ILLUMINATIONS

Development of a risk-based, large-group revision quiz for first-year undergraduates

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INTRODUCTION

We have experienced increasing demand from undergraduate students, particularly those in the early years of study, to be able to access more “test-style” material to help with revision, as well as guidance on how to approach their university assessments. This demand may be driven by previous experience of preparation for school tests via the use of past exam papers, coupled with concerns over the unfamiliarity of university assessments. With increased use of multiple-choice questions (MCQs) in university assessments in the biomedical sciences, especially in the first year, there is often reluctance from course organizers to make more questions available to students, as good MCQs are challenging to write and are, therefore, kept for use in summative tests (4).

Throughout their studies, students need to be able to develop confidence in their knowledge and their ability to answer unfamiliar questions, as well as apply their knowledge to new questions. Case and Swanson (4) emphasized that the purpose of testing is to communicate to students what material is important; it also motivates them to study and can help identify areas of deficiency. There are many ways outside of the “end-of-course” summative assessments in which to achieve this, such as via social media (12) and online question platforms like Peerwise (10) and Quizlet (5). Many of these platforms, however, see the student working alone or in digital communities with fellow students and do not enable real-time academic input to the process of attempting unfamiliar questions. An opportunity for students to attempt test-style questions in a formative setting with immediate academic feedback not only allows students to gain confidence in tackling the question formats they will encounter in tests, but also allows them to learn from mistakes and avoid repeating these in summative assessments (7).

Strategies and practice in answering MCQs on course material can be developed through tutorial-style small-group teaching for which there is strong evidence for the effectiveness of this style of learning (9). However, there is often variability in experience between tutorial groups with different tutor and student dynamics, which highlight the complex challenges that come with small-group teaching compared with large-group teaching (11). Small-group teaching is also labor intensive and requires considerable staff time and the physical space to deliver such teaching. A solution to this is whole class group tutorials, which allow all students to receive the same teaching experience and are less staff intensive. This style of teaching has the potential of not engaging the whole cohort as effectively as in a small-group setting; however, team work between small groups of students within a larger group can promote engagement of all students, especially if an element of uncertainty is built into the activities (8).

It is well documented that introducing elements of student-led learning into courses improves student outcomes (1). A means for engaging students and allowing them to determine the outcome of the teaching in a large class setting can be achieved by using audience response devices via e-voting (clickers). E-voting has been demonstrated to improve student engagement, and its use can be adapted to encourage collaborative working (3). This is particularly the case if the students are influencing the outcome of a session by choosing the material delivered using e-voting. The use of clickers also allows students to judge their performance relative to their peers anonymously, and for teachers to identify and immediately clarify misconceptions, which is often lost when using other forms of e-learning (3).

In addition to the choice element, to maintain student engagement, it has been shown that introducing some “risk” into answering questions can help to reinforce learning (8). A session where students work in teams allows an element of risk or jeopardy to be included into the session that is perhaps less threatening as the risk is shared within the teams (2).

We describe the development and delivery of a whole class revision quiz tutorial to three cohorts of first-year students (Dentistry, Veterinary, and Bachelor of Science Physiological Science students) that includes elements of e-voting and risk. Although content specific to these disciplines was used, this format of teaching could be used for any knowledge-based course that is assessed via MCQs. Students choose their own teams and use clickers to help shape the delivery of the quiz by voting on the difficulty of question rounds answered. The session was introduced to engage students in the style of a “pub quiz” but had an additional element of jeopardy or risk with students judging their confidence in their own team’s answers, which then reflected the overall marks awarded (jeopardy score).

METHODS

The session outlined below has been used with three different cohorts of first-year undergraduate students taking basic biomedical science/healthcare degrees over the past 3 yr; the format worked the same for all cohorts, but the questions used were adapted accordingly to suit course content.
All sessions were delivered in a standard lecture theater in a timetabled session toward the end of the academic year and before the start of the revision period for the end-of-course assessments. A 2-h slot was booked to ensure adequate time for delivery of the quiz and for any follow up of misconceptions at the end of the session.

The session was run by one member of staff (usually the course organiser or someone equally familiar with content across the course) using a predeveloped PowerPoint presentation. Students attended the session with no prior knowledge of what would be delivered or any expectation of preparation and were able to sit wherever they chose. Students organized themselves into teams, and each team was assigned an audience response device or “clicker” and asked to nominate a team captain to contribute to the e-voting for the interactive aspects of the session.

With the time available, the session was run with three rounds of five questions per round, categorized as either easy, medium, hard, or pot-luck (random), as judged from the previous performance of the questions in summative assessments. There was also an additional “picture round” of five questions that focused on the practical content of the course (Fig. 1). To encourage student engagement, a small prize was obtained to award to the overall winning team at the end of the session.

**Starting the session.** On arrival, the purpose of the session was outlined to the students by the academic lead. Students were asked to organize themselves into teams of a maximum of five students per team. Depending on class size (ranging from 70–200 students), this equated to between 14 and 40 teams participating in the quiz. Each team was given a clicker and a printed blank score sheet on which to note its answers and scores; this also featured the five picture round questions on the reverse (Fig. 1).

The structure of the session was explained by the academic lead (Fig. 2), including the application of the jeopardy score (explained further below). Each team then nominated a team captain to vote for the rounds of questions to be used in the quiz using TurningPoint software and e-voting clickers. This e-voting system allows students’ responses to be collected anonymously and displayed to the whole class. The team captains voted on which three difficulty categories of questions would form the rounds of the quiz for all teams; these were picked from four categories entitled: easy, medium, hard, and pot-luck (random). The highest voted difficulty categories were used to generate the quiz.

**The quiz.** Five best of five MCQs per difficulty round, voted for as explained above, were presented in turn by the academic lead with the use of PowerPoint to the whole class, and the teams discussed and entered their chosen answers on the score sheet. A paper-based score sheet was used to record the teams’ answers and jeopardy scores at this stage to allow teams to then swap sheets for marking by another team at the end of the quiz (Fig. 2). This is the same approach used in a traditional British “pub quiz” on which the format of this quiz is based. E-voting on the answers was only used during the marking of the score sheets at the end of the quiz to allow answers to be displayed to the rest of the group for further discussion.

All questions complied with good practice in writing this style of question, including adhering to the cover-up test, i.e., ensuring the question could be answered even without the potential answers being viewed, and ensuring that all distractors were homogenous, i.e., all potential answers having the same theme, such as hormones, cells, drugs, etc. (4). Question topics included all of the key subjects taught in that course and included a mix of pure knowledge recall and more problem-based/data-interpretation style questions. At this stage, no e-voting was required.

In addition to each chosen answer, teams had to decide on a “jeopardy score” per question based on how confident they were with their answer. Team members had to decide if they were very confident, fairly confident, or not confident that their answer was correct. The jeopardy score would influence their mark for that question, with those who were very confident in their answer scoring highly (4 marks) if they were correct, but receiving a negative mark (−2 marks) if they were incorrect. Similarly, teams that were not confident in their answers would score a positive but lower mark (1 mark) for correct answers, but were not penalized for incorrect answers (0 marks). Those who were fairly confident in their answer scored 2 marks if correct and were penalized −1 mark if incorrect (Fig. 3). For example, a team rating all 5 answers in a round as very confident and getting them all correct would be rewarded with a score of 20, but getting them all incorrect would score −10. A team rating all 5 answers in a round as not confident and getting them all correct would score 5, but getting them all incorrect would score 0. Adequate time was given per question to allow students in each team to decide on their chosen answer and to agree on a jeopardy score per question before moving on to the next question in the round.

When all rounds were complete, the teams were given time to complete the picture round (Fig. 1) before swapping score sheets to mark another team’s answers. The picture round included questions such as identifying the correct setup of equipment (e.g., the correct positioning of ECG electrodes) and extracting information from a figure or graph and calculating a value (e.g., calculating cardiac output from a data monitor displaying heart rate and stroke volume). The picture round was not included in the jeopardy scoring and, therefore, had a maximum potential score of 5.

**Marking.** Completed score sheets were randomly swapped with another team, and the quiz questions were displayed to the class again in turn in the order in which they had been delivered during the quiz, this time using the TurningPoint software. Each team captain was instructed to vote for the answer given by the team whose score sheet he/she was marking using the team clicker (Fig. 2).

The percentage of teams giving each answer was revealed on each slide, along with the correct answer (Fig. 4), and students marked the score sheet in front of them. The mark awarded for each question took into account the jeopardy score as outlined above. Each correct answer was then explained, and any misconceptions were clarified by the academic lead.

The final team scores, including the jeopardy scores and those of the final picture round, were calculated by the marking teams, and score sheets were collected. The winning team was verified by the academic lead before score sheets were returned to the original teams. The team captain reported his/her team’s score in a final slide using e-voting to enable each team to see where it came in the rankings. A small prize, such as a bag of sweets, was then awarded to the members of the winning team.

**Evaluation.** Initial observations from academic leads within these sessions are that it was apparent that the students were engaged and there was good discussion within the teams about the answer for each question. When a new question was revealed, there was always a short period of silence as the teams read and digested the question and then a noisier period as the students discussed the answer within the teams. There has been no evidence of any students being left out of their team’s discussion or any students being too dominant within a team. The jeopardy aspect of the scoring forced students to think carefully about their answer before committing and highlighted areas to earmark for further study, as well as providing an opportunity for misconceptions to be explained.

At a later date, students were asked to evaluate the revision quiz as part of the course evaluation. This was carried out by the students answering questions on the course content with their individual clickers. Evaluation by the different cohorts of students was consistent. Typically 85% of students agreed or strongly agreed that the quiz was a useful revision exercise, and 67% agreed or strongly agreed that deciding on a jeopardy score in their team helped to identify areas of the course where knowledge was strong or weak.

**Suggestions for adaptations and extensions.** For the purposes of the session outlined here, the revision quiz was a one-off informal and fun way to engage first-year undergraduate students in formative assessment of basic biomedical science principles in a group-style setting.
Group members: ____________________

PICTURE ROUND

QUESTION 1
Which of the above traces would best represent a lead II ECG recording in a healthy adult?
A. A
B. B
C. C
D. D
E. All of the above

QUESTION 2
On the person above, where would you attach the positive electrode to record a lead II ECG?
A. A
B. B
C. C
D. D
E. E

Question 3
Which of the following respiratory parameters can be measured using this piece of equipment?
A. Dead space
B. Tidal volume
C. Residual volume
D. Respiratory rate
E. Forced vital capacity

Question 4
Above is a urine dipstick that has been used to test the urine of a subject pictured alongside the reference chart. Which of the following physiological/pathophysiological conditions would give this dipstick profile?
The subject is
A. is a healthy individual
B. has untreated diabetes mellitus
C. has untreated diabetes insipidus
D. has glomerular damage
E. has intravascular damage

Fig. 1. Picture round used in quiz.
However, aspects of this session could be used in different ways and extended for a variety of purposes.

The style of the session could be used for any discipline that uses multiple-choice-style questions and, instead of a one-off, end-of-course session, could be used regularly as “pop quizzes.” If used in this way, the jeopardy element could be introduced from the beginning or brought in later in a course when educators might want to start challenging students to consider the answers they choose. If used regularly, course organizers might want to introduce a summative element to the marks, especially if students remained in consistent teams, although the relative contribution of these marks to a course must always be small due to the group nature of the work. Even if used in a formative manner, for the purposes of monitoring student attendance and progress, score sheets could be taken in after the session and verified by staff if necessary.

Other question styles may also work in this format of quiz, such as calculation-style or specimen identification questions. The number of questions per round and the number of rounds per quiz are entirely at the discretion of the academic lead based on the time and questions available. The authors found that a 2-h session enabled four rounds of five questions to be delivered without rushing and with time for feedback on each question during the scoring at the end of the session. Students could be encouraged to contribute to this feedback, with each team having to provide an explanation to a question it got correct to the rest of the cohort, depending on class size. Often it is also useful to highlight questions students have gotten incorrect and ask a willing volunteer to explain his/her logic to help correct misconceptions or miscalculations. This would further engage the students in the whole process. The use of clickers is also optional; there are currently several different options on the market with varying effectiveness, including the use of smart phones and software such as Poll Everywhere (6).
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