0	2.5	3.0
C	8	1	2.0	2.0	Yes	3.0	1/0	3.0	3.0
D	9	3	3.0	3.0	No	1.5	2/0	2.0	2.0
D	10	3	2.5	2.5	Yes	2.5	2/0	2.5	2.5
D	11	3	2.0	2.0	No	2.0	2/0	2.0	2.0
E	12	1	2.0	1.7	Yes	2.7	2/0	2.3	2.7
E	13	3	3.0	2.7	Yes	2.7	3/0	3.0	3.0
E	14	3	3.0	3.0	Yes	3.0	4/0	3.0	3.0
F	15	3	2.5	1.5	Yes	2.5	2/0	2.0	2.0
F	16	3	2.3	1.8	Yes	2.5	4/0	2.3	2.3
F	17	3	2.5	2.0	Yes	2.5	2/0	2.5	3.0
G	18	1	1.0	2.0	Yes	2.0	1/0	1.0	2.0
G	19	2	3.0	2.5	Yes	2.0	2/0	2.5	2.5
G	20	1	2.0	1.5	Yes	2.8	4/0	1.5	2.5

NR: no response

The results of the industrial sponsors' survey are shown in Table 2. Though the data lack completeness, again it appears that a faculty advisor's lack of relevant technical expertise does not play a significant role in the success of the project as assessed by the industrial sponsor. Furthermore, there are some interesting differences between the authors' opinion of a faculty advisor's expertise and the assessment generated by the industrial sponsor.

Final Remarks

- Faculty advisors should be assigned design projects for which they bring considerable relevant technical expertise.
- The faculty-advisor needs to be clearly understood as not being the technical expert for the team but rather as one who guides the team and facilitates the team's learning experience.
- For design teams to overcome a lack of relevant technical expertise by a faculty advisor, other faculty members who have the relevant technical expertise need to be available to consult with the team.
- Poor performance by faculty advisors can easily be identified with the survey used in this paper.

Author Biographies

CRAIG W. SOMERTON
Craig W. Somerton is Associate Professor and Associate Chair of Mechanical Engineering at Michigan State University. He teaches in the area of thermal engineering including thermodynamics, heat transfer, and thermal design. Dr. Somerton has research interests in computer design of thermal systems, transport phenomena in porous media, and application of continuous quality improvement principles to engineering education. He received his B.S. in 1976, his M.S. in 1979, and his Ph.D. in 1982, all in engineering from UCLA.

BRIAN S. THOMPSON
Brian S. Thompson is a Professor of Mechanical Engineering at Michigan State University. Currently he serves as the Departmental Design Coordinator. Dr. Thompson has published in the following areas: mechanisms, smart materials, composite materials, flexible fixturing, robotics, variational methods and finite element techniques. He received a BSc and MSc from Newcastle University, England, in 1972 and 1973 respectively, and a Ph.D. from the University of Dundee in Scotland in 1976.

CRAIG J. GUNN
Craig J. Gunn is Director of the Communication Program in the Department of Mechanical Engineering at Michigan State University. In this role he directs the integrated communication program in mechanical engineering
while providing help to the cooperative engineering education division of the College of Engineering. He has spent thirteen years of teaching in the public school system and fifteen years at Michigan State University. He serves as editor for the *CED Newsbriefs* and *MCCE Co-op Courier*.

Table 2 Results of Industrial Sponsor Surveys

Advisor	Project	Authors' assessment of faculty advisor's relevant technical expertise.	In your opinion what level of technical expertise did the faculty advisor bring to this specific design project?	What was the contribution of the faculty advisor to the project through his/her technical expertise?	What was the contribution of the faculty advisor to the project other than through his/her technical expertise?	What is your overall appraisal of the success of the project?
A	1	1	NR	NR	NR	NR
A	2	2	NR	NR	NR	NR
B	3	3	NR	NR	NR	NR
B	4	3	3	1	2	2
B	5	2	NR	NR	NR	NR
C	6	3	1	1	2	3
C	7	2	NR	NR	NR	NR
C	8	1	3	3	2	2
D	9	3	NR	NR	NR	NR
D	10	3	NR	NR	NR	NR
D	11	3	NR	NR	NR	NR
E	12	1	3	3	3	3
E	13	3	NR	NR	NR	NR
E	14	3	3	3	1	2
F	15	3	2	2	3	3
F	16	3	NR	NR	NR	NR
F	17	3	3	3	2.5	2
G	18	1	NR	NR	NR	NR
G	19	2	1	1	1	2
G	20	1	NR	NR	NR	NR

NR: no response