Concept Circuit Training: A new pedagogic approach for better teaching and learning

Malin Sjöö, Elin Östman, and Marilyn Rayner
Department of Food Technology, Engineering and Nutrition, LTH

***Abstract*— The course Food Science, Complex Food Systems (KLG080) is an advanced level course in the food specialization of the bio-engineering program at Lund University. It has previously been based on a set of rather diverse activities (such as labs, lectures, PBL cases, etc.) that were weakly linked to each other. This caused fragmented knowledge among students and did not favor a deep learning approach. By replacing these activities with a new pedagogic approach, concept circuit training (CCT), followed by a milestone exam and a minor project, the aim is to design a course using the theories of constructive alignment. CCT theme meetings, with subsequent peer assessments and individual tasks related to each theme, will be based on identified core concepts and threshold concepts. Activities during each CCT theme meeting will be designed to stimulate and result in deep learning and mastery of concepts.**

***Index Terms*— Core concepts, threshold concepts, constructive alignment, food science education**

I. Introduction

Food Science, Complex Food Systems (KLG080-7.5p) is given in English during the 4th year of the Biotechnology program and International Masters Program. The course aims at integrating knowledge from three food areas, i.e. nutrition, technology and engineering. Previously the course included several diverse activities that were generally poorly integrated. There were several teachers involved, and the three areas were clearly separated. This has caused fragmented learning and has not favored a deep approach.

We have taken the idea of physical circuit training, where the exercises focused on a limited number of carefully chosen exercises, and applied it to develop a new pedagogic methodology "Concept Circuit Training", where focus is on improving the students' numeracy, problem solving skills and critical thinking.

We have developed and intend to use a series of stations containing different types of leaning activities that are planned to train/teach the students in various aspects of a course subject. The critical feature of this development effort was to identify the concepts that are of central importance to the course-subject, devise learning activities that help student learn these concepts, in particular those which the student find difficult, to further increase their mastery of the subject on a deeper level. The aim is to align learning objectives, teaching activities, and assessments, and to design a course with a clear framework.

Manuscript received October 31, 2010.

Malin Sjöö, Elin Östman, and Marilyn Rayner are with the Department of Food Technology, Engineering and Nutrition, Lund University
e-mail: Marilyn.rayner@food.lth.se

II . Consolidating fragmented course curriculum

There is an observed tendency among academic teachers to overfill their courses with content, and when students are faced with too much content they tend to take a surface approach to learning (Stokes, King, & Libarkin, 2007). Furthermore, the course, in its previous form involved a large group of teachers; all of whom are experts in their own areas, which they feel contains a critical set of knowledge important for the students' overall mastery of the subject. We propose that we need to focus on the most important concepts, to pare away all of the "should know" content to reveal the core of what if fundamental to grasp the subject. According to Cousin (2006) an effective way to take a "less is more" approach to course curriculum design is to focus on the threshold concepts of the subject.

III: Threshold concepts versus Core Concepts

Within every discipline or subject, there are some ideas which hold the key to students' deep understanding called "threshold concepts".

> *"A threshold concept can be considered as akin to a portal, opening up a new and previously inaccessible way of thinking about something. It represents a transformed way of understanding, or interpreting, or viewing something without which the learner cannot progress." (Meyer and Land, 2006)*

Threshold concepts can be seen as a sub-set of what university teachers' typically describe as "core concepts" or "key concepts". Core concepts are building blocks that are necessary in the students' progress within the subject. Although core concepts are crucial to understand in order to master the subject, they do not necessarily lead to a qualitatively different view of the subject matter (Meyer and Land 2006) See figure 1.

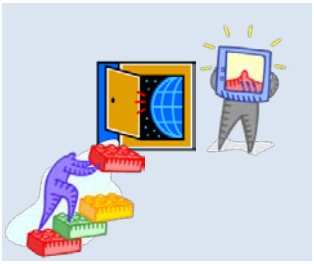

Figure 1: Core concepts versus threshold concepts

IV. Translation of Concepts into learning activities to achieve Constructive alignment

According Biggs', theory of constructive alignment, students construct meaning from what they "do" to learn, not what we "teach" them. (Biggs 2003) Thus our time should be spent on creating appropriate learning activities, doing things, rather than presenting more and more material.

V. Methods

Interviews and a half day workshop with teachers within the food specialization have been carried out. We have sent the material out to all the senior lectures at the department and have also created two reference groups, one of former students and one of formerly involved teachers. Discussions have also been taken with the Program Leader.

VI. Results

From our discussion with colleagues and the reference groups, we have identified many core concepts and some threshold concepts. We have also been able to group them into four main themes which will be Concept Circuits.

A. Food products and their raw materials.
B. Temperature and its effects.
C. Control of food related kinetics.
D. Structure and how we experience it.

The main development was to construct and align teaching and learning activities and assessments/examination that are clearly linked and related to the learning goals of the course. The mix of course activities allows for both action and discussions in groups as well as reflection and contemplation on an individual basis.

The idea of concept circuit training, comparable to physical circuit training, is to achieve a set of specific goals. The new course activities during the first 4 weeks are based on the CCT methodology and focus on one theme per week to achieve the identified leaning goals. Each 5 hour CCT session begins with a short lecture followed by a circuit of activities e.g. demonstrations, minor case studies, supervised group discussions, mini-labs, etc. Students complete the circuit mainly in small groups (3 students), but also some activities in larger groups of varying size. The specific activities vary between themes. Relevant literature related to each theme will be recommended to the students.

A peer assessment will be given some days after each CCT session, in form of short questions or a quiz. During each CCT session the students will also be assigned an individual task related to the specific theme to complete and reflect on until the day before the next CCT session. The idea is that the students can discuss general problems of the individual task in groups during the CCT session but that they then solve it individually. These planned activities will replace previous activities and create a better aligned course. Not only will this be advantageous for the students, but also for the teachers, in terms of better coordination and knowledge transfer among teachers.

After the four thematic CCT sessions, a milestone exam will follow. This exam constitutes the basis for passing the course and for students who fail the first time we will arrange activities to help them further in their learning. The aim of the milestone is to assure that the students pass the basic course criteria and the peer assessments will be designed to demonstrate the criteria for each theme. The peer assessments will therefore not be compulsory although strongly recommended in order for the students to pass the milestone exam.

The final course weeks will be dedicated to project work in groups, where the four different concepts should be applied to a food process. At the end of the course the students will report their project and they will also have a short exam. This exam will be based on their project, closely aligned with the CCT themes and formulated in order to encourage the students to answer by synthesizing and drawing conclusions. This exam is intended to be optional and only offered to students who passed the milestone, but compulsory for those students that aim for a grade higher than passed and then provide an individual basis for grading. At the same occasion the milestone will be given to students that did not pass the first time. This structure has been discussed with and approved by the Program Leader.

VII. Evaluation

To evaluate whether or not these changes actually lead to improvement, the plan is to form a council of volunteering students with varying background that will participate in weekly discussions about the course activities. In addition, we will compare results from CEQ with previous years, and interview new and former students and teachers of following courses.

VIII. Conclusions and Future Outlook

We believe that the concept circuit training pedagogic approach will benefit not only the students learning but also lead to a greater congruency among all the courses taught at our department by creating a framework for teacher co-operation in curriculum development.

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