WEEKLY QUIZZES AS LEARNING EXPERIENCES

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SUMMARY

This article describes a weekly quiz implementation which incorporates peer interactions in the form of follow-up collaborative group quizzes, and additional formative assessment through post-quiz reflection assignments.

In this article I describe a weekly quiz activity used in my small and medium enrolment (12–54 students) introductory physics, third-year quantum mechanics and third-year digital electronics courses. I first describe the orchestration of the weekly quizzes and then the benefits to learners and instructors of the three key features of the quizzes: (1) the frequency of the quizzes; (2) the follow-up collaborative group component that accompanies the individually-written quiz (often called a two-stage quiz or exam); and (3) the use of quiz reflection assignments which provide an opportunity for the students to earn back lost marks while learning from their mistakes.

ORCHESTRATION OF THE WEEKLY QUIZZES

In this section I detail the orchestration of the weekly quiz activity, which consists of the following sequential steps:

1. Students write a quiz individually.
2. After the individually-written quizzes have been collected, students write the collaborative group portion of the quiz in groups of three or four.
3. Upon their graded quizzes being returned, students are assigned an optional quiz reflection assignment in which they can earn back lost marks for reflecting on their mistakes from the quiz.

For my implementation, quizzes were written during the lecture period and this time was broken up into two stages: a 15 to 25 minute individually-written portion, and a10 minute follow-up collaborative group portion. A few additional minutes were also required for the transition between the two stages.

In the first stage students would write the quiz individually, which consisted of three to six multiple-choice or short-answer conceptual questions and a short problem. After the individually-written quizzes were collected, the second stage of the quiz would begin and students were asked to self-organize into groups of three or four. The group portion consisted of the same questions as the individually-written quiz, with all questions being presented as multiple-choice questions and each group answering their questions on a common IF-AT (Immediate Feedback Assessment Technique) testing form [1]. This is a commercially produced "scratch and reveal" form which has a single keyed answer under one of the five options for each question. Students receive confirmation that their answer is correct when a star appears where they have scratched away the waxy coating for that option. If a star does not appear for a chosen option, the student receives feedback that their initial answer was incorrect and is then able to make additional attempts to find the correct answer, with the points awarded for a correct answer being reduced for each attempt required beyond the first. When buying these forms, the manufacturer provides a variety of forms with different answer keys, thus the instructor tailors their quiz or exam to match the answer key for a given form.

Although all questions were converted to multiple-choice for the group portion, keeping non-multiple-choice question types, such as short answer and short problems, on the individually written portion allowed for partial marks to be awarded and reduced the marks which could potentially be earned through guessing on the individually-written portion. Since the groups typically did very well on the group portion, with class averages in the 90–95% range as opposed to averages on the individually written portion near 65%, guessing on the group multiple-choice questions was not seen as a large concern.

The quiz grade for an individual student was weighted 75% for the individual component and 25% for the group component, where the group component was not counted if it would have lowered that student's quiz grade.

The quizzes were returned to the students during the next class and students were given a few days to submit a quiz reflection assignment, which allowed them to earn back half of the marks they lost on their individually-written quiz through reflection on their own errors. Instead of

simply being asked to correct their mistakes and submit those, students were asked to complete diagnosis and generalization phases for each incorrectly answered question. The diagnosis phase asked them to identify what went wrong in their answer and the generalization phase asked them to explain how they have gained a deeper understanding of the relevant physics through the process of correcting their mistakes. For an example of a detailed handout describing these phases, see the supplemental materials in [2].

In my implementation a properly completed quiz reflection assignment would earn the student back half of their lost marks, thus a student who completed their reflection assignment and earned an initial grade of 60% on their quiz would have their grade on that quiz increased to 80%.

Although it varied from course to course, the quizzes were typically worth 20% of the final course grade compared to a combined total of 50% for the midterm and final exams. Inclusion of the group portion of the quiz and of the quiz reflection assignments could only improve a student's quiz grade, which has the benefit of lowering the stakes of the quizzes and is likely to contribute to students' overall positive attitude toward the quizzes.

BENEFITS OF FREQUENT QUIZZES

From a learning perspective, it well known that frequent testing can enhance retention relative to additional study of the material by a well-studied phenomenon known as the testing effect [3]. Additionally, recent work [4] has shown that moving from two midterm exams to thirteen weekly tests significantly reduced the self-reported student use of homework cheat sites.

From a teaching perspective, weekly quizzes can provide a more accurate picture of the current level of student understanding than would a weekly homework assignment, allowing the quizzes to be viewed as a form of formative assessment, guiding both future instruction and future student studying.

BENEFITS OF TWO-STAGE QUIZZES

The collaborative group portion of a two-stage quiz builds additional elements of formative assessment into what is typically a primarily summative type of assessment [5]. Following up the individually-written quiz with a collaborative group quiz offers the same type of learning benefits as Peer Instruction [6], but with an even higher level of student engagement. In my experience, the room is much more animated and the discussions more intense when I compare my observations of students writing a group quiz to those of students discussing a clicker question.

Two studies, one in Physics [7] and one in Earth Science [8], have shown that the learning which takes place in the group portion of a two-stage exam is, on average, retained when the students are re-tested two weeks or three days later, respectively.

Rieger and Heiner [9] found that 76% of the students responding to a survey in an introductory physics course ($N = 123$) had generally positive opinions of two-stage exams. In my own introductory physics course ($N = 47$), when asked how they felt the group quizzes contributed to their learning, 87% of students responded that they made "a large contribution to my learning," as opposed to "a small contribution to my learning," or "they don't contribute to my learning."

One final benefit from my implementation is that the IF-AT testing forms were used to provide the groups with immediate feedback on their answers, allowing every student to know all the correct answers upon completion of the quiz.

BENEFITS OF REFLECTION ASSIGNMENTS

I engage my students in quiz reflection assignments so that they will take the time to look critically at their own mistakes and reflect on the thinking that led them to their incorrect answers. Formative assessment tasks, such as these reflection assignments, have been shown to reduce the performance gap between low- and high-achievers when given a follow-up transfer problem [10].

SUMMARY

I have successfully used the approach to weekly quizzes described above in courses with up to 54 students. Although implementation of the quizzes reduced the weekly lecture time by 35–40 minutes, I feel that the benefits discussed in this paper outweigh that loss of lecture time. Students appreciate the approach and say that it helps them learn physics. The largest time commitment for grading was the individually-written quizzes due to the inclusion of problems and short-answer questions, but converting all questions on the individually-written quizzes to multiple-choice can minimize this time commitment. The time commitment for grading the group portion was minimal due to the IF-AT testing forms. The time commitment for grading the reflection assignments can vary from small, if you are quickly scanning them to check for an appropriate level of effort, to large if you are reading them carefully and providing detailed feedback. In large-enrolment courses, options for grading the reflection assignments include the use of appropriately trained Teaching Assistants, automatic participation marks assigned to online submissions with random spot-checks to check for appropriate effort, or online peer assessment if appropriate time is taken to train the students how to grade fairly. I believe that this entire approach to weekly quizzes can be used in large-enrolment courses with only some minor adjustments and I encourage you to try this approach in your own courses.

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