

Connecting Quantitative and Qualitative Studies on Teaching and Learning: The Impact of Students' Perception on Their Introductory College Physics Performance

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Abstract

This study investigates how introductory physics students perceive learning physics and their perspectives on how instructors' presentation formats might be developed. Within a constructivist framework, it is of fundamental importance that instructors understand and address student expectations about effective instructional methods and educational technology-integrated curricula in particular. The triangulated results gathered through quantitative and qualitative methods enable a holistic understanding of the likely impact of student expectations of learning outcomes and other intrinsic factors of the educational process, with a specific focus on the effects of gender, as part of the implications of improving the approach towards teaching.

Physics is a science composed of well-founded expectations of how the natural world should behave, and it uses the tool of mathematics to describe these behaviors. Physics learning therefore involves observing phenomena, quantifying the observations, and synthesizing the results into theories. Most college introductory physics instructors want to make the classroom a place where students are encouraged to test ideas, make connections among subjects and content areas, explore problems and issues, work cooperatively, and become lifelong learners. They believe that students must be intellectually engaged and actively involved in their learning, and that traditional instruction is likely failing to provide this engagement.

Tremendous efforts have been made by educators to help students learn physics. Peer group and collaborative learning have been introduced into physics classrooms. Collaborative learning promotes communication of ideas and understanding of concepts. In addition, innovative courses using interactive strategies and educational technology were developed or adapted from existing curricula in an effort to increase student understanding of the concepts.

Students bring to class not only their prior understanding of physics concepts, they also bring a set of attitudes, beliefs, and assumption about the nature of physics knowledge, what they are expected to learn, what skills will be required, and what they need to do to succeed. Educational technology teaching tools were considered to be one of two types, a tool of instruction presentation and a method of communication. This study focused on investigating some intrinsic factors relevant to students' perceptions and performance in learning introductory college physics while five specific research questions were generated:

- 1) Were high school math and science preparation of students predictors of their performance?
- 2) Were learning perceptions of students associated with their performance?
- 3) Were male and female students significantly different in their performance?
- 4) Were there gender differences in physics learning perceptions?

- 5) Can educational technology improve introductory college physics learning?

A total of 267 students, 161 males and 106 females, who enrolled in four algebra-based and two calculus-based introductory physics classes in the Spring of 2002 participated in the study. The survey package consisted of the student consent form along with the three parts of instrumentation which were developed to collect quantitative and qualitative data for this study.

In this study, students performed better in physics courses by trying to understand the physics materials and relate physics problems to the real world situation. The perception of Physics Learning by Rote did not help students learn well or perform better.

Overall, gender was not related with performance. The findings of this study therefore delivered some very encouraging information to physics educators. First, male students did not outnumber female students in introductory physics classes. Second, female performed comparably with their male counterparts. Third, female students studied physics by attempting to understand the principles behind the course material while male students tended to memorize the course material. Fourth, nine out of every ten students in the technology-integrated classrooms reported being benefited by the learning environment while every seven out of ten students in the traditional classroom setting indicated their preference in having the technology integration. Fifth, a higher percentage of students with a preference for a technology integrated learning environment received a final grade of B or higher compared to the students who did not feel the benefit from the same learning environment.

Based upon the results of this study, several recommendations for further research were generated. The exploration of the confounding effects related to physics learning perceptions, integration of technology in aiding the student comprehension, and the performance needs to be done to fully understand the features that enhance students learning best and which instructional formats are more potent than others.