THE CONCEPT OF THE CONCEPT INVENTORY ASSESSMENT INSTRUMENT

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***Abstract* ¾ *The well-known Force Concept Inventory (FCI) instrument has been in use over the last 15 years and is now credited with stimulating reform of physics education. An instructor can give the FCI as both a pre-test and as a post-test to produce data that can be used in a continuous improvement manner to evaluate the effectiveness of various instructional strategies. This presentation will review the development and history of the FCI from the standpoint of what makes it so effective for this use. This presentation will be a lead-in to presentations at this conference of four new Concept Inventories, two in thermodynamics (one for a first year course and one for a second year course), one in signals and processing, and one in strength of materials. Other Concept Inventories are known to exist or are being created (e.g., wave phenomenon for electrical engineers and energy principles in physics).*

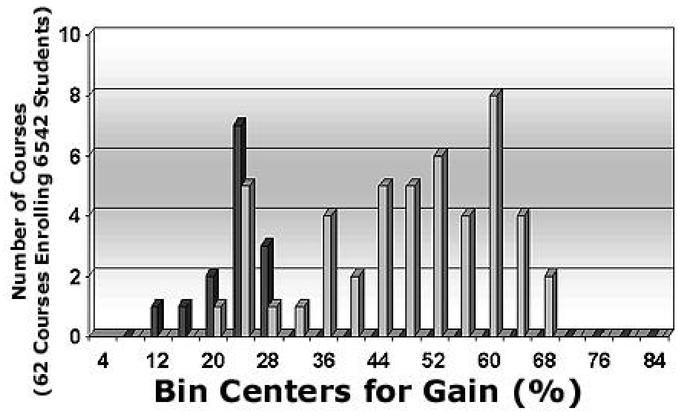
Index Terms ¾ *assessment, continuous improvement, course concepts, evaluation, outcomes*

PAPER SUMMARY

This work will review the influential, groundbreaking Force Concepts Inventory (FCI) of Halloun and Hestenes [1]. As they contend, the design of an effective instructional strategy requires a thorough understanding of the "initial knowledge state" of students. This has been one of the shortcomings of traditional delivery models of instruction; i.e., traditional instruction tries to impart new knowledge to learners without recognizing their "initial knowledge state."

For example, students in most subjects come into a particular course with preconceived ideas of how the world works. Most of these are built up from experience, but some are due to poor instruction encountered previously. For example, by the time that students get to a physics course, they know that, if a large truck and a little car collide head on, they would rather be in the large truck. When they start talking about forces, they turn this into a tightly held misconception that the force that the little car applies to the large truck is smaller than the force the large truck applies to the small car. Most traditional instruction on Newton's Third Law fails to change this tightly held misconception.

Data accumulated on FCI gains (defined as the percentage of what students didn't know at the beginning of the course, they know at the end) show that effective and useful instruments can be designed to measure if instruction has changed some of these misconceptions of important concepts.



The histogram above [2] shows the number of classes that attained each class-average gain for 62 different physics mechanics classes that have used the FCI to measure student gains in understanding of mechanics concepts. The left hand bar in each gain bin represents gains in traditionally delivered instruction classes (e.g., 3 credit hrs of lecture, 1 hr of recitiation and 1 hr of lab), while the right hand bar in each bin is for classes using "active engagement" instructional methods. Note the limited gains for traditionally delivered instruction.

The design of Concept Inventory requires lots of teaching experience in order to be able to recognize the common misconceptions that exist in students' minds on each of the important concepts. The questions on the Inventory must be designed so that the array of possible multiple choice answers include common-misconception-aligned answers as well as an answer that contains the true interpretation of the concept.

This presentation will cover ways to use such instruments to design instructional strategies in a continuous improvement fashion, as well as covering the design of the instruments.

REFERENCES

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