TEACHING TEAMWORK: FACTORS THAT INFLUENCE RESEARCH UNIVERSITY ENGINEERING FACULTY TO IMPLEMENT TEAM ACTIVITIES IN THEIR CLASSES

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Abstract ¾ This qualitative grounded theory and quantitative multiple logistic regression mixed study examined why research university engineering faculty do— or do not—change their teaching methods. Results from the qualitative component, tested in a larger population and analyzed using multiple logistic regression, showed that previous experience being on teams or using teams in the classroom, whether successful or unsuccessful, training on using team activities in the classroom, and having few time constraints were significantly related to the future use of team activities in the classroom by research university engineering faculty.

Index Terms ¾ ABET, research university faculty, teaching, teamwork, team activities

RESEACH OBJECTIVE

Employers are increasingly relying on teams to increase productivity in the workplace [11] and are encouraging higher education institutions to help undergraduate engineering students to develop collaborative communication skills [1] [8]. Research evidence shows that student-centered teaching practices such as cooperative or collaborative learning, enhance college students' cognitive, affective, and professional development [9] [5]. Nevertheless, over three-fourths of new and senior higher education faculty use lecture as their only or primary method of teaching [7].

Most research university faculty receive little formal training in teaching; instead, they rely on informal training achieved by observing their own professors, reading about teaching, discussions with colleagues, or occasional formal instructional development workshops [14]. Scholars have considered personal motivation and organizational context as possible reasons why higher education faculty might change their teaching methods [3] [4] [12]. There is little empirical evidence, however, to show what induces research university faculty to change from teacher-centered to student-centered methods of instruction, such as from lecture to team activities. To address this gap, this study explored what personal and organizational factors enhance or constrain engineering faculty efforts to initiate team activities in their classrooms.

The research was conducted in two phases. First, qualitative methods were used to develop a substantive theory [13] grounded in the actual experiences of research university engineering faculty who were implementing team activities in their classrooms, as well as in literatures on self-efficacy and individual change. The working hypotheses developed from these analyses were then tested with quantitative analyses of a survey administered to all research university faculty in the same college of engineering.

GROUNDED THEORY—DEVELOPMENT OF WORKING HYPOTHESES

A project funded by a United States corporation and implemented by the College of Engineering at a large public research university from 1997-2000 provided an opportunity to explore what factors enhance or constrain faculty use of teamwork in their classes. Twenty-two engineering and physics faculty participated in the project, which encouraged collaboration across departmental boundaries and the use of team activities in the classroom. A subset of seven engineering faculty agreed to participate in exploratory research about the factors that influenced implementation of teamwork. Three of the participants were tenured professors whose teaching experience ranged from 14 to 25 years. One other tenured professor had less than 10 years teaching experience, while three others were non-tenured with 4 to 11 years of teaching experience. All participants were male. In addition to regular project activities, these seven faculty participated in three interviews, completed three questionnaires, and allowed their classroom teaching to be observed twice during 1997-98.

Structured classroom observations showed that all seven of these motivated faculty implemented six of seven specific characteristics of team activities in at least one of their classes during the period of study. Interviews and questionnaires conducted at the beginning, middle and end of the data collection period revealed participants' perceptions of the facilitators and barriers to implementing team activities in their classes. Factors that emerged as important included previous experience with teams, time constraints, perceived availability of resources, and employment security.

Of the seven participants, those who had recent training in teamwork, positive previous experiences as team members, or experience guiding teamwork as professors were more likely to implement team activities sooner than

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those who did not. Similarly, Bandura's [2] social cognitive theory suggests that self-efficacy, the belief that one can successfully complete specific tasks, may affect faculty members' willingness to change their teaching methods. Evidence from the seven faculty members, informed by this theory led to the following hypothesis: Faculty who have a personal history of successful experiences working on teams or guiding teamwork will be more likely to implement team activities in their classes than faculty who do not.

Six of the seven participants cited time constraints as an obstacle to implementing team activities. Similarly, Fairweather [6] found that research university faculty were discouraged by the time required for reforms, and believed that time spent on research rather than teaching remained the most reliable means toward advancement. Thus, I developed the following hypothesis: Faculty who perceive less time constraints will be more likely to implement team activities in their classes than faculty who perceive more time constraints.

Five of the seven professors suggested that faculty would be more likely to implement team activities when they perceived their work environment provided such resources as teaching assistants, reduced course loads, and instructional consulting. Similarly, Blackburn and Lawrence [4] concluded that time devoted to teaching was directly affected by colleges' and universities' missions and available resources, through their effects on class size, number of laboratories, and quality of teachers recruited. For example, they found that more faculty in a liberal arts college engaged in innovative teaching methods when financial resources were readily available to support such changes. Consequently, I developed a third hypothesis: Faculty who perceive that departmental resources (e.g., teaching assistants, reduced teaching load, instructional development consultants, released time) are available and helpful will be more likely to implement team activities in their classes than faculty who do not.

Three of the seven faculty who had initially committed to learning about team activities later seemed hesitant to implement them. I expected this to occur with junior faculty who were seeking tenure, rather than with tenured senior faculty. However, one full professor who was applying for another higher education position was also concerned that student evaluations of his teaching might decline if he implemented team activities in his classes, and in turn, affect his chances for new employment. Similarly, Schein's resistance theory of change [10] and his theory of an individual's need for psychological safety in the workplace assert that in order for change to take place, a safe environment for change is needed. This may include a period of time to experiment with teaching methods in which teaching evaluations are temporarily suspended. Since a period of learning is often required before an individual is able to accept or implement a change in teaching methods, a safe environment may also include an approved series of professional development workshops designed to enhance a

faculty member's ability to implement team activities in their classroom. My qualitative analyses and Schein's theories led to a fourth hypothesis: Faculty who perceive safety and security in their employment status will be more likely to implement team activities than faculty who do not.

TESTING HYPOTHESES—METHODS AND RESULTS

To see if the views of the seven research university engineering faculty were held by the rest of the College of Engineering faculty at the same institution, a questionnaire was constructed and administered to 330 College of Engineering professors who had full time status and had taught classes within the last five years. The college administration had recently been encouraging team work, and the percentage of faculty using teams was high: 77 percent of the 113 respondents reported using team activities in their classes during the Fall '97/ Spring '98 semesters.

A principal components factor analysis of 14 survey items that might enhance or constrain faculty implementation of team activities in their classes produced three factors: Previous Experience (3 items, alpha = .65), Time Constraints, (5 items, Cronbach's alpha = .72), Perceived Support for Employment Security (two items, Cronbach's alpha = .71). Because no clear, reliable factor for Resource Accessibility emerged from the factor analysis, the construct was measured by other questions on the survey. Bivariate analyses were used to test each hypothesis independently. A multiple logistic regression model produced estimates of the effect of each independent variable, controlling for all others in the model.

Results supported the hypothesis regarding previous experience. Forty-one percent of the respondents who had not used teams in the past, used them in the Fall '97/Spring '98 semesters, compared to 64% of those who had used them unsuccessfully in the past and 94% of those who had used them successfully in the past. Respondents who attempted to use team activities in the past but were unsuccessful were more likely to use team activities than those who had never used team activities. Those who were successful using team activities in the past were the most likely to use team activities in the Fall '97/ Spring '98 Semesters (p<.001). In addition, respondents who had received training on team activities were significantly more likely to use team activities during the Fall '97/ Spring '98 Semesters than those who had not received team activities training (p<.05). Eighty-nine percent of those who had training used team activities compared to 67% of those who did not have training.

Results also supported the hypothesis about time constraints. Those respondents who had higher scores on the time constraints index were significantly more likely to use team activities during the Fall '97/ Spring '98 Semesters than those scoring lower on the index (p<.05). A lower score

on the index indicates that respondents rated various factors as constraining the likelihood that the respondent would implement team activities in one or some of their classes. On average, those who used team activities during the Fall '97/ Spring '98 Semesters had a score of 2.4 on the index while those who did not implement team activities had a score of 2.0. Results from the logistic regressions did not support the hypotheses about resource accessibility or employment security.

SIGNIFICANCE OF STUDY

Administrators and colleagues from all disciplines who wish to encourage research university faculty to use student-centered teaching methods, such as team activities, may benefit from this grounded theory study which examined why faculty do—or do not—change their teaching methods. Results showed that even unsuccessful experiences using team activities are significantly related to future use of team activities in the classroom. Training also encourages faculty to implement new teaching activities. On the other hand, the amount of extra time needed to plan and implement team activities constrain their use. Creating an environment conducive to experimentation and easing time constraints to allow for faculty to learn about new teaching activities will be helpful in furthering the use of teaching initiatives such as team activities.

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