EXAMINING THE EFFECTS OF COMPUTER-BASED ASSESSMENT TOOLS ON STUDENTS' CONCEPTUAL UNDERSTANDING OF PHYSICS TOPICS

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RESEARCH FOCUS:

The primary focus of my action research was to investigate the utility of the feedback provided to both teacher and student from a computer-generated diagnostic assessment tool and its effect on students' conceptual understanding of physics content. The effectiveness of the website alone as well as the effectiveness of the website along with a conscious intervention were investigated at different times. Also, the effects of the website on students' attitudes about the concepts as well as their opinion regarding the utility of the website were also considered.

WHAT THE LITERATURE SAYS...

-Common sense beliefs don't always go hand-in-hand with correct physics concepts. In fact, many incorrect common sense beliefs were held by many great intellectuals of the past (Hestenes et al).

-Traditional instructional methods do not effectively address students' misconceptions of physics concepts (McDermott).

-Students who show significant conflict show a greater conceptual change than students who do not (Kwon et al).

-Feedback alone is not enough to correct misconceptions. Teachers must directly address the misconceptions with activities that offer "guidance and direction" to students (Guskey).

-Some computer-guided instruction has shown some positive effects regarding students' attitudes as well as their understanding of particular physics concepts (Murray et al).

WHAT THE DATA SHOWS...

The data indicated that the students' scores increased slightly after they took the Diagnoser post-test. An introduction of an intervention usually resulted in a more pronounced improvement in the understanding of a particular concept. The percentage of students who chose an answer that corresponded to a particular misconception decreased in most circumstances—either with or without intervention, but few misconceptions were eliminated completely.

When surveyed regarding their attitudes and opinions about using the Diagnoser website, students overall had positive opinions about the usefulness of the site. When asked whether they pay attention to the feedback that the Diagnoser website gives them while they are taking the quizzes, only 13% of the 68 students in the study responded with "rarely" or "never." Eighty-four percent of the students answered in the affirmative when asked if they feel that the Diagnoser quizzes overall have helped them to understand the material better. Many students offered comments relating to this. Wrote one student regarding the quizzes: "They give me a good idea of how much I am really understanding and what I need help on." Another student felt that the website will "help you correct any mistakes you make right away, as opposed to homework, where you'll have to wait until the next day in class to discuss."

PROJECT DESIGN:

The study was conducted at a suburban high school north of Detroit. The community is an upper-middle to upper class community. The high school is regularly ranked in the top 100 public high schools in the country and is a top performer on state standardized tests. The school is extremely diverse—primarily due to a large international population. Students involved in Phases 1 and 2 of this study were from three sections of Physics 1, a college preparatory course. The majority of these students were 11th graders.

The topics covered during Phase 1 were linear motion topics —constant velocity and acceleration. During this phase of the treatment, students were introduced to the unit concepts in regular class fashion. They were presented with a question, designed an investigation to answer the question and finally reached conclusions based on the investigation. This was followed by practice worksheets. After the introduction of a new concept, students took selected quizzes from www.diagnoser.com (Diagnoser) that corresponded to those concepts. Each concept listed had two quizzes associated with it. The students took the first of these quizzes shortly after the concept was introduced and the second quiz after they had practiced the concept significantly. During Phase 1, no conscious intervention took place between the time the students took the first quiz and the second quiz. Instruction proceeded as usual. Students were given an attitude survey at the end of Phase 1 to determine their feelings regarding the usefulness of the website and their confidence regarding their conceptual understanding of the material.

Topics covered during Phase 2 of the study involved forces and motion. During this phase of the treatment, an intervention was introduced to address each misconception between the concept quizzes. The interventions were adapted from those suggested by the Diagnoser website for each particular misconception. Wave motion was the primary topic for Phase 3. During this phase, teacher-designed interventions were introduced.

The Diagnoser website is free online assessment tool designed to assess students' misconceptions relating to particular science concepts. It provides students with feedback as they are taking the quizzes. At the end of the quiz, students are asked to rank their confidence of their answers. Teachers are able to see a summary of the students' scores and self-rankings. Each wrong answer is coded according to the corresponding misconception. A summary of the results is posted at the end of the website's report. It includes a summary of the percentage of students who held a particular misconception, which the website refers to as "facets".

Sample Question from the Diagnoser website

Frank is experimenting with a metal ball that he is holding up at the end of a string as shown at right.

Which of the following is the best statement about the forces acting on the ball?

(a) Frank is pulling up on the ball.
(b) The ball hangs down tight on the string so the weight of the ball is greater than the pull of the string.
(c) The ball is not moving so there are no forces involved in this situation.
(d) The up force of the string is equal to the force of gravity on the ball.

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