DO GROUP CREATED LAB DESIGNS HELP AID STUDENTS IN UNDERSTANDING OF CONTENT AND SCIENCE PRACTICES?

Background

I created this action research project to enhance the learning environment of my community college engineering and biological science (pre-med) students in their first semester physics. I noticed that students focus on developing the mathematical problem solving abilities, but do not gain a strong understanding of the concepts, science practices, and overall confidence in the material. This leads to low retention of the knowledge (an equation has no meaning if you do not remember the concept it is connected to) and so high drop and low exam rates in future engineering and physics courses. It is my belief that the lab is the perfect place to address issues of concepts, science practices, and confidence in physics material.

Treatment

My intervention took place over the first unit (motion and forces) in which three labs were conducted. For each students were given a problem and were asked to design an experiment to test against the problem and then, to mimic peer review, present their experiment and results to the class to be critiqued. They would need to gather data, apply known models (learned in class) to assess the data, analyze the data to account for error, and think of issues in the experiment design that would account for the error. Growth in conceptual understanding is tracked by pre/post tests, the force concept inventory and the first exam. Growth in science practices will be assessed partially based on personal observation and partially pre/post-tests. Growth in confidence will be assessed by student surveys and interviews.

Questions & Data Collection Instruments

Focus Question: What is the effect of using student group designed experiments in a problem based laboratory environment on student physics conceptual understanding?

Sub-questions	Data Source		
Sub-question 1: What is the effect of a problem based lab environment on student understanding of physics concepts?	Pre-Test	Force Concept Inventory	Post-Test & Exam 1
Sub-question 2: Does designing and implementing an experiment give students more confidence with physics content?	Pre-Survey	Student Interviews	Post-Survey
Sub-question 3: What is the effect of a problem based lab environment on student understanding of scientific processes and data analysis?	Pre-Test	Group Lab Analysis	Post-Test
Sub-question 4: Does designing and implementing an experiment give students more confidence and understanding of scientific processes?	Pre-Survey	Student Interviews	Post-Survey

Results

- A noticeable increase in student conceptual understanding was found. This was evident by increased scores on the lab pre/post quizzes, as well as normalized gain of 0.34 ± 0.08 on the FCI.
- A noticeable increase in student confidence with physics content, data analysis, and general science processes. This was evident in pre/post survey data, as well as came out in student interviews. I personally saw students grow in their ability to openly discuss science concepts and data interpretation during group presentations.
- Data analysis is where I feel the intervention had the greatest impact. As was evident when comparing pre/post data analysis test scores, it was observed that students became more comfortable with regression modeling, error analysis, standard deviation, etc.

Value

The intervention was valuable to my students learning, but also to myself by making me step out of my comfort zone and try something new. I am now more actively involved in using physics education research to continue evolving how I run my classroom, and work to get students more engaged.

Future

I feel as if the intervention had many good outcomes, but was also frustrating to students. I plan to continue with student designed labs, but with more guidance then was given. I will also be adding more group experiences into the lecture portion of my class as well.

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