ACTIVATING DEEP APPROACH TO LEARNING IN LARGE CLASSES THROUGH QUIZZES

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ABSTRACT

Large classes are challenging when designing learning activities suitable from a perspective of constructive alignment and at the same time being restricted to large class lectures due to external factors. In the present study a learning activity was desired to increase reflection and active repetition in a large class (75-100 students) of engineering students in a basic course in Materials Science and Engineering. Current repetition by lecturing was not satisfying from a learning perspective. Well known techniques such as mud cards and concept questions were not feasible, mainly for reasons of time to manage feedback or design proper concept questions. The aim of this paper is to describe a newly designed learning activity called Reflection quizzes, the process of design and also to analyse how student learning was affected. The result of the Reflection quizzes was overwhelming. The students were all actively engaged but took on different approaches; some discussed together (peer learning), some competed against each other (increasing motivation), some wanted to sit on their own using their notes (reflecting). The student survey showed that students appreciated to test themselves without it being assessed, many stated that the best was to find out why wrong was wrong and it was clear that they took on a more deep approach towards learning.

KEYWORDS

Large class, Active learning, Deep approach to learning

INTRODUCTION

Large classes are often a challenge. The course is ideally organised to attain “constructive alignment” as developed and described by Biggs [1], [2]. Learners are said to construct knowledge by their own activities, building on what they already know. Biggs claims that if learning is to take place, there should be clear intended learning outcomes (ILO:s) and the students should perceive these goals as meaningful. The assessment should be appropriate and there should be student-teacher atmosphere characterised by open dialogue. The design is then “aligned” if these clear ILO:s are supported by teaching and learning activities that make it possible for the students to acquire the knowledge and skills defined by the ILO:s and when the assessment appropriately test the fulfilment of the ILO:s. Moreover, e.g. Bloom has reported on the advantages for design of learning activities by applying taxonomy and stating clear goals focused on what the student should be able to perform [3]. It is also well known how important reflection is in order for students to take a deep approach to learning in e.g. a Kolbian coil manner as described by Cowan [4]. He suggests three planned reflections; *For*; to decide what the process will be to fulfil learning needs, *In* the middle to consider how the process has fulfilled the aims and *On* the learning process to decide what has been accomplished and what is lacking; with the aim of improving.

However, in large classes traditional lectures are used even though they might not be the ideal learning activity for the intended outcomes. They are chosen for many other reasons such as time management, economy or tradition. In those cases it is important to attain as good result as possible by designing the lecture activities accordingly. Within the CDIO model for engineering education there are numerous good examples of course design that facilitates for students to focus on understanding. Many of the teaching strategies described are adapted for project based courses or smaller classes but there are also some applied in large classes [5]. Furthermore, in the literature there are described two well known strategies or learning activities to attain reflection and activity in the classroom; the use of mud cards [6] and concept questions [7].

Being a teacher with good experience of CDIO, I made some changes to a traditional basic compulsory Materials Science and Engineering course for 75-100 students trying to attain constructive alignment. The redesign included a change towards product focus (starting the course lecturing about a product instead of introducing the subject at the atomic level), elements of active learning during lectures, a writing assignment to apply theory to a real product, continuous assessment and a study visit. However, basic Materials for engineers is a subject that requires learning of many new words (e.g. martensite, bainite, hypoeutectic, peritectic and cross-linking) and it also brings about some new concepts that are complex to grasp such as phase transformations, dislocations, hardening or band diagrams. Both of these require that time is spent on repetition and reflection, and it was found important to design the lectures allowing time for this. 5-10 minutes in the beginning of each lecture was thus dedicated to repetition, but it was not satisfying. The perception was that it was boring for all including the teacher, and the efficiency of learning was low. Something else was needed.

The aim of this paper is to describe a new learning activity, called Reflection quizzes, that was designed to meet the need of repetition and reflection in large class lectures. The paper is organised as follows; firstly the process of design is described, followed by a description of the quizzes, a brief analysis on how student learning was affected and some concluding remarks.

PROCESS OF DESIGN OF THE REFLECTION QUIZZES

As mentioned, the course in Materials Science and Engineering required more teaching activities focused on reflection and repetition to facilitate for the students to attain the ILO:s as described in Table 1. The lecture started with revisiting the most important aspects of the previous lecture, but the choice of one–way communication was definitely not ideal.

“Mud cards” were tested, where students write a short sentence describing the muddiest point in the lecture on a card in the end of lecture. The students appreciated to write them and it led to active reflection. However, they raised an immediate urge for feedback which added too much administrative work on gathering and sorting and answering for 100 students attending 3 lectures per week. Frankly, it was the students that needed to spend more time on task, not the teacher.

“Concept questions” as described by Mazur [7] is a very interesting teaching strategy that definitely could be applicable in this case. There are numerous examples described by Mazur in the field of physics. But the design of concept questions in materials science was found to be quite a complex task. It should be the right questions, with three answers whereof one showed the right concept while the others catch common misconceptions. This resulted in a barrier. Moreover, the effect of concept questions is that the students invest in their answering which generally is a very positive aspect of the learning activity. This could actually be a problem; I instinctively felt it might lead to a drawback for students with low self-efficacy. If repeatedly failed, it might become a high stake activity for them.

Table 1
Intended learning outcomes for the course in basic Materials Science and Engineering (translated from Swedish)

After the course the student should be able to;	**Comment**
• Describe how different types of materials (metals, polymers and ceramics) are structurally build up in terms of atomic bonding and crystal structure and discuss how the structure affects some of their properties.	*Requires some rote learning of structures which requires repetition. The subsequent analysis of the relation between structure and properties requires reflection to be able to understand fully.*
• Describe how, primarily mechanical, properties for the materials above can be affected by changes in the microstructure and be able to relate this to relevant hardening mechanism.	
• Use a phase diagram and a TTT-diagram; read it and from the diagram predict microstructure at a given heat treatment or cooling procedure.	*Requires reading complex phase diagram and the same time imagine the solid state diffusion that takes place. Requires reflection on several levels to learn. Learning is supported by interactive software.*
• Do a simple choice of manufacturing technique and /or heat treatment to attain specific properties and microstructure and discuss the choice of criteria to attain a desired result.	*This is a difficult learning outcome which requires synthesis of the above outcomes. It is a pre-stage to the advanced master courses.*
• Describe how corrosion is developed related to material and environment and discuss how to best avoid corrosion in a product.	*Learning is supported by discussion in class on actual corrosion cases found by the students at campus*
• Identify some selected polymeric materials	*Learning is supported by experimental class*
• Make a simple reflection on the material selection for an industrial product applying sustainability aspects.	*Learning is supported by an interactive lecture of a workshop type*
• Recognize product related problems which requires that the engineer needs to consider the microstructure of the material	*Learning is supported by discussion two by two in class on several occasions*

In the end I just set up a list of wishes or demands of the desired learning activity which were: Student active learning, prompt feedback, reflection, if possible peer learning and not taking additional teacher time. Based on the demands I spent time thinking on how we learn completely different things today, using new technology. For instance it is very popular today among our students with quizzes on Facebook and other communities or a for instance a pub quiz. A quiz could accommodate all the demands and by making it less serious it could become a low stake activity; active but not far from the comfort zone.

DESCRIPTION OF THE REFLECTION QUIZZES

The Reflection quizzes are given during 5 minutes in the beginning of each lecture allowing the students to test themselves on how much they remember from the previous lecture. They are not expected to prepare. They contain 4-6 questions with multiple answers, as shown in table 2, and everything is allowed, with or without book, alone or together. Afterwards I go through the answers briefly during 5 minutes, mentioning why the wrong ones are wrong, which supplies immediate formative feedback. If anyone wants to repeat further they can find the questions on the homepage afterwards.

Table 2
Sample reflection quiz

	1	X	2
Small grain size results in hardening 1. because grain boundaries stop dislocation movement. Small grains = large grain boundary area X. since dislocation movement is only possible if the grain is larger than 50 µm 2. but decreases ductility considerably			
Solution hardening 1. demands addition of atoms of a radius larger than the host atom X. harden since the presence of solute atoms creates a stress field, which dislocations have difficulty to pass 2. is only possible in aluminium			
Precipitation hardening 1. works out since it is possible to cut through coherent precipitates X. results in more hardening the more the particles grow 2. results in more hardening the closer the particles are to another			
Annealing 1. of cold rolled sheet is made in order to harden it further X. is done in order to heal the cracks that are developed during rolling 2. can result in three changes in microstructure (depending on time and temperature); recovery, recrystallization and grain growth			
Phase diagrams are 1. describing which phases that are present at a certain temperature and composition assuming thermodynamic equilibrium X. always determined experimentally 2. used to predict mechanical properties of different phases			

LEARNING DURINGTHE REFLECTION QUIZZES

The result of the Reflection quizzes was overwhelming. There is no claim that the questions are the right questions that assess how they will be managing the exam, just some fun tests on how much they remember from last lecture. This made the quiz easy to design, and accidentally some of the questions turned up to be quite good concept questions. It took in general 20 minutes to design a quiz.

The students took on different approaches; some discussed together (peer learning), some competed against each other (increasing motivation), some wanted to sit on their own using their notes (reflecting). All were actively engaged but in their own preferred way. Figure 1 below show how they are actively engaged in the morning, some use their books, some use their hands to explain to friends and some just make it as a test to see how they are doing.

Figure 1. Students engaged in reflection quizzes early in the morning

The comments in the student survey showed that students highly appreciated the possibility to test themselves without it being assessed, many stated that the best was to find out why wrong was wrong and it was clear that they took on a more deep approach towards learning. They stated that the course was mainly focused on student understanding instead of learning by heart. The quizzes were the most popular activity.

CONCLUDING REMARKS

In the present study a newly designed learning activity is described, called Reflection quizzes. It is intended to increase reflection and active repetition in a large class (75-100 students) of engineering students in a basic course in Materials Science and Engineering.

The result of the Reflection quizzes was positive. The students were all actively engaged but took on different approaches; some discussed together (peer learning), some competed against each other (increasing motivation), some wanted to sit on their own using their notes (reflecting).

The student survey showed that students appreciated to test themselves without it being assessed, many stated that the best was to find out why wrong was wrong and it was clear that they took on a more deep approach towards learning.

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