AC 2011-1961: ASSESSING CHALLENGES AND AFFORDANCES OF A TRADITIONAL INSTRUCTOR'S PEDAGOGICAL CHANGE DURING GUIDED IMPLEMENTATION OF INNOVATIVE PEDAGOGY

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Assessing Challenges and Affordances of a Traditional Instructor's Pedagogical Change During Guided Implementation of Innovative Pedagogy

Abstract

In order to improve the understanding of issues that arise during implementation of innovative materials and practice, progressive pedagogical materials (developed using research based principles) were integrated into an introductory materials engineering course taught by an engineering instructor who had teaching with traditional classroom practice. To do this, a graduate research associate worked with the faculty member to support implementation of student engagement modules for four topics in the course which included: atomic bonding, crystal structures, dislocations and defects, and phase diagrams. During each class period a Reformed Teaching Observation Protocol (RTOP) observation was completed to assess the instructor's classroom pedagogical practice in order to determine how it might have changed over the course of the semester. Students in the course completed daily reflections and an exit course survey to assess their perception of how supportive various components of the course were to their learning. Data suggested there were minor changes in teaching behaviors over the semester, and that time spent on activities and number of slides in the instructor's presentation influenced these changes. Additionally, students perceived that many of the integrated innovative curriculum materials were supportive of their learning. Challenges and affordances for implementing the progressive pedagogical tools were also identified. These included time constraints, limitations due to textbook choice, and epistemological beliefs of instructor and students with respect to the nature of learning.

Introduction

A well known challenge of education research is the utilization of research to improve practice. Often, knowledge of education research may not extend past the research community, and not reach practitioners who could implement research findings to impact classroom practice. As the National Science Foundation focuses efforts towards bridging research and practice in undergraduate STEM fields, it becomes imperative that research is done to document opportunities, issues, and effectiveness of the implementation of theoretically based pedagogical tools in real classrooms settings with typical instructors.

Background

In order to observe, quantify, and research these relationships, an instrument for measuring classroom and instructor dynamic must be used. The Reformed Teaching Observation Protocol[1,2] (RTOP) is a tool that assesses to what extent a given instructor's classroom behaviors align with research-based best-practice principles of classroom practice that promote student engagement and effective teaching and learning. It gives researchers a valid and reliable quantifiable insight as to how "reformed" the instructor's actions are based on best practice as identified by previous educational research. Research on teaching is not the same as research on

learning. Thus far, engineering education research has been focusing more on the student and student learning, and less on teaching, especially with respect to instructor classroom behaviors. The RTOP gives researchers a way to measure the teacher and the level of best-practice teaching.

By further examining the instructor dynamic and challenges, it may be possible to better understand the gap between results of education research and the effectiveness of their utilization to change practice. For example, we may begin to understand the challenges instructors face when implementing innovative practice into traditional engineering settings. If that gap can be addressed, there may be the potential for the research community to have significant, *real* impact on student learning and success in the classroom.

Methods

The primary purpose of this study was to understand the challenges and dynamics of integrating innovative pedagogical materials and practice into a traditional engineering classroom.

Participants and Context

Participation in this study was voluntary, though assessment was discussed and primarily collected during the course of a regular class. Participants in this research were from a sample of 25 students enrolled in a course that met daily for 8 weeks during a summer 2009 semester of an introductory materials science and engineering course.

The introductory course in which the sample was drawn was required for most engineering majors meeting for ninety minutes five times per week. The course was taught by a professor with a Ph.D. in engineering and over 15 years teaching experience. The instructor, primarily teaching in a traditional mode, with the help of a graduate assistant, integrated his traditional materials with progressive, research-based materials and assessments. These materials included contextualized content, Concept-In-Context Maps, Concept-In-Context group activities, Daily Reflections for Students, and Multi-Model Topical Module Assessments for each module.

Results and Discussion

With the understanding that there would be strong variance due to the nature of human behavior being difficult to predict, a scatter plot was produced to explore the relationship between instructor RTOP scores, number of slides, and time on activities. To better examine trends, linear trend lines were created to see if there were any clear trends from the longitudinal data. This graph is shown in Figure 1 below. It is shown that RTOP scores generally decreased over the two week time frame. This is consistent with our experience, two fold. First, activities created near the beginning of the semester were stronger and had been more refined than those later as the semester progressed. Second, the instructor became increasingly concerned about timing and worried that content may not be covered in the timeframe of the course. This resulted in a challenge for implementing progressive materials, magnified by the summer schedule of the course.

Figure 1. Correlation of RTOP Score to Characteristics of the Class and Instructor Practice

RTOP Score, Number of Slides, & Time on Activities Over Two Weeks of Class
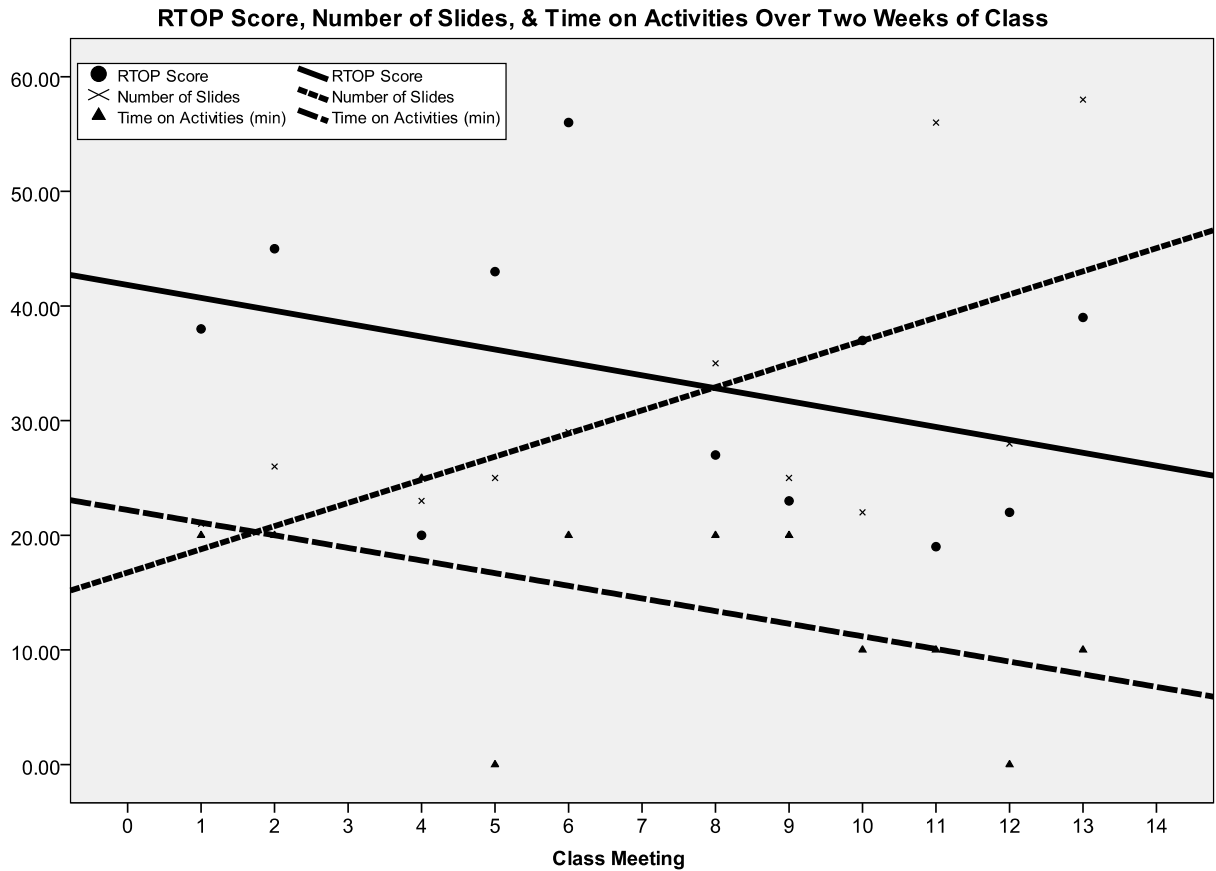
Figure 1 represents RTOP scores, number of slides, and time on activities as a function of time and progress through the course. Because, RTOP Scores were measured to two decimal places, the vertical axis is represented to two decimal places. As shown in Figure 1, the time spent on activities for the day also decreased over the course of the semester. By examining the graph, it seemed that they changed at nearly the same rate. This suggested that the time spent on activities may be related or correlated to the instructors RTOP score. In examining number of slides present in an instructor's presentation, it was found that the number of slides present generally increased as time progressed. This was also consistent with the concern of "covering enough material". In reviewing the slides used, it was noted that the amount of content presented on each slide remained relatively consistent over the two week period. On average, each slide contained one or two graphics (either pictures or mathematical graphs) and two new concepts (where a concept is referred to as either a new term, relationship, or mathematical equation). It appeared that there also may be some relationship of negative correlation between number of slides present and instructor RTOP score. This preliminary examination of data prompted further examination of data.

The linear combination of number of slides, time spent on activities, and average student value score accounted for 15.7% of the variance in the instructor's RTOP score, $R^2 = .157$. Despite this moderate effect size, the model was not statistically significant, $F(3,7) = .434$, $p = .74$, presumably due to lack of power resulting from the small sample size ($N = 11$).

Summary and Implications

This data suggests that by examining the number of slides the instructor's presentation, how much time he spent on team activities, and how high in value students rated the class that day, a relatively large amount of the level of reformed teaching could explained. This is consistent with prior research as fewer slides (less transmission lecture), more activities (higher student engagement), and higher value (more relevant knowledge) are all characteristics of progressive pedagogy. And while this result cannot be generalized to a larger population of instructors teaching materials science at this point, it is worth examining further with a larger sample size. By continuing to use the RTOP to assess instructors as they implement new pedagogical tools, we can start to understand the challenges and affordances of those tools in *real* classrooms under *real* conditions. This will give opportunities for research to inform practice but, more importantly for practice to inform research. Until we can do the latter and allow practitioners to feel positive about the value of educational research, educational theory will remain only theory and not bring about the change required to help real students learn effectively in a classroom, not an experimental setting.

Acknowledgement

References

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[2] Sawada, D. Piburn, M., Turley, J., Falconer, K., Benford, R., Bloom, I., & Judson, E. (2000). Reformed Teaching Observation Protocol (RTOP) Training Guide (ACEPT Technical Report No. IN00-2). Tempe, AZ: Arizona Collaborative for Excellence in the Preparation of Teachers.