



The Connected Lab: Enhancing Laboratory Learning with Technology

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Overview

In *The Laboratory in Science Education: Foundations for the 21st Century* (2004), Hofstein and Lunetta suggest that it is the responsibility of faculty to rethink and redesign laboratory experiences to engage our current student populations in ways consistent with their experience, knowledge and preferences. Students entering college in the 21st century have been exposed to the use of technology throughout their entire lives, including in their previous educational experiences. Moreover, they gather information using technologies not yet viewed as mainstream educational technologies, such as wikis, blogs and podcasts. They are used to constantly working in an environment where they control the speed and availability of access to information. In the laboratory, 21st century tools can be used to transform the laboratory experience as well as to increase student efficiency, collaboration and reflection on experimental outcomes.

This work demonstrates pedagogical application of on-demand digital libraries of techniques, accompanied by real-time dynamic data sharing in the laboratory to make it more accessible to the “digital” student. Digital media and communication technologies were used to enhance the learning environment in both Anatomy and Physiology and Ecology laboratory courses, making course content and process more relevant to the experience and learning modes of current students.

With funding from the Davis Educational Foundation, this project is in the pilot phase of implementation. This poster presents preliminary data on the following outcomes:

The integration of new technologies (using new equipment) to collect and combine student-generated data during teaching labs

The use of digital media to supports independent procedural learning in the lab

Methods

Videos

Pre-lab information was communicated to the students via podcasts. These podcasts demonstrated both the laboratory procedure as well as any intricate set up. The laboratory set up and procedure demonstration was recorded using a digital video recorder. The resultant videos were then edited and produced in a podcast compliant format using video editing software. Podcasts were made accessible to students via the university's streaming server, allowing students to access them before, during and after their laboratory session.



Video capture equipment



Video editing software

Methods Continued

Classroom Response System

Following completion of their lab students input their data into the class wide data sheet utilizing a numerical input capable Classroom Performance System (CPS) clicker. Data were displayed in real time during the lab, and made available to students for subsequent analysis and report generation.



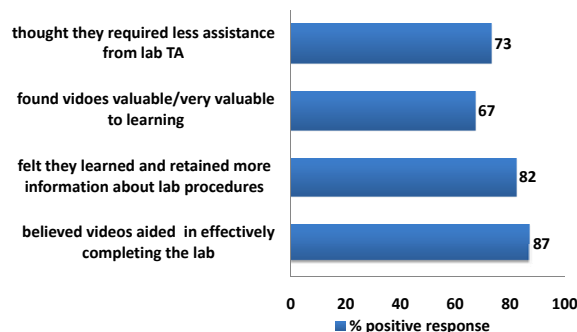
Classroom Performance System – eInstruction

Results

Student evaluations regarding usefulness of digital media :

Results of a survey of 87 student users regarding their impressions of the usefulness of the digital media indicate that students generally thought that the videos were useful, had a positive impact on learning, and increased their independence and efficiency (Fig 1). 67% of those surveyed indicated that they routinely watched the videos before coming to lab, and 94% agreed that the technology should be implemented in other labs at WPI.

Fig. 1: Student responses to survey regarding the use of digital media.

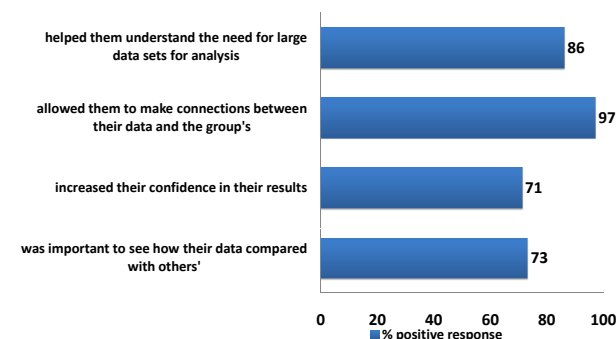


Student evaluations regarding usefulness of real time data display:

The same 87 students were surveyed regarding their impressions of the usefulness of the real time data. Their responses indicate that students found data sharing increased their confidence, helped create community, and provided insight into data analysis and use. (Fig 2). When these data sets were used to support the teaching of statistical analysis, 45% of respondents agreed that they better understood how to analyze data. In an objective test of their knowledge, students showed significant improvement in understanding and using statistical concepts.

Results Continued

Fig 2: Student evaluations regarding usefulness of electronic data sharing



An additional positive outcome of the technology was that real time data display allowed instructors to keep track of students' progress in the laboratory and trouble shoot as needed. This increased the likelihood that students left the lab having performed the experiment correctly.

Student quote:

“The clickers responded very quickly, and it was a nice way to see if the experiment was proceeding the right way or not. It helped to understand data by having such a large data set, and the clickers allowed us to have that data with ease.”

Discussion

While we hope these technologies will streamline some of the processes in the lab, we also hope it will allow us to change the philosophy of the laboratory courses, aiming for the experience to be more relevant and familiar to students and the way they gather, integrate, and synthesize information in the 21st century. Ultimately the application of this technology will provide students with a sense that they are working scientists, learning procedures, carrying out protocols, collaborating with colleagues and building concepts and models based on data.

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References

Hofstein A. and Lunetta V.N., (2004), The laboratory in science education: foundation for the 21st century, *Science Education*, 88, 28-54.