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A Flexible Homework Method

Flexible Homework: a Simple Method to Introduce Flexibility and Real Time Feedback in Teaching and Learning

Homework is an important tool for learning. By doing homework, students are expected to practice with the knowledge learned in class in different contexts and to acquire necessary problem-solving skills. Graded homework also provides useful feedback to students on their understanding of the content and their approaches in solving problems.

Traditionally, homework is assigned to students on a weekly basis with a definite set of problems often due in a week, at which time solutions are posted. There are a number of concerns to this homework cycle. It is expensive to grade students' homework at a level that gives enough detail to be useful as feedback to students. Since graded homework is usually returned after a week, when the next assignment is due, students usually don't have time to study the solutions of the previous homework in detail and thus are not getting useful feedback to their work and possible difficulties.

Therefore it is useful to explore new homework methods that can engage students in learning and offer immediate feedback to students' learning practices. There are many new technologies such as the web-based homework systems that can offer real time feedback to students. However, current systems can handle primarily simple numerical answers which are not the ideal types of problems that can trigger deep thinking. In our research, we developed a no-cost homework method that offers students real time feedback and flexibility and freedom in picking the problems they practice and submit. This method, referred to as flexible homework, can be easily implemented in virtually all educational settings and with all existing technologies.

In a typical flexible homework assignment, the instructor will assign twice as many problems as he/she would give in a traditional homework. These problems are divided equally in two groups, Group I and Group II. The solutions to the problems in Group I are given three to four days before the due date. The complete solutions to Group II problems are not given until the homework is submitted. Students are requested to submit half of the assigned problems each week, half of which at least have to come from Group II (the ones without solutions). All problems are labeled with "A", "B" or "C" to indicate their level of difficulty.

The two groups of problems are carefully chosen to match in content areas, formats and difficulty levels in order to encourage students to study the Group I problems carefully and then apply what they learned to solve the Group II problems. Half of the homework grade is based on the quality of submitted solutions, and the other half is based on correctness of one or two randomly picked Group II problems.

This method has been implemented in both paper based and web based homework systems. Our research shows that most students preferred the new approach than the traditional approach. It is suggested that high achieving students may make more constructive use of the method than students with a lower level of achievement even though most students submitted work of similar quality. The statistics on students' preferences indicate that good students prefer to have all the solutions before the due date while mid-level students prefer a mixture of hints and solutions. Students reported that they study the Group I problems and solutions as examples to help them solve the Group II problems. Through controlled studies, students' performance data on standardized physics tests also show 5~7% increases in scores for classes using flexible homework compared to identical classes in the same course using the traditional homework method. Additional suggestions for use of this approach include:

- Avoid listing the problems in the same order as the textbook, because students tend to choose the first few problems to do.
- When resources are limited, providing 150% of (rather than twice as many as) the number of questions required for submission is sufficient to satisfy the students' desire for freedom.
- Match Group I and Group II with similar problems to promote practice-and-apply type of behavior. Solutions prepared based on known research results are preferred. For example, the solution might address several different types of alternative (often naive or inappropriate) ideas and methods that are commonly seen among students.
- Provide a balanced set of A, B, and C level problems with diverse settings and requirements.

In our recent study on learning and scientific reasoning (Science, Jan. 30, 2009), it has been shown that learning content knowledge in science and mathematics under current education settings doesn't help students develop general skills in scientific reasoning. It has also been suggested that inquiry based learning in more flexible education settings, which gives students more freedom in self-guided explorations, can have sizable impact on improving students' scientific reasoning ability. This simple method of flexible homework is another practical example for introducing flexibility into teaching and learning.

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