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Assessing reflective thinking and analytical skills in final exams

Pernille Kæstel

Department of Human Nutrition, LIFE, University of Copenhagen

Introduction

Since I worked with the pre-project for a higher education teaching course, I have changed my attitude towards exams. Previously, I did not acknowledge exams and marks as a driving force for students' motivation and learning process. However, during my pre-project work, I realized that exams and marks are important for students. Many students need exams as immediate goals, although they also know that learning is not for the exam, but for life. Therefore, we should use the exams wisely and make sure we test what we expect the students to learn and not something else. If we are successful in doing so, exams can facilitate students' learning processes. But we should be careful not to teach the students one thing, test them in another thing, and actually want them to learn something different.

It is my impression that even in postgraduate courses, far too often exams are testing the ability to copy and repeat exact knowledge (surface learning) rather than scientific abilities in more advanced levels of the learning hierarchy. And students tend to learn what the tests reflect (Biggs & Tang; 2007). Unfortunately, students often tend to believe that they have to learn facts and theories by heart and be able to remember and copy what the lecturers tell them, in order to obtain good marks in exams (Andersen; 2005). If this is what is practised in exams, then they are useless and may even be harmful. In order to give direction for the students and to assist in the learning process, the teaching activities and assessment should be coherent with the intended learning outcome. The course should be constructively aligned.

In the following, I will focus on the exam, and how we can address reflection and critical thinking in the exam, and how to evaluate the quality of the student performances.

The context: The course and its environment

The model course chosen for this project is "International nutrition and health, course no. 270083", a non-compulsory 7.5 ECTS postgraduate course offered at LIFE. The students are typically from the MSc programmes in Human Nutrition or Agricultural Development, a number of foreign exchange students typically with food science or agricultural science background, and a few public health students. The number of students is normally between 25 and 35.

The learning objectives for the course are presented as knowledge, skills and competences, but still somehow reflect the course content rather than the learning objectives. Some of the learning objectives for the course are evaluated during continuous assessment by smaller group-based reports which should be submitted and passed in order to register for exam. The learning objectives, in their current form, are a bit difficult to use as a basis for the exam, as many are topic specific, and therefore difficult to apply in an exam unless each topic is covered in the exam. If the general learning objectives are reflective thinking, analytical skills, overview and understanding within the context of the course topics, then these abilities do not need to be demonstrated for each topic in the exam.

In addition, in my opinion, there are some more general academic tools which must be assessed in postgraduate exams. Maybe it would be an idea to include some of these as explicit learning objectives for the course as well. Relevant examples of these are: analytical skills, ability to identify, digest and analyse relevant information, clarity and conciseness in writing, etc.

Course history, past experiences and reflections

Previously, the final assessment of this course was pass/fail of a written group report based on a student-chosen subject. Since the group evaluation as an assessment form was abandoned a few years ago and we did not want to stimulate the students to combine individual work and call it group work,

we decided to change the assessment form and introduced an individual 48-hour take-home exam as the final assessment. In 2009 it was conducted as a pass/fail exam. However, for two reasons, in 2010 we decided to give marks for the final exam. First of all, exchange students need marks in order to get credits for their course work at their home university. Secondly, the course is competing for student engagement and motivation with other courses taken simultaneously, and we had a few bad experiences with some students who took the course to collect some easy ECTS which negatively affected the whole learning environment. In conclusion, we decided to assess this course from 2010 with a 48-hour take-home exam with marks.

To avoid student confusion and frustration about the exam, and to develop the format, we introduced an individual assignment halfway through the course which was modelled on the final exam. It gave the students an idea of the form and the expectations, and in addition, it gave us some material for developing types of questions. We are definitely going to repeat this session in the coming years as it was well received by the students and in addition provides an opportunity for formative assessment and timely feedback which the students can use in their learning process.

Using this individual assignment before the final exam also improves the transparency of the assessment criteria and explicitly shows the students what we expect from them. If the assignment is properly designed and reflects what we want the students to learn, the students' learning may become more focused. By introducing rehearsal, the students will feel more prepared for the final exam and the assessment criteria become more transparent, which may also improve student performance (Johnsson; 2010).

The individual take-home assignment as a learning tool and as a final exam

The way we approach this 48-hour exam is by selecting one or two scientific papers which address one or two main course topics, but have not previously been used in the course. It is not an essay, but rather it consists of a number of focused questions which relate directly or indirectly to the papers. First, the students are expected to read and understand the texts and then use the texts directly as a basis for their answers. The specific tasks may be to extract the most important messages from the papers, to explain some figures, to discuss specific findings, to relate the findings to other con-

tent covered in the course etc. It may also be to identify knowledge gaps in the actual papers and search for further information via the internet.

The extended time removes the focus from time pressure and introduces time for reflection and discussion. In many ways, it reflects a real life situation where academics can search for information, discuss, and digest knowledge before they provide answers to a given problem. Students are allowed to discuss the assignment with colleagues, friends and family, and to search for information, and they have time to read and investigate, to think and reflect. Finally, they have to wind it all up in their own individual written answer. The exam does not leave much room for plagiarism as the students are unlikely to be able to find and copy answers to the specific questions.

It enables the students to demonstrate a variety of skills and competences. It is not merely assessing declarative knowledge, which unfortunately many other exam forms do. I think it is a potentially very useful exam with many advantages and few disadvantages (time consuming to evaluate) and if well planned it can work perfectly as part of a postgraduate course aiming at student ability to crystallize information from scientific papers and reports and discuss it in the course-specific context.

Design of questions and development of a generic grading rubric

Different competences need to be assessed using different types of questions or tasks (Biggs & Tang; 2007). Hence, the final exam should use a variety of assessment tasks to assess a variety of competences rather than merely declarative knowledge (Biggs & Tang; 2007).

Together with my colleague, associate professor Nanna Roos, we developed and selected five types of questions because they address different competences which we want the students to obtain (Fig. 8.1). I have then seen these questions as representatives for some more general types of questions and elaborated on which competences they assess.

Most of the questions address learning at a high level of understanding and in addition, they reflect different aspects of the desired competences. This is a major advantage, as the assessors may focus on specific competences during assessment of the different tasks.

So far so good – a thoughtfully designed assignment is the first step towards a successful exam. However, the student contributions have to be

Type of question/task	Competences addressed
Introductory questions *Basic understanding of text and topic*	Address *basic understanding* of the text: Mainly included in the assignment to get the students into the game, to make sure that everyone feels they can get started and get going. These questions will not count much in the overall grade as they only address very basic skills.
Discussion questions *Discuss main findings, contradictory results or surprising findings*	Address *depth of knowledge and scientific overview* and ability to transform critical thinking into a well structured and balanced discussion.
Illustrate *Illustrate numbers from the text in alternative ways and comment on the figure*	The students are asked to extract figures or numbers from the text, illustrate them in an alternative way (as a diagram, a figure, a plot) and comment on their figure. This addresses wider understanding and *ability to use the available information in another way and present it in an appropriate way*. Assesses the ability to take the information a step further, out of its immediate context and present and interpret meaningfully.
Prioritize information *Suggest and prioritize actions to take based on the findings in the text*	For example suggest and *prioritize* at least three solutions to a given problem. Answers should always be justified and based on context relevant arguments. This task assesses familiarity with and overview of relevant knowledge within the scientific area, *ability to reflect* and *professional confidence* to prioritise the suggested actions according to importance.
Identify new information *Identify databases, literature or reports of relevance for the specific question.* *Evaluate and present the information*	Address the ability to *search for, identify and select appropriate information* needed to fill a predefined knowledge gap. This type of question may also entail an evaluation of the strengths and weaknesses of the identified information, and *identification of knowledge gaps*, or to suggest new approaches.

Fig. 8.1. Types of assessment tasks and the competences they address.

assessed and marked as well. As such, there is rarely one right answer in this type of assignments, but the quality of the performance is rather determined by the strength of arguments, the demonstration of overview and deep understanding, the structure and the organization of the answer.

Criterion-based assessment will be applied to the exam assignments (Biggs & Tang; 2007). With this approach, students are not ranked, the marks are not supposed to follow any normal bell-shaped curve, but the performances are independently assessed according to some pre-specified criteria. In order to increase the transparency and fairness and to smooth the progress of the assessment, it may be useful to design a rubric which clearly defines the assessment criteria for each element in the final exam (Mertler; 2001). Figure 8.2 presents a rubric developed to assess the different types of questions suggested for the 48-hour exam with an overall focus on critical thinking (Peirce; 2010).

Suggested assessment criteria according to the 7 point scale

Question type	Excellent		Good		Fair	Insufficient	
	12	10	7	4	02	00	-03
Introductory questions **Basic understanding of text and topic**	Accurately describes the main message, demonstrating full understanding of the text	Accurately describes the main message, demonstrates good understanding of the text	Adequately describes the main message, demonstrating good understanding of the text	Adequately describes the main message, demonstrating good understanding of the text	Evidence of some misunderstandings or misinterpretations of main results from the text	The most basic messages are misunderstood and misinterpreted	
Discuss main findings, contradictory results or surprising findings	Identifies relevant arguments and limitations. Convincingly analyses and evaluates major points of surprise. Draws sound, balanced and precise conclusions. Clearly distinguishes between evidence and opinion	Identifies relevant arguments and limitations. Adequately analyses and evaluates major points of surprise. Draws sound, balanced conclusions	Identifies relevant arguments. Adequately analyses and evaluates major points of surprise. Draws right but slightly unfocused and vague conclusions	Identifies some relevant arguments. Analytical level is superficial and unfocused. Draws unfocused and vague, maybe wrong conclusions	Identifies few and poor arguments. Analytical level is superficial and unfocused. Draws vague and maybe wrong conclusions	Lists some arguments but they are poorly used to discuss the findings. Vague or wrong conclusions. Analytical level superficial. Lists own ideas, unsupported by the course content	
Illustrate numbers from the text in alternative ways and comment on the figure	Identifies the relevant numbers and convert them wisely and creatively into alternative presentation form. Demonstrates complete understanding and ability to use appropriate terms in presenting the figure	Identifies the relevant numbers and convert them wisely and creatively into alternative presentation form. Demonstrates ability to use appropriate terms in presenting the figure	Identifies relevant numbers but presents them in a less obvious way. Presentation and description of the figure may be a bit unclear or insufficient	Misunderstands the assignment and creates a framework/figure which does not relate to the actual numbers. Presentation and description of the figure may be a bit unclear or insufficient	Misunderstands the assignment and creates a nonsense framework/figure which does not relate to the actual numbers. Presentation and description of the figure unclear and insufficient	Misunderstands the assignment and creates a nonsense framework/figure which is not appropriately presented	
Suggest and prioritize actions to take based on the findings in the text	Demonstrates scientific confidence to select and prioritize actions in a given context. The prioritized order is logical and based on valid arguments. Strong evidence of familiarity with relevant literature	Demonstrates scientific confidence to select and prioritize actions in a given context. The prioritized order is logical and based on valid arguments. Shows familiarity with relevant literature	Suggests context appropriate actions. Prioritization maybe unclear or absent. Shows familiarity with relevant literature	Suggests context appropriate actions, but fails to prioritize. Answer lacks focus and does not refer to relevant literature. May be an unjustified list of ideas	Presents an unjustified list of ideas in random order. Does not take context into consideration. Limited evidence of understanding of the course content	Presents an unjustified list of ideas in random order. Suggestions are irrelevant or at least inappropriate	

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Question type	Suggested assessment criteria according to the 7 point scale						
	Excellent		Good	Fair		Insufficient	
	12	10	7	4	02	00	-03
Identify further data/information. *Browse the internet and identify databases, literature or reports of relevance for the specific question.* *Evaluate and present the information*	Appropriate information was identified and critically evaluated according to quality, source and relevance. Information is convincingly presented, its strengths and limitations mentioned and the conclusions fully reflects the identified strengths and weaknesses	Appropriate information was identified and critically evaluated according to relevance. Information is convincingly presented, its strengths and limitations mentioned and the conclusions are balanced	Appropriate information was identified. Information is adequately presented, and the conclusions are balanced. The data quality is evaluated based on its origin (organisation) rather than by its quality *per se*	Some information was identified and adequately presented but the conclusions may be wrong or exaggerated. The evaluation of the data quality is either absent or based on its origin (organisation) rather than by its quality *per se*	Some information was identified and shown but the conclusions may be wrong or exaggerated. The evaluation of the data quality is absent	irrelevant information was identified and shown and the conclusions may be wrong or exaggerated. The evaluation of the data quality is absent	
Overall impression of the assignment. *Organisation and structure.* *Capacity to use relevant arguments.* *Clear and concise text*	Language is clear and concise. Conclusions are balanced but as strong as possible. Evidence of extensive understanding of the course content. Structure, organisation and presentation is convincing and well-developed	Language is clear and concise. Conclusions are balanced but as strong as possible. Evidence of good understanding of the course content. Text is well structured, organised and presented	Language is generally clear with some imprecision. Conclusions are balanced but maybe a bit vague. Evidence of good understanding of the course content. Text may lack a bit of focus and accuracy	Language is generally unclear and messy. Conclusions are vague or wrong. Only demonstrates limited understanding of the course content. Answers are not well structured but may merely consist of lists of arguments	Language is generally unclear and messy. Conclusions are vague or wrong. Demonstrated lack of understanding of the course content. Answers are poorly structured and may merely consist of lists of arguments	Language is widely unclear and shows major lack of academic writing skills. Conclusions are vague or wrong. Demonstrated lack of understanding of the course content	
Final mark							

Fig. 8.2. A generic grading rubric. Criteria are not included for -03 as it was difficult for me to imagine a situation where a contribution is worse than 00.

The rubric was designed from the left side, at which end the highest performances are placed. In other words, the first column resembles the perfect answers. Moving to the right, there is room for some mistakes or limitations. Finally, the last column represents answers which will fail. I only added one "fail" category, as my imagination has difficulties in seeing the performance which is worse than none (-03). The students' answers may be very different, but different answers may very well be of the same academic quality, and a rubric like this may assist in the grading process to fairly reward the good performances. It has to be finally decided how much weight the different questions are given. The basic understanding and knowledge may be given lower weight than the more advanced higher level thinking.

Unfortunately, we did not manage to have this tool in place before the exam this year, but it was prepared based on the experiences with assessing the assignments and we will apply it next year. I am convinced that this tool will make the assessment process smoother and fairer in the future.

Conclusion

The development of the exam and the assessment tool is going to be a continuous process. It may involve a revision of the course ILOs, as well as to make sure they are coherent with the teaching activities and the final assessment. What we want the students to learn should be the heart of the course, supported by the teaching activities and properly assessed by the exam. The course ILOs should preferably be on a higher more general course level, supported by the specific content-oriented ILOs for each teaching activity. The course ILOs can then be addressed in the final exam regardless of the topic.

There is still a lot to learn, and definitely still room for improvement. The first step is, indeed, that we as teachers become clearer about what we expect the students to learn and are explicit about how we will assess it. This process has now started and a little extra investment of thought will definitely improve the course, the exam, the fairness and the transparency of the evaluation process for the students.

Tests should not be overemphasized, but should not be neglected either as they play a central role in student motivation and thereby potentially in the learning process. If properly designed and reflecting the teaching, the exams may enhance the learning process, while if poorly aligned with the

teaching exams may negatively affect the learning. As long as we can use the exams to enhance the students' learning process, they are useful and most welcome in my future courses.