Introducing Formative Exam Practice to a Summatively Assessed Equine Science Module

Mae'r Cylch Dysgu hwn o'r portffolio TUAUU wedi'i gyflwyno i CADAIR gyda chaniatâd yr awdur uchod. Adnodd i'w ddefnyddio gan ymgeiswyr y TUAAU yn y dyfodol a staff eraill ydyw, fel rhan o'u datblygu proffesiynol ym Mhrifysgol Aberystwyth. Os hoffech gyfeiriadau terfynedig, cysylltwch â thestaff@aber.ac.uk.
Teaching Cycle 3: Introducing formative exam practise to a summatively assessed equine science module

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Aims and Rationale
During my first year at Aberystwyth University I was responsible for teaching the year 1 Equine Science module 'Foundations of Equine Performance Science' and have continued to teach this module thereafter. Following the first year that I taught the module I was disappointed with the exam results of the students. From marking the exam scripts I identified that poor marks were not necessarily associated with lack of understanding but rather misinterpreting the question. For example, one question was 'Describe the physiological changes that occur to the cardiovascular system after a training programme', but many answers, rather than consider the affect of training (i.e. over a pro-longed period of time), answered in the context of a single training session (i.e. an exercise bout). Therefore, I wanted to devise a method by which I could convey the emphasis of questions to students and, considering the students are in their 1st year, provide an opportunity for insight and practise of exam technique.

During a departmental meeting, it was suggested that introducing smaller tests (formative assessment), rather than a final summative exam had been successful at improving marks in a different Equine Science module co-ordinated by a colleague. I was not able to simply instigate formative assessment in place of summative because this requires many administrative steps and approval by the university's Learning and Teaching Committee. Therefore, as an alternative I decided to investigate the effect of introducing informal, practice exam questions to the students within the module, without changing the assessment criteria. The aim was to write a series of questions which were given to the students within lecture time at the end of week 4 and 9. Students were advised at the beginning of the module that they would be receiving these questions during the course and the questions provided were written in the style of an exam, without repeating questions that would ultimately appear. The questions covered topics that had been most recently covered and each student was given 10 min to answer their questions. Students were able to discuss the answers with
colleagues and use notes to help them. Once completed, I described the answers using an open discussion with the students and noted down key points and model answers on the whiteboard. Although it is difficult to directly compare the first group of students who took this module that did not receive exam practice to those who did in the following year, mean exam marks as a general guide to the effect of this intervention were considered.

Generally, 2 types of assessment are employed during academic study. Summative assessment aims to sum up learners achievement by testing knowledge at the end of a course. In contrast, formative assessment is an on-going process during the course (Petty, 1998). Generally, it is believed that formative assessment is more effective because it highlights areas of poor knowledge or difficulties and enables remedies to be implemented before the course ends, whereas summative assessment only tests knowledge recall, after which the course has finished and no further action can be taken to improve the final mark awarded (Petty, 1998). Considering these common conceptions it is surprising that summative exams frequently account for at least 40 % of the final mark awarded for a module at Aberystwyth University and indeed, for the modules under investigation in the present study, the exam accounted for 100 % of the mark.

Further justification for introducing formative methods within the module is apparent because summative methods do not satisfy the seven principals of good practice for assessment. In contrast, formative assessment methods, such as that which will be employed in the present study, do satisfy these principals. The seven principals are defined as: encourage student-staff contact; encourages co-operation among students; encourages active learning; gives prompt feedback; emphasises time on task; communicates high expectations; respects diverse talents and ways of learning (Chickering et al. 1987). In addition to the seven principals of good practice, assessments should be designed to reflect the skills and knowledge being acquired, commonly termed constructive alignment (Biggs, 1999). To some extent, my proposed method of practising exam questions within the module is an example of constructive alignment. Admittedly, in a module that examines the science of training performance horses, the best form of constructively aligned assessment would be for students to train a horse, however, temporal and practical issues do not allow for this.
Therefore, an exam is a more appropriate assessment and thus the module itself should be aligned to the exam by providing examples of practise questions. Therefore, the choice of activity (practise exam questions introduced periodically within the module and informally), is appropriate for this module and these students.

It is notoriously difficult to assess students undertaking equine science. As already highlighted above, the best assessment would match the learning outcomes. However, where outcomes are to understand the physiological changes that occur after training or to design a fitness programme, testing these objectives is not possible for each student, or even groups of students to train a horse over a number of weeks for the purpose of assessment. Therefore, more traditional methods of assessment, such as coursework assignments and/or examinations are used within IBERS as an alternative. Undergraduate veterinary programmes that are clinical in nature experience similar problems in designing appropriate assessment. Therefore, Objective Structured Clinical Examinations (OSCE’s) were introduced in medical (Elliot et al., 1994) and subsequently, veterinary schools in the 90’s. The OSCE’s consist of several stations that students rotate around in turn, each station provides a patient with presenting clinical signs forming the basis of a scenario and students were given a specified time to answer questions from a clinician. However, it is acknowledged that this is labour and resource intensive, requires much planning and equipment and may not be appropriate for Equine Science students where learning is much less clinical. One advantage of the OSCE is the ability to assess large numbers of students (Elliot et al., 1994), in the magnitude of 100 to 200; however, this is not an advantage at Aberystwyth University where student numbers are rarely above 45. One group of workers tested the introduction of weekly, multiple-choice, quizzes for students studying veterinary anatomy and correlated the results to the final summative examination (Lukic et al., 2001). The authors concluded that the results of the multiple-choice quizzes correlated significantly with the summative exam and may be better for acquiring synthetic understanding of anatomical concepts. In addition, the authors recommended quizzes as reliable and objective means for monitoring students' performance (Lukic et al., 2001).

In summary, equine science courses are renowned for being difficult to test on a constructive alignment basis. Therefore, on-going formative methods must be
introduced and adapted as best they can to maximise the preparation and performance of students subjected to traditional and cost-effective summative examinations. The aim of this study was to compare 2 groups of students, one group assessed solely by summative assessment, and a second group who were given practise questions during the course in a formative manner before completing a similar summative examination.

Materials and Methods
Two groups of students were used for this intervention; both groups were taught the same, 11 week module 'Foundations of Equine Performance Science', one year apart. Group 1 (n = 38) were taught the module without any formative practise and were assessed summatively at the end of the course. Group 2 (n = 34) were taught using the same prepared lectures and Power Point presentations during the 11 week course, but in addition, time was given within week 4 and 9 lectures for an informal exam practise session (Fig. 1). Both student groups were given a handout illustrating the scheme of work (Fig. 1) during week 1. During week 1, group 2 students were alerted to the 'Test' at week 4 and 9 and the rationale for including these was explained.

The questions given to students in group 2 during week 4 and 9 'Test's were designed so that they addressed topics covered in the previous weeks lectures and were written in a similar style to those that would appear in the forthcoming end of semester examination. The 'Tests' can be seen in Appendix 1. In both weeks 4 and 9, questions were provided to the students on a handout, so that students could keep them as revision practise. Once distributed, students were allowed 10 min to answer the questions and were able to discuss with colleagues and with myself as the lecturer. After 10 min had passed, the questions were discussed as a whole class and model answer were written by the lecturer on the whiteboard. The discussion time enabled students to ask questions and mark their own answers.

The effect of the practise questions was assessed by comparing the final summative examinations results of group 1 and 2 students. In order to demonstrate that the formative tests given to group 2 were adequately representative of the final summative examination, the exam has been provided in Appendix 2. Statistical analysis was performed using SPSS (version 16) and an independent T-test was used to compare the means of group 1 and 2 because the data was normally distributed and
different participants were used in the two groups. Significance was assumed when P < 0.05.
<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Day</th>
<th>Start</th>
<th>End</th>
<th>Activity</th>
<th>Topic</th>
<th>Staff</th>
<th>Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30\textsuperscript{th} Jan</td>
<td>Wednesday</td>
<td>1200</td>
<td>1400</td>
<td>Lecture</td>
<td>Introduction: Selecting a sports horse, training principals and science versus practice of training</td>
<td>DMN</td>
<td>W19</td>
</tr>
<tr>
<td>2</td>
<td>6\textsuperscript{th} Feb</td>
<td>Wednesday</td>
<td>1200</td>
<td>1400</td>
<td>Practical</td>
<td>Training aids and measuring fitness</td>
<td>DMN</td>
<td>Yard</td>
</tr>
<tr>
<td>3</td>
<td>13\textsuperscript{th} Feb</td>
<td>Wednesday</td>
<td>1200</td>
<td>1400</td>
<td>Lecture</td>
<td>Energetics of exercise. Hand out assignment</td>
<td>DMN</td>
<td>W19</td>
</tr>
<tr>
<td>4</td>
<td>20\textsuperscript{th} Feb</td>
<td>Wednesday</td>
<td>1200</td>
<td>1400</td>
<td>Lecture</td>
<td>Muscular response to exercise \textsuperscript{TEST}</td>
<td>DMN</td>
<td>W19</td>
</tr>
<tr>
<td>5</td>
<td>27\textsuperscript{th} Feb</td>
<td>Wednesday</td>
<td>1200</td>
<td>1400</td>
<td>Lecture</td>
<td>Cardiovascular response to exercise</td>
<td>DMN</td>
<td>W19</td>
</tr>
<tr>
<td>6</td>
<td>5\textsuperscript{th} March</td>
<td>Wednesday</td>
<td>1200</td>
<td>1400</td>
<td>Lecture</td>
<td>The respiratory response to training</td>
<td>DMN</td>
<td>W19</td>
</tr>
<tr>
<td>7</td>
<td>12\textsuperscript{th} March</td>
<td>Wednesday</td>
<td>1200</td>
<td>1400</td>
<td>Practical</td>
<td>Heart and lung dissection</td>
<td>DMN</td>
<td>W18</td>
</tr>
<tr>
<td>8</td>
<td>9\textsuperscript{th} April</td>
<td>Wednesday</td>
<td>1200</td>
<td>1400</td>
<td>Lecture</td>
<td>Skeletal, tendons and ligament response to exercise</td>
<td>DMN</td>
<td>W19</td>
</tr>
<tr>
<td>9</td>
<td>16\textsuperscript{th} April</td>
<td>Wednesday</td>
<td>1200</td>
<td>1400</td>
<td>Lecture</td>
<td>Adaptations to training, fatigue, thermoregulation \textsuperscript{TEST}</td>
<td>DMN</td>
<td>W19</td>
</tr>
<tr>
<td>10</td>
<td>23\textsuperscript{rd} April</td>
<td>Wednesday</td>
<td>1200</td>
<td>1400</td>
<td>Lecture</td>
<td>Sports injuries and breakdowns + module review</td>
<td>DMN</td>
<td>W19</td>
</tr>
<tr>
<td>11</td>
<td>30\textsuperscript{th} April</td>
<td>Wednesday</td>
<td>1200</td>
<td>1400</td>
<td>Lecture</td>
<td>Complete any unfinished work. Exam prep and module review (Debbie away on study tour)</td>
<td>DMN</td>
<td>W19</td>
</tr>
</tbody>
</table>

Figure 1: Scheme of work for groups 1 and 2 for Foundations of Equine Performance Science. The informal practise exam questions for group 2 are termed ‘\textsuperscript{TEST}’ during weeks 4 and 9.
Results
The mean mark for students in group 1 was 42.8 (± 15.8 SEM) and in group 2 was 53.4 (± 20.5 SEM). A summary of results according to the number of students gaining marks within each degree class category is shown in Table 1. The difference between the marks of group 1 and group 2 was significantly different (P = 0.015) and therefore, marks from group 2 students were significantly greater than those of group 1 (Table 1).

Table 2: Marks gained by students in group 1 (received no formative exam practise) and 2 (received formative exam practise) according to the number of students who gained a mark in each degree class category

<table>
<thead>
<tr>
<th>Marks category</th>
<th>Number of students in group 1 obtaining results in each category</th>
<th>Number of students in group 2 obtaining results in each category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st 70-100</td>
<td>3 (7.9 %)</td>
<td>8 (23.5 %)</td>
</tr>
<tr>
<td>2:1 60-69</td>
<td>3 (7.9 %)</td>
<td>3 (8.8 %)</td>
</tr>
<tr>
<td>2:2 50-59</td>
<td>7 (18 %)</td>
<td>8 (23.5 %)</td>
</tr>
<tr>
<td>3rd 40-49</td>
<td>8 (21.1 %)</td>
<td>8 (23.5 %)</td>
</tr>
<tr>
<td>Condoned fail  30-39</td>
<td>13 (34.2 %)</td>
<td>4 (11.8 %)</td>
</tr>
<tr>
<td>Fail 0-29</td>
<td>4 (10.5 %)</td>
<td>3 (8.8 %)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>38</strong></td>
<td><strong>34</strong></td>
</tr>
<tr>
<td><strong>Maximum mark</strong></td>
<td>76.8</td>
<td>93</td>
</tr>
<tr>
<td><strong>Minimum mark</strong></td>
<td>16.7</td>
<td>0</td>
</tr>
<tr>
<td><strong>Mean mark</strong></td>
<td>42.8</td>
<td>53.4</td>
</tr>
<tr>
<td><strong>Standard deviation</strong></td>
<td>15.8</td>
<td>20.5</td>
</tr>
</tbody>
</table>

Discussion
It can be concluded that the marks of group 2 students, who received formative yet informal exam practise during the course of their module, were significantly improved above that of the marks of group 1 students, who did not receive practise questions. Therefore, the findings of the present study agree with those of Lukic et al (2001) who
used weekly quizzes to improve student performance. As Luvik et al., (2001) suggest, the improvement in marks by the formative practise questions, may be due to the 'Test' offering the students an insight to their progress as well as the desired technique for written skills to tackle the exam successfully. However, an alternative explanation may be that changes were made to the exam after the initial year that I was teaching it (after teaching group 1), including using a new set of questions and careful wording of the exam questions to prevent misinterpretation (applied to group 2). These changes cannot be easily disentangled from the effect of introducing exam practice during the course alone. However, student feedback following module evaluation did indeed reveal positive comments about having practise exam sessions, and some students requested this should be increased.

Having been convinced of the value of informal practise questions it would now be appropriate to develop this further within this Equine Science module. The use of practise questions will be continued but it may not be appropriate to increase the frequency of using these every week, as students may become 'bored' and the importance placed on this exercise may be lost. However, the value of students being able to assess their own performance during the course is still paramount. Therefore, in addition to practise questions, it would now be appropriate to introduce multiple choice tests on other weeks within the 11 week course. Multiple choice questions could be introduced in a novel and 'fun' manner, such as using Qwizdom, an electronic keypad given to each student who press the button relating to the correct answer and the central computer collates the answers. Such a system enables instant feedback for the student regarding their performance (or not depending on how the lecturer pre-sets the equipment). In addition, a student-focused activity encourages deep, rather than surface learning technique as recommended to improve knowledge retention and enriches the learning experience (Trigwell, 1999). Several colleagues have used Qwizdom within Aberystwyth University and have reported very positively upon its effect on teaching. Furthermore, reports are emerging in educational literature that also endorses the use of Qwizdom. Physics teachers in the United States have been using the Qwizdom system since 1995 and have observed drastically improved learning experience amongst students and as a result student attendance and retention has also increased (Bernstein and Lederman, 2001).
As a result of the present study the use of practise questions for teaching this module will be repeated in the forthcoming academic year. In addition, formative, practise exam questions will also be introduced them to other 1st and 2nd year modules that I co-ordinate and developing this type of formative, yet informal assessment by adapting to the use of the Qwizdom system.

List of References


Appendix 1: In formal, formative tests provided for Group 2

Week 4

Preparatory Test 1

Section 1 (short answer questions)

Q1. Draw a labelled diagram to show the rate of energy expenditure as speed increases for the horse when allowed to chose its own pace and how this differs if asked to walk/trot/canter as fast as possible

Q2. Describe the structure of the training triangle and give examples of types of exercises that may be performed at each stage of the triangle

Q3. Name 2 types of high energy phosphates that the horse uses for creating energy and explain when they would be used in the context of a horse race
Q4. Describe 3 different methods of testing performance in order to assess the fitness of a horse and explain what each method indicates

Section 2 (Long answer questions)

Q5. Explain the adaptations that occur to the muscles of a horse after a training programme has increased the horses fitness
Preparatory Test 2

Section 1: Answer ALL Questions

(BSc, marks not given for each question so learn to 'guess' how many marks may be available. Usually in section 1 requires shorter answers and each question carries 5 or 10 marks. Section 2 requires longer answers and each question may carry up to 20 marks)

Q1 Write an equation (including the correct units) to show how minute ventilation (VE) is calculated and then perform the calculation using data that would be typically obtained from a horse at rest and then again using data typically obtained from a horse undergoing maximal exercise

Q2 Draw a labelled graph to describe how bone strain changes as increasing load is placed upon it
Q3 List the 4 ways in which heat is lost from a horse’s body by thermoregulation during exercise and explain the physical effects that may occur if a horse exercises in a hot and humid atmosphere.

Section 2: Choose 1 of 2 questions

Q4 Describe the changes that occur to bone and tendons/ligaments that occur when an unfit horse has been trained to become fit. How may this inform training of horses of different ages?

QS Scenario type of question: Imagine you are an endurance rider and you and your Anglo Arab are going to compete in a 50 mile ride, in 3 weeks time (which will be in the month of August). What precautions can you take to ensure the welfare of your horses performing during potentially hot and humid conditions? Describe any metabolic disorders you must be aware of.
Appendix 2: The summative end of module examination

PRIFYSGOL ABERYSTWYTH ABERYSTWYTH UNIVERSITY

ABERYSTWYTH

BSc EXAMINATIONS SEMESTER 2, 2008

INSTITUTE OF RURAL SCIENCES

Module identifier RSI0410
Module title Foundations of equine performance physiology
Co-ordinator Debbie Nash
Semester Semester 2
Assessment Exam 40 00

Date
Start time

TIME ALLOWED: 1.5 hrs

ANSWER QUESTIONS:

Section 1: Answer all questions (allow 1 hr for this section)

Section 2: Long answer questions, answer 1 of the 2 questions (allow 30 min per question)

SECTION 1

Q1 Explain why conformation is important to assess when selecting a sports horse. Use two named examples of specific conformation characteristics that may be assessed and for each discuss the implications of faults in your chosen characteristic

(5)

Q2 Competition horses in all disciplines are trained overland, however, in some sports, the use of a treadmill is becoming increasingly popular. Compare the treadmill to overland methods for the purpose of performance testing. Include in your answer a list of different tests that can be performed, and any advantages or disadvantages associated with each method

(10)
Q3 Horse muscle cells will utilise different fuel sources (substrate) in different aerobic or anaerobic pathways at the beginning of exercise, during and at the end of exercise. Explain the fuel sources and where appropriate, they types of pathways they are used in by a horse undergoing a 1 mile flat race at the beginning, midway and end of the race.

Q4 Draw a labelled graph to show the relationship of blood lactate concentrations as running speed increases and clearly mark the Onset of Blood Lactation Accumulation (OBLA).

Q5 List and explain reasons why the respiratory system may be considered a factor that limits the equine species in athletic performance.

Q6 Write an equation (including the correct units) to show how cardiac output (Q) is calculated and then perform the calculation using data that would be typically obtained from a horse at rest and then again using data typically obtained from a horse undergoing maximal exercise.

Q7 Describe the factors that lead to fatigue in a horse that is exercising maximally (i.e. during fast work).

SECTION 2 (Answer! of the 2 questions)

Q8 Describe the changes that occur to the heart, blood and capillaries after an unfit horse has been subjected to a training programme and has become fit.

Q9 Describe the changes that occur to skeletal muscles and their blood supply after an unfit horse has been subjected to a training programme to become fit. You should also include in your answer changes in muscle fibre types I, IIa and IIb in relation to their function.