Active Learning through Student Generated Questions in Physics Experimentation Classrooms

Abstract

Helping students become more active and intellectually engaged learners while conducting physics experiments has been a focus of many physics educators. Over the past decade or so, a number of projects, for example, Tools for Scientific Thinking, Workshop Physics and the Physics Studio, etc. have been developed that emphasize engaging activities that students are exposed to in physics labs sessions. While empirical evaluations of those projects yielded supportive evidence of their effectiveness and efficiency, these innovative projects tend to be more expensive in terms of instructional time, development time, specialized training for instructors, and/or space required than the traditional format. Moreover, they usually make strong use of computer equipment and peripherals, which usually demand major modifications of a traditional structure and additional financial inputs from affiliations, making widespread implementation difficult. In hopes of counteracting undergraduates' passive learning mode and inertia, a multiple-choice question-generation learning strategy was introduced to supplement traditional lab reports on the premise that only a fairly minor modification of traditional laboratory exercises is required.

A single group research design involving non-participant observations and document analysis were employed in the study. In total 40 university freshmen from the department of civil engineering, while taking a "Laboratory for Physics" course, participated in the study during the spring of 2004. To shed some lights on how and in what ways multiple-choice question-generation strategy might influence students' in-class learning behavior and study patterns, a multiple-choice question-generation component was introduced to the class after the 6^{th} class session. Comparisons could then be made between "the before" and "the after" on students' question-posing and instructional VCD viewing behavior. Specifically, all questions students posed toward TAs and the instructor during the lab sessions were carefully recorded and analyzed in terms of its fluency (the number of questions generated), flexibility (the number of different categories of questions generated), complexity (demanding application of more concepts/principles for solving), or any categories emerged as a result of inductive data analysis. Besides, the number of times students accessed instructional

VCD (containing explanation and demonstration of all experiments by the instructor) and the total viewing time of each student was recorded and compared.

Though complete data collection will not be available until the end of May, 2004, a preliminary analysis using data collected so far indeed showed prominent changes in students' in-class question-posing behavior in terms of fluency, interaction patterns among group members, and VCD viewing habits, which were in alignment with the researchers' expectation. By requiring students to generate multiple-choice questions, it seemed to cultivate an active and constructive learning environment and help nurture self-regulated learners. Potential topics for future study and suggestions for physics instructors will be offered.