29

Enhancing student learning with case-based teaching and audience response systems in the MSc. Course "Food Innovation and Health"

Davide Giacalone

Department of Food Science
University of Copenhagen

Introduction

As many people of my generation, I am mostly familiar with a "teacher-centered" approach to lecturing, in which a teacher is expected to deliver a content so as to cover a course curriculum. To a large extent, lecturing is still the dominant teaching method in most higher learning institutions, and often – due to habit and ignorance of alternative approaches – the only method adopted at all (Gibbs 1981, Mazur 1997). It is certainly easy to see why lectures are popular: they are time and cost efficient, and they give the teacher full control on the content (Bates & Galloway 2012) giving that comfortable feeling that "the ground has been covered" (Schneider 2007). Unfortunately, there is plenty of evidence suggesting that lecturing is actually not a particularly effective way of promoting student learning (Bates & Galloway 2012, Chew 2014, Trigwell et al. 1999).

After joining the teacher development program at University of Copenhagen, I have had the chance to reflect at length about my own teaching, and think about ways to move towards more interactive, student-centered approaches. Luckily, much has been written on classroom techniques to engage students and achieve more effective teaching and better learning experiences. The purpose of this paper is to share an example of how two of them – the use of case-based teaching, and the use of response technologies – were implemented into a food science M.Sc. course, and to discuss some of the observed outcomes.

Classroom techniques promoting student activation

Case-based teaching

Many studies suggest that educators should move away from traditional lectures and focus on improving the way content is taught and delivered in higher education courses (Arámbula-Greenfield 1996, Duffrin 2003, Mazur 1997). Case-based teaching (CBT) is an active learning strategy in which students apply their knowledge and their analytical skills to complex, real-life scenarios relevant to the subject matter. In general, CBT is considered a useful way to combine traditional lectures with problem-based learning (Coorey & Firth 2013, Van der Veken et al. 2008), as it emphasizes social interactions between students, and the development of learner autonomy and learning situations that resemble those relevant to the profession. Accordingly, the use of case studies has been found helpful for engaging and creating relevance for students (Duffrin 2003), and for helping the students to organize and identify gaps in their knowledge (Stern 1996).

In CBT, students are introduced to complex situations requiring a decision. Such situations can be real (e.g., examples from past or current research) or just realistic, and can vary in degree of complexity. The development of a case study should start with identifying a set of key concepts that the students should rely on, and careful consideration should be given to their potential to achieve learning outcomes (Duffrin 2003). Students are often asked to work in groups and to evaluate each others' opinions before any plenum discussion takes place. Working in groups can help students develop interpersonal skills and the capacity to work in a team, and accordingly CBT contributes to raise student's ability to communicate about a topic (Coorey & Firth 2013). After considering the case at hand, students (or groups) are asked to make a statement about their suggested solution to the case. The teacher in this case can facilitate a classroom discussion by asking questions to probe the reasoning behind the suggested solutions, and ask other students to evaluate them. Assessment of case studies is usually offered at the end of the class discussion and, depending on the format, can be used for both formative and summative purposes (Biggs & Tang 2011*a*).

In general terms, cases are especially useful to assess the application of concepts to appropriate professional practices. By placing them in real situations and asking them to take decisions, case studies help students to connect their knowledge with their decision-making skills, as well as to distinguish high-priority elements from low-priority ones. Indeed, compared to lectures, cases are a much better way for the teacher to see whether students are able to apply the knowledge they have been studying.

The available literature on CBT specific to food science education is limited. There are a few notable exceptions (e.g., Duffrin (2003), Coorey & Firth (2013)), that suggested that CBT be more widely adopted in food science education, given that the applied and interdisciplinary nature of the field is very well suited for a problem based approach.

Audience response systems

Another helpful strategy to improve student engagement is the use of audience response systems (ARS), technologies that allow an entire classroom to respond to various questions projected on a screen using a remote control device, with real-time visualization of results (Bruff 2009, Caldwell 2007, Greer & Heaney 2004, Kay & LeSage 2009)[1]. ARS are usually associated with relatively large class sizes and with multiple-choice questions, though applications in smaller audiences and with different question formats are also found (Kay & LeSage 2009). Student responses can be stored (anonymously or otherwise) and used for both summative and formative assessment by the teacher. With real-time feedback from the classroom, ARS provide teachers the opportunity to facilitate a discussion about the concept being covered (Kay & LeSage 2009). Some teachers like to combine ARS with the peer instruction format, in which students answer the question, then discuss their answers in pairs or small groups, and then answer the question again (Mazur 1997). The use of ARSs in higher education was originally limited by technology, but has become increasingly widespread due to the development of free web-based ARSs which allow students to easily answer questions with their own devices (laptops, tablets, smartphone, etc.). ARSs are associated with a number of benefits. Among other things, they have been found effective for improving student interaction, activation, and attention (Draper & Brown 2004, Hinde & Hunt 2006, Greer & Heaney 2004), stimulating peer and class discussion (Kay & LeSage 2009, Pelton & Pelton 2006), enabling formative assessment (Caldwell 2007), improving student learning (El-Rady, 2006), and increasing classroom attendance (Bullock et al. 2002). Students and teachers who have used ARSs are generally positive or even enthusiastic about their effects on the classroom,

[1] ARS are also known with a variety of synonyms in the literature, e.g. “clickers”, “computerized voting systems”, “student response technologies”, etc.

and there is wide consensus that these technologies have great potential for improving student learning (Beatty 2004, Caldwell 2007).

Course details and learning outcomes

"Food Innovation and Health" (FIH) is a thematic M.Sc. level course taught at University of Copenhagen, Denmark. The course typically enrolls 15-20 students, with a background in human nutrition, food science, or home economics. Most of them take the course as part of the eponymous MSc. Program[2], an interdisciplinary program focused on food product development and combining knowledge of human nutrition, food chemistry, culinary techniques, sensory science, consumer behavior, innovation and entrepreneurship. FIH is the last course students take before their thesis work, and is designed for the students to build on previous knowledge acquired in the first year of the program.

The objective of the course is to provide students with knowledge of practical food production and innovation, with a focus on palatability and health in food products as well as in meals.

The course starts with a confrontation-intensive period, which covers the first three weeks. In that period, teaching takes place 4-5 days a week. For the rest of the block students work in groups and organize their time independently. The course is very popular and well evaluated, and it was elected by the students as best course of the faculty of Science in 2012, and was runner up for the same prize in 2013. The main reason why this course is so popular is most likely the extensive project based phase where students develop, test and pitch actual food products, based on challenges from food companies or other organizations. For example, this year's students worked on making snack bars using brewers' spent grain, examined gastronomic strategies to masking boar taint in entire males meat, and developed a non-alcoholic drink based on Nordic ingredients targeted at restaurant goers.

Table 29.1 summarizes the course overall learning outcomes:

[2] MSc. Program in Food Innovation and Health: http://studies.ku.dk/masters/food_innovation-and-health/

Intended learning outcomes for M.Sc. in "Food Innovation and Health"
Knowledge
1. Experience with ideation and business model generation for developed food products.
2. General knowledge of basic operations and tools for gastronomic food production.
3. Innovation, intra-, and entrepreneurship in relation to foods.
4. Describe carbohydrates, lipids and proteins basic function and characteristics in food and point out the effects of culinary processes on physical, chemical and sensory conditions of food components.
5. Adapt methods of preparation for different raw materials based on a rational gastronomic foundation.
6. Reflect on the nutritional aspects of raw materials and their changes in culinary processes.
7. Pointing out the essential microbiological risks connected with especially low temperature preparation methods and the necessary precautions for handling raw material.
8. Describe the effect of physical processes such as pressure treatment and freeze-drying on the structure of food and how physical treatment can be used for developing gastronomic dishes.
9. Give an overview over aesthetics in relation to food, meals and eating.
Skills
10. Use techniques to foster innovation and creativity related to development of new foods.
11. Production of prototypes of complex foods, production in pilot scale of complex foods, including demonstration of practical abilities with culinary techniques.
12. Consumer tests of complex foods.
13. Reflection upon own development, and ability to see opportunities and the potential for students' professional competences in intra- and entrepreneurship and innovation.
14. Work in a gastronomic laboratory with chosen experimental techniques and culinary methods.
15. Communicate in writing the topics in the gastronomic area with regard to innovation in foods.
16. Integrate aesthetics in relation to food, meals and eating.
17. Communicate gastronomic concepts to professionals and relevant employers/purchasers.
Competences
18. A scientific approach to food innovation and small scale food production.
19. New Product Development of healthy and palatable foods.
20. Integrate academic disciplines (food chemistry, sensory science, and nutrition) to innovation and business development in the food sector.
21. Use and adapt techniques for characterization of sensory properties and consumer experiences.
22. Interdisciplinary cooperation with other students on planning, carrying out and evaluating experiments in relation to new product development of healthy and palatable foods.
23. Work independently and efficiently together in a group on joint projects.

Table 29.1. Overall course ILOs. The ones most related to my own teaching are italicized.

In this course, I teach about sensory science, which is the discipline concerned with measuring and understanding responses to food properties as perceived by the senses such as sight, smell, taste, touch and hearing (Martens 1999). Sensory science has many applications in the food industry: it can be used to evaluate whether there exist a perceptible differences between two stimuli (e.g., the same product stored at different temperature), to quantify specific properties in a food sample (e.g., its sweetness, its color, or the hardness of its texture), or to evaluate the hedonic value of foods and beverages (e.g., quantify the degree of liking or whether a version is preferred over another). Given the breadth of application, different sensory methods exist depending on the project purpose, the type of assessors available, the magnitude of differences between stimuli, and on other practical considerations. Furthermore, data sets resulting from sensory tests can be quite large, and can often present peculiar structures. Multivariate data analysis methods can be very useful in the exploration of the structure of such data (Dijksterhuis 1995).

Normally, most students will have at least some prior background in sensory science from previous courses. However, their practical experience with sensory science is limited (sometimes none, which is often the case for exchange students, or of students enrolled in other programs that take the course as elective). Essentially, my role in the course is to teach students about different sensory evaluation methods that can be used in a product development context, and how to match the right methods to available resources and the specific problem at hand. I also teach about sensometrics (statistical analysis of data from sensory experiments) in relation to different type of data. This can be expressed into two main intended learning outcomes (ILOs):

ILO 1 (*sensory methods*): the students should identify existing sensory methods and their requirements, and to select the right method in relevant situations;

ILO 2 (*sensometrics*): the students should be able to arrange and perform appropriate statistical analyses on data from different sensory methods.

Implemented changes in teaching approach

I am responsible for four "lectures", with a main confrontation time of 8 hours. The first lecture focuses on sensory methods (ILO 1), the second on practical planning of sensory tests (ILO 1), the third on data analysis or *sensometrics* (ILO 2), the fourth is a tutorial on specific data analyses using sample datasets (ILO 2).

Previously, my teaching approach has been pretty much lecturing. Although I generally receive good end-of-course evaluations, I have often wondered about the effectiveness of my lectures.

This year I implemented a change of lecture format in the direction of CBT, thinking that the applied nature of the course would lends itself very well to the purpose. I thus devised a series of activities based on actual examples from ongoing research or from literature. The goal was challenging students with a scenario where they needed to apply their knowledge of the subject matter, while providing them with immediate feedbacks on their learning (Mazur 1997, Schneider 2007).

Essentially, I structured the lectures such as it consisted of short presentations (20 min) about a central point, followed by a case study related to the points being presented, which the students were invited to think about individually or in group. I have used a variety of approaches to activate students, some of which based on ARSs, and experimented with several formats (group and pair discussions, multiple choice questions, open-ended questions, etc.), as this is advised for providing a refreshing variation and to increase student's attention (Schneider 2007). Some of the activities were especially inspired by Eric Mazur's concept of peer instruction (Mazur 1997, 2009). Peer instruction (PI) is built on the idea that better learning can be achieved if the students actively discuss the subject matter with their peers instead than if they just listen passively.

Regardless of the format, the common goals of these activities were that they (1) should engage students and make the lecture more student activating, and (2) that they should provide opportunity for formative assessment, either by making students discuss their understanding with their peers (peer instruction), or by allowing me to modify my explanations or way of delivering the content according to the class discussion.

First example (ILO 1). My first lecture concerned sensory methods and their applications. I introduced briefly the classification of sensory descriptive methods in *verbal-based*, *comparison-based*, and *reference-based* Varela and Ares, 2012). Instead of providing examples of application, I thought placing the students in the position of a sensory lab manager having to decide the best course of action would be a more effective learning experience. Therefore, I developed a series of case studies in which the students were asked to determine the best sensory methods based on the three central aspects in any sensory study: the purpose of the project, the difficulty and number of samples, and the type of panel available for the job (Table 29.2). Basically, the students were given the case study individually for a minute or so. Then, I asked them to speak to their neighbors and convince them or their answers for about five minutes. Afterwards, to nudge the discussion towards some critical aspect, I also gave them an "extra hint"[3], and provided a few more minutes to reconsider their assessment

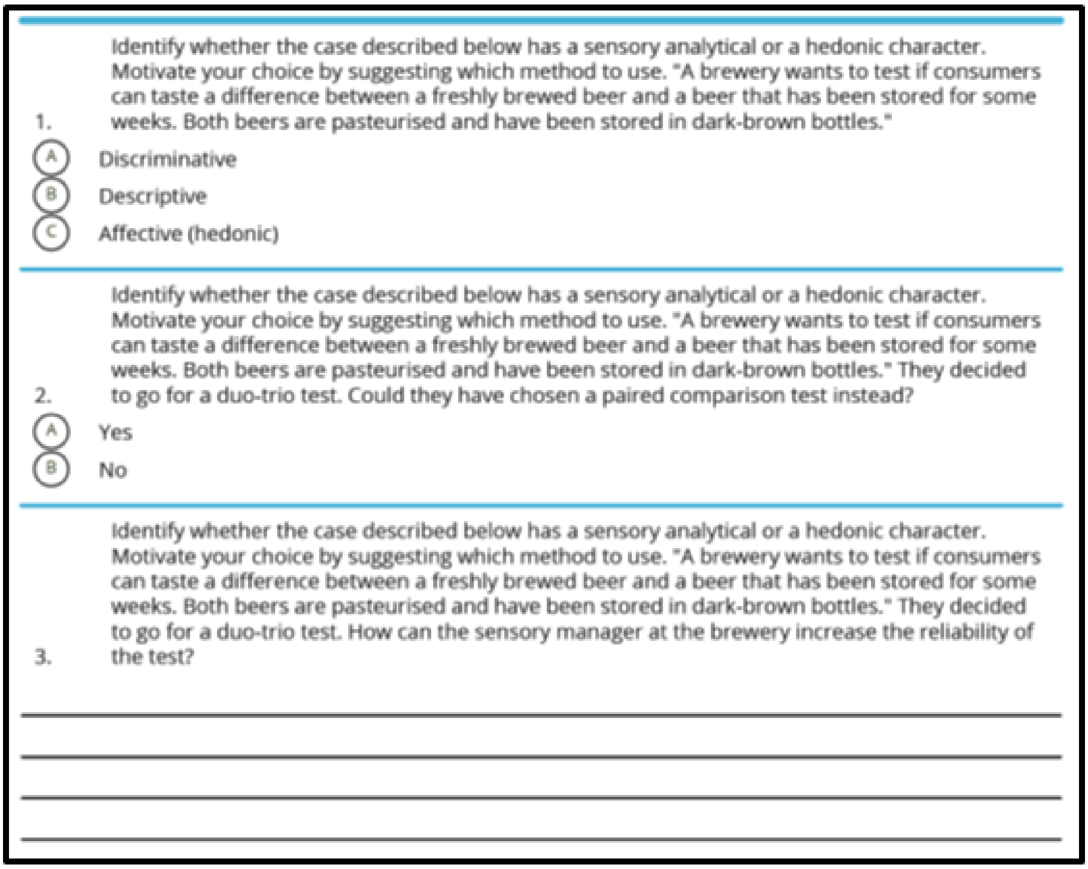
[3] For instance, Case 3 was about municipal water, which is relatively difficult to describe from a sensory point of view. The hint indicated that there are some known key parameters for water taste quality, and that therefore a method based on comparison with references – say, two samples representing an acceptable range of salinity – might be a good choice in this case.

of the case. Finally, I reviewed the problem together with the students. In this case, I opted for a plenum discussion format because of the classroom size ($N = 15$), but also because all cases had more than just one possible solution. In doing this, I tried to facilitate further peer assessment (e.g. orchestrating a discussion between groups to argue against/defend their suggested solution) before getting to the "institutional" point of view, i.e. offering my own assessment of the case.

Case 1: **"A new sea-buckthorn juice"**	**Case 2:** **"Common roasting defects"**	**Case 3:** **"The taste of water"**
Purpose: Developing a new sea-buckthorn base beverage together with a local producer. The goal is to obtain a sensory description of the samples and also identify preferred prototypes.	**Purpose:** A small coffee producer wants to investigate the effect of common roasting defects on the final sensory quality of their coffee.	**Purpose:** Assessing the sensory quality of Danish municipal water.
Samples: 8 prototypes developed by blending sea-buckthorn juice with either apple juice or orange juice.	**Samples:** 6 (1 reference + 5 common defects).	**Samples:** 10 water samples collected at 10 different locations in Denmark.
Trained panel available: No.	**Trained panel available:** No, but company wants to train own employees (12 potential assessors) for that purpose.	**Trained panel available:** Yes (10-12 trained judges).
Extra hint: Both sensory and preference data are needed…	**Extra hint:** Coffee temperature rapidly decreases…	**Extra hint:** Previous studies suggest that the level of salinity (Na concentration) and the total amount of dissolved solids (TDS) are important parameters…

Table 29.2. Three examples of case studies discussed in class (from actual recent/ongoing projects in my group).

Second example (ILO 1). A second example concerned the practical planning of sensory science experiments. This lecture is very fact-based and the background literature covers very straightforwardly principles of good practices required for this type of experiments (e.g. experimental design and treatment structures, sample preparation and serving procedures, ISO standards for sensory evaluation facilities, panel screening, selection, and training, and legal aspects/requirements for using humans as subjects of sensory tests (Lawless & Heymann 2010). To increase students' activation, I decided to use again CBT, this time using the ARS "Socrative" (*MasteryConnect* 2014). The cases were meant to illustrate practical considerations during planning of sensory studies, and varied in format (multiple choices, true/false, and open ended). A sample from the case studies is shown in Figure **??**.



1. Identify whether the case described below has a sensory analytical or a hedonic character. Motivate your choice by suggesting which method to use. "A brewery wants to test if consumers can taste a difference between a freshly brewed beer and a beer that has been stored for some weeks. Both beers are pasteurised and have been stored in dark-brown bottles."

(A) Discriminative
(B) Descriptive
(C) Affective (hedonic)

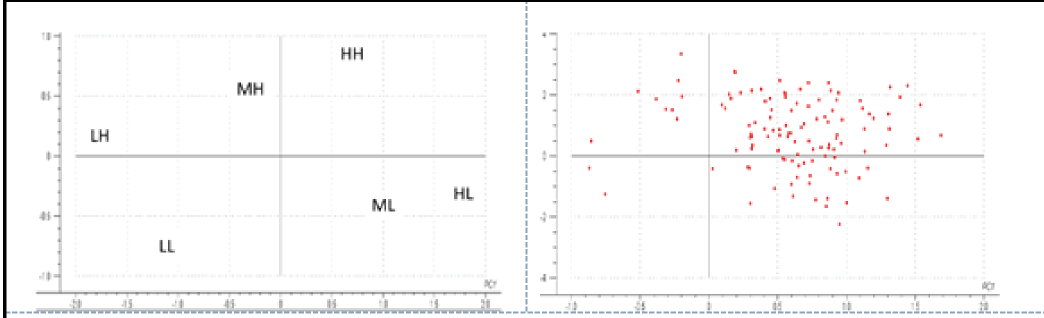
2. Identify whether the case described below has a sensory analytical or a hedonic character. Motivate your choice by suggesting which method to use. "A brewery wants to test if consumers can taste a difference between a freshly brewed beer and a beer that has been stored for some weeks. Both beers are pasteurised and have been stored in dark-brown bottles." They decided to go for a duo-trio test. Could they have chosen a paired comparison test instead?

(A) Yes
(B) No

3. Identify whether the case described below has a sensory analytical or a hedonic character. Motivate your choice by suggesting which method to use. "A brewery wants to test if consumers can taste a difference between a freshly brewed beer and a beer that has been stored for some weeks. Both beers are pasteurised and have been stored in dark-brown bottles." They decided to go for a duo-trio test. How can the sensory manager at the brewery increase the reliability of the test?

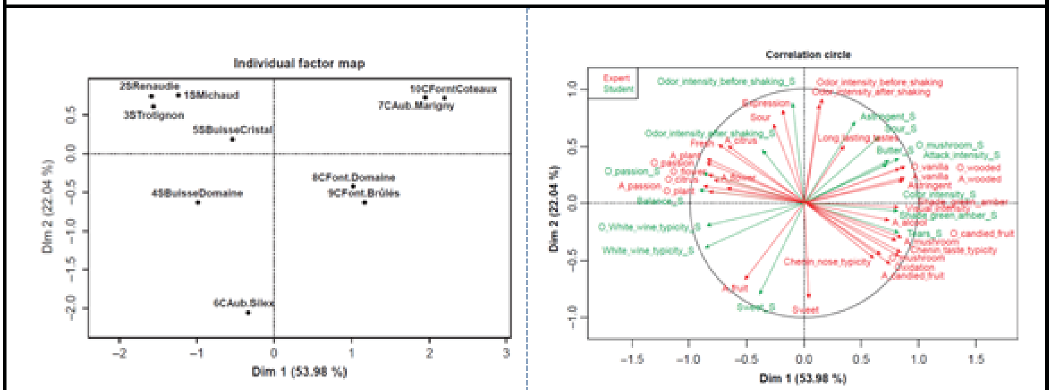
Fig. 29.1. Examples of case studies used in relation to ILO 1. Correct answers (Q1:A; Q2:No, because paired comparisons assume prior knowledge of the nature of the difference); Q3: Several possible answers, e.g., improve statistical power, increase number of tests/subjects, select more sensitive subjects, provide training, etc.).

Third example (ILO 2). A third example concerned the data analysis methods (ILO 2). Teaching data analysis to students without a firm grasp on statistics (often the case in particular course) is always a challenge. The risk that the students will adopt surface learning strategies is much higher than for other parts of the curriculum. I wanted to use apply CBT learning in statistics, as students are more motivated and better understand concepts when real data sets are used. I also wanted to structure my student activation activity around visual results interpretation, both because this is the key skill students will need when communicating the results from sensory tests to other professionals, and because visual explanations have been mentioned to be very effective in food science education (Schmidt 2009). In order to do that, I developed a series of concept tests based on different plots form multivariate data analyses of sensory and consumer science data. They were designed so that the students would learn how to interpret and draw conclusions multivariate plots. The students discussed the cases with their neighbor, and then a plenum discussion followed.



Background. EU project focusing on reducing the sugar content in apple juice (Rødbotten and others, 2009). Sensory testing of apple juice from concentrate. Six samples were developed by adding water, sugar and acid, following 2*3 factorial design, with three levels of sugar (H, M, L), and two levels of acidity (H, L). Samples were tested by 126 consumers (nine point hedonic scale), and the data analyzed by Principal Component Analysis (80% variance explained in the first two components).

Q1. Which samples are most different?
Q2. Which sample(s) seem to be most liked?
Q3. What seems to be the main 'driver' of liking?



Background. A sensory profiling of ten Loire Valley wine, conducted by a panel of trained assessors and a panel of food science students (Pagès and Husson, 2009). Samples 1-5 are Sauvignon, S6-10 Chenin; Samples 7 and 10 are aged-casked (woody taste), Sample 6 has high residual sugars (10 g/l).

Q1. What seem to be the main sensory differences between the samples?
Q2. Are the two panels describing the wines similarly?

Fig. 29.2. Two examples of case studies discussed in class

Fourth example (ILO 2). The idea with this test was for the students to think about different data structures resulting from sensory experiments. For each of them, they would indicate the most appropriate data analysis method among those covered in the course, using a multiple response question format in Socrative. The key elements that the student would have to consider in this task were essentially two: (a) the number of data matrices (one, two, or more than two), and (b) the type of data (quantitative or categorical) obtained in the study. The goal of the exercise was for the students to work out those essential elements during the task. Ideally, there is a simplified decision tree one can use (which I in fact used to summarize the discussion after the task).

1. Q1. Researchers at UCPH ran a study to investigate the effect of cooking time and temperature on the sensory properties of beef cooked sous-vide. Three different cooking temperature (56, 58, and 60 degrees C) and four cooking times (3, 6, 9, and 12 hours) were considered producing 12 samples in total. The data consists of a sensory evaluation by a trained panel, averaged over assessors and replicates. Now you want to use a MV to visualize the main differences in sensory properties between your samples and assess the effect of time and temperature. Think about how the data would look like, then indicate what MV method seems most appropriate. NB: more than one answer may be correct..

(A) Principal Component Analysis (PCA)
(B) Correspondence Analysis (CA)
(C) Partial Least Squares Regression (PLSR)
(D) Multiple Factor Analysis (MFA)

2. Q2. You are the panel leader of a sensory lab running a project about chicken meat fed with 4 different feeding strategies.You run a sensory profiling with 10 sensory panelists in triplicates. Now you need to explore the data and to find out out whether the feeding strategies affect the sensory quality of chicken meat. At the same, you want to evaluate whether your panelists are generally agreeing with each other, and whether the different replicates produce the same results. Think about how the data would look like, then indicate what MV method seems most appropriate. NB: more than one answer may be correct..

(A) PCA
(B) CA
(C) PLSR
(D) MFA

3. Q3. Together with a small local producer, you are working on a project developing new fruit juices based on nordic ingredients. You are asked to provide reccomendations based on sensory insights. You set up a large consumer test (N=200) where consumers report their liking for the juices and also describe their sensory properties by a CATA questionnaire. You want to visualize the sensory properties of the juices and relate this information with the preference data. Think about how the data would look like, then indicate what MV method seems most appropriate. NB: more than one answer may be correct..

(A) PCA
(B) CA
(C) PLSR
(D) MFA

4. Q4. You are running a study investigating chemical and sensory properties of apples with different storage time (10 days and 20 days at −0.5 °C) and regimes (air vs controlled atmosphere). The data consists of some physico-chemical data (volatiles analysis, firmness, % solubles solids, etc) and of sesnory assessment by a trained panel. You need to analyze the data in order to determine the relationship between sensory and instrumental parameters and the influence of storage period and storage atmosphere on the chemical and sensory composition of the apples. Think about how the data would look like, then indicate what MV method seems most appropriate. NB: more than one answer may be correct..

(A) PCA
(B) CA
(C) PLSR
(D) MFA

Fig. 29.3. Example of case studies used in connection to ILO 2. Correct answers (Q1:A; Q2:D; Q3:B,C,D; Q4:C,D).

Assessment of teaching effectiveness

Considering the limited class size, and the even smaller number of students who completed the evaluation survey, I relied on both formal and informal assessments of my teaching approach, such as:

1. My own reflections and observations;

2. Quantitative course evaluations by the students;
3. Critical feedbacks provided by my pedagogical supervisor and the course coordinator, who sit through some of the lectures;
4. Insights from a focus group I conducted with a subset of students ($N = 7$), shortly after the end of the course.

Student evaluations for the course were generally very good (Figure 29.4). The applied aspect of the course and the real world relevance was mentioned as the most significant positive aspect of the course. Some comments raised during the open-ended online evaluation and the focus group interview were:

- really applied course with interesting projects;
- so much fun! Both with the kitchen exercises and the project work. It is nice to be able to use the knowledge from my previous courses in FI&H - everything comes together in this course;
- it gave us the opportunity to work on a real case scenarios;
- the course rounds off perfectly what we have learned during the MSc programme. Very exciting and relevant.

All of the student who completed the online evaluation totally agreed with the statement that participation in the course was a “rewarding” experience (Fig. 29.4).

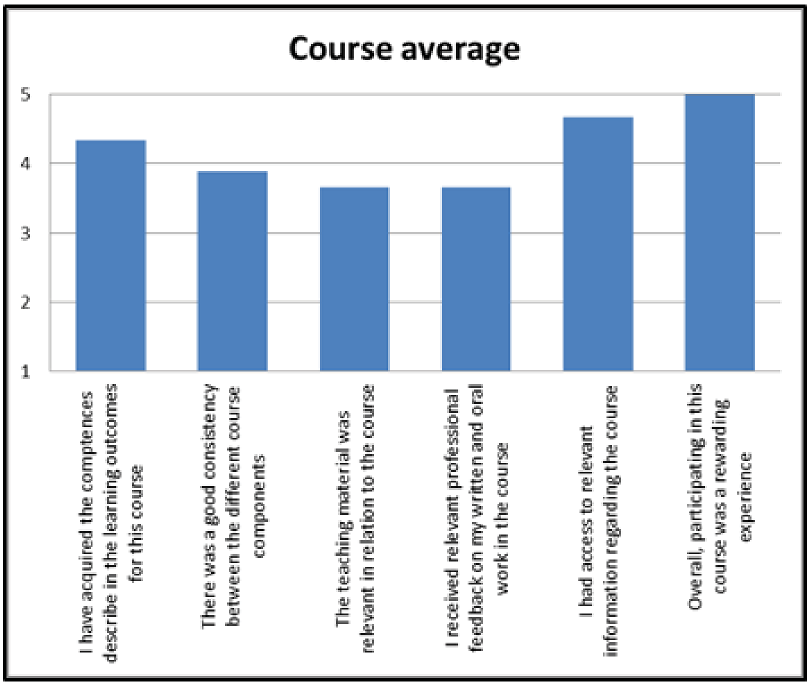


Fig. 29.4. Average student evaluations of the course (Likert scale, 1=Totally Disagree, 5=Totally Agree).

Regarding my own teaching, my overall impression is that CBT worked very nicely in activating the students and shifting the focus from lecturing to a more student-oriented way of learning. This was no doubt facilitated by the applied focus of the course and the small class size.

The activities that had a peer instruction component (e.g. Example 1) were particularly successful in engaging the students and the discussions between neighbors were surprisingly animated. As a teacher, I tried to facilitate the plenum discussion and to fully discuss each point of view before moving on to the next exercise. Actually, a “mistake” I found myself doing a few times is giving too quickly my own assessment of the case, before having exhausted the arguments from the students. As soon as I did that, all potential for further discussion was quickly lost because of the institutional aspect involving in the teacher speaking. In hindsight, I wished I had resisted the temptation to end the ambiguity, and given the students more time to discuss the issues that were raised. It is well known that less experienced teachers may have need some time adjusting to students feedbacks (Kay & LeSage 2009), so I think more experience with this teaching style will certainly help with pacing the discussions. On the other hand, including a peer instruction part (which I know worked well in engaging the students

– the class size was small so it was easy to eyeball the interactions), could be useful in making sure that students achieve the right level of activation.

Regarding the use of ARS, it was clear that the students liked it a lot and found it very entertaining. There has been some questioning in the literature whether or not this positive attitude towards ARSs, which is often reported, is associated with actual learning (Kennedy and others, 2006). In the more quantitative question formats, students responses were extremely good so that suggests that there was at least successful in solidifying concepts presented in the lecture. Although ARSs are obviously more beneficial in larger classroom, I will continue to use them as students liked it and it has the additional benefit of enabling summative assessment.

Overall, the students gave good evaluations (Figure 29.5), and the focus group interview suggested that the teaching format was effective in reaching the learning outcomes:

- Socrative was nice and useful also to make it in more entertaining;
- Very nice with Socrative!
- Case studies very useful;
- Some overlap with sensory science teaching in previous courses, but good to get the basics;
- Clear approach to choosing methods, good decision path, was easy to match methods with goals b/c of the teaching;
- Statistics is a difficult topic, but cases helped making it understandable.

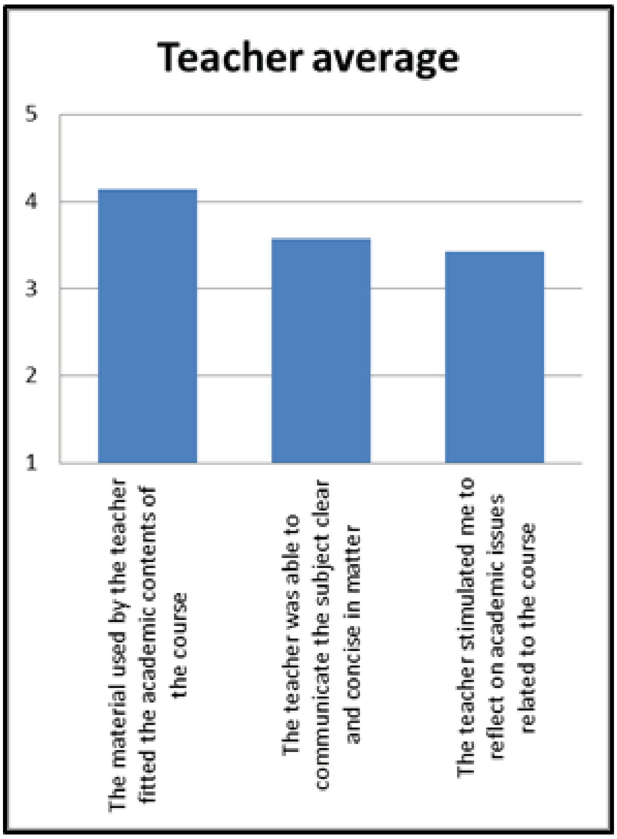


Fig. 29.5. Average student evaluations for my teaching in this course (Likert scale, 1=Totally Disagree, 5=Totally Agree).

Among the most interesting suggestion for improvement during the focus group was that I should avoid long lecturing streaks, and getting faster to the part where "they do something". I was both pleased and surprised to hear this comment, which all students present at the focus group seemed to subscribe too. Pleased as this suggested that the students liked the changes towards active learning, surprised because these were the classes were I lectured the least ever!

Conclusions

This project focused on the use of CBT and ARSs into a food science M.Sc. course. It was observed that the particular initiatives were very effective in engaging student participation and promote a more active way of learning. STR further facilitated class discussion, in addition to providing a real time of assessment of the teaching effectiveness. Both the use of CBT and ARS were well received by the students and were facilitated by the applied profile of the course. Creating and implementing these activities has required a substantial effort (especially relative to a normal lecture), but eventually it has been a most rewarding experience after witnessing their potential in enhancing the learning of my students.

Acknowledgements

I am grateful to the teachers, staff, and fellow participants from the *Teaching and Learning in Higher Education Programme* at University of Copenhagen. Prof. Marianne Ellegaard (Dept. of Plant and Environmental Sciences, University of Copenhagen) and Dr. Michael Bom Frøst (Dept. of Food Science, University of Copenhagen) are thanked for sitting some of the classes and providing excellent feedbacks.

All contributions to this volume can be found at:

http://www.ind.ku.dk/publikationer/up_projekter/2015-8/

The bibliography can be found at:

http://www.ind.ku.dk/publikationer/up_projekter/kapitler/2015_vol8_nr1-2_bibliography.pdf/