CONCEPT FEEDBACK IN COMPUTER-GRADED ASSIGNMENTS[1]

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Abstract *¾ Information technology in education has greatly enhanced feedback for students and instructors. However, the feedback for instructors has been more difficult to get as individualization of problems has evolved in sophistication and complexity to insure that students are inhibited from mindless copying other students' work without impeding useful collaboration. This has led to a redesign the problem coding and assessment tools in newly developed software to enable meaningful feedback. The method used and examples of concept feedback are presented and discussed.*

Index Terms ¾ Feedback, computer-graded assignments, detecting misconceptions.

DISCUSSION

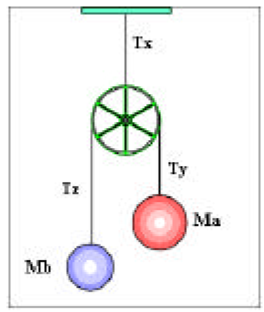
It is widely recognized that feedback is essential for learning. The increasing use of information technology in education has facilitated that feedback for students, and also provided teachers timely data that accurately identified difficulties which students encountered in solving numerical problems and in understanding underlying concepts.

We have been assigning computer-graded homework for the past decade in a number of introductory physics courses, and have used the feedback on student difficulties to adjust the lectures and discussion session to address these problems[1]. Unfortunately, some years ago, students began to share solutions via the Web so that simply entering variables in a formula gave the answers. This "sharing" has further evolved so that a few computer litterate students now provide spread sheets to their fellow students. Thus answers to typical numerical problems can be trivially obtained with even less effort or understanding.

The coding of problems has thus had to evolve to meet this challenge. In many instances this has reduced our ability to get meaningful feedback for problems that are thus not easily shared among students, especially for conceptual problems. We therefore had to rethink and redesign the problem coding and assessment tools. This is being done in the newly developed LON-CAPA software [2]. We are now getting useful feedback on such problems. Students can still collaborate in working out solutions, but it has become more difficult not to do their own work.

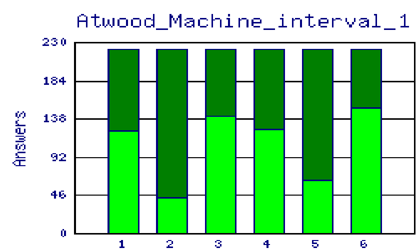
A typical conceptual question is displayed below. The labels Ma, Mb, and Tx, Ty, Tz are randomly permuted, as is the order of questions presented individual students. In addition, each of the six concepts has several variations, resulting in numerous (>10k) problem versions.

A frictionless, massless pulley is attached to the ceiling, in a gravity field g. Mass Ma is greater than mass Mb. The tensions Tx,Ty, Tz, and the constant g are magnitudes. (For each, select: Greater than, Less than, Equal to, True, or False)



1)The acceleration (magnitude) of Mb is .... that of Ma.
2) Tz+Ty is .... Tx.
3) (Mb)g is .... Tz.
4) (Mb)g + (Ma)g is .... Tx.
5) Tz is .... Ty.
6) The center-of-mass of Mb and Ma does not accelerate

The resulting bar graph below shows, for the initial 12% of entries, the number of correct (lower bar) and incorrect (upper bar) responses to each of the six concepts listed.



- Two M's have same size acceleration (string does not stretch)
- Weight of the two M's > tension in top string (cm accelerates)
- Top tension equals the two bottom tensions. (pulley mass = 0)
- Tension acting on the two M's are equal (pulley mass, frict, = 0)
- Accelerations: small M up (T>Mg), large M down (T<Mg)
- Center of mass accelerates downward

Thus grouped, student misconceptions are identified easily. The method and the evolution of responses with time for the above and other examples will be discussed.

REFERENCES

[1] Kashy, D A, Albertelli, G, Kashy, E, and Thoennessen, M, "Teaching with ALN Technology: Benefits and Costs", *Journal of Engineering Education*, Vol. 90, No. 4, October 2001, pp. 499-505

[2] Learning Online Network with CAPA. The software is free, licensed by MSU under GNU General Public License. http://lon-capa.org

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