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Case studies and digital response systems in science courses for master students: Are we encouraging valuable discussions?

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Introduction

This article reviews the learnt experiences from the implementation of a Case Study and two student response systems in a MSc. lecture that originally had a teacher-based style. The lecture was selected from the **'Fruit and Berry Crop Physiology and Quality'** (FBCPQ) , a 7.5 ECTS course in which I have been teaching for some years. This Course is part of the MSc Education Program in Agriculture, under the sub specialization Plant Sciences. The cooperation partners in this Course are the Copenhagen University Fruit Genbank: the Pometum and a number of fruit companies and educational institutions in Denmark and abroad.

The lectures in this course take place on Tuesdays and Thursdays. Each year the course attracts students from different nationalities and agro/food-related backgrounds such as: Natural Resources, Agriculture, Horticulture, Plant Science, Agrobiology or Environmental Science from Danish, Nordic or international universities, Agricultural and Environmental Management from Danish Business Academies. Students with Biology, Geography, Geoinformatics and Biotechnology backgrounds are also admitted. For international applicants, there is a requirement of higher English sufficiency exam.

The 'FBCQP' course has a combination of classroom lectures and practical exercises /excursions. The individual lectures in which I have been teaching cover Fruit production and Juice quality aspects with focus on quantitative and qualitative techniques for Quality Control, in which both,

theory and practical exercises are addressed. The theoretical lectures take place on Tuesday mornings, whereas one of the practical parts is scheduled for one entire afternoon (usually a Thursday) in the University laboratories and facilities, after the theory presented on tuesday. The module contents have been organized in this manner to balance the interaction classroom vs. laboratory for students and teachers, that otherwise would have to spend entire days in the classrooms. Besides this, some of the topics are presented by external teachers, PhD students, Postdocs or guest lecturers, who participate in the course one or two times.

The Problem

Although the course has a reasonable combination of theoretical presentations, excursions and lab exercises, the theoretical lectures –teacher-centered, are sometimes exhausting for teachers and students.

On Tuesdays, students participate in oral lectures from 8:30 to 12.10. Each subject is presented during 45 -50 minutes, with 10 minutes pauses in-between. It means that there are 3-4 topics presented during the morning. This format allows for improvements in the activities and time allocation used during the lectures.

Under these premises I investigated whether including case studies in teacher-based lectures will promote a more active participation and learning satisfaction among the students taking the FBCQP course. Therefore, the objectives of the study were the following:

- Review complex scientific and old dated terminology/contents in the teaching material, and introduce case studies, to improve students understanding of key concepts and provide them with better preparation to the practical exercises connected to the lectures.
- Engage students during the lectures with the help of: infographics, interactive tools (on-line quizes, intuitive colaboration tools)
- Discuss with peer teachers/evaluators on any additional pedagogical elements that can be improved or implemented

Theoretical Background

The student participation dynamics in University classrooms change constantly. Students are increasingly being exposed to a huge range of digital

tools to complement their learning. Modern technology however, can also become a potential procrastination partner for them (Anshari, Almunawar, Shahrill, Wicaksono, & Huda, 2017; Furst, Evans, & Roderick, 2017). On the other hand, the new generation of teachers joining the academia, have an additional challenge. With little pedagogical experience and time, they take part on lectures that traditionally use a monolog approach and have to quickly adapt to new teaching material or pedagogical tools to provide quality education.

Lectures at Universities have been traditionally based on the teacher's academic knowledge rather than the student learning (Rienecker, Jørgensen, Dolin, & Ingerslev, 2015). The higher demand for quality teaching and reduction of teaching resources, is moving this trend towards the use of alternative learning tools in classrooms (Zainuddin & Halili, 2016). Clickers, quizzes, or different response systems encourage student participation and thus the interaction teacher-student . At the Science educational programs in Copenhagen University, these interactions are being ranked high or very positive on the student's preferences and Course evaluation surveys.

However, such digital solutions cannot ensure assimilation of contents on their own without valuable teaching material behind it. Today, such material has to deliver theoretical knowledge and reflections from situations in the 'real world' to be considered 'high quality' by the students.

Case-based learning

Case Studies and group discussions are excellent solutions for ensuring that a lecture is not passed on into a mere transferal of notes and bring theoretical component in practice (Rienecker et al., 2015). Apart from the known advantages such as encouraging own understanding, improving communicational skills, create collaboration communities, strengthen connections, remove misunderstandings, increased effort, reduce study time, provide insight to collaboration, formulate academic arguments, etc., group work can also introduce the following challenges: power struggles, personal positioning, stress- or the like. These issues require attention and well planning ahead from the teachers before, during and after the lecture (Bonney, 2015). Evidence shows that groups of 3 to 5 members work best under the University settings. Furthermore, teachers should ensure that student expectations and requirements are covered in the group work. In practice little time, highly diverse student groups, or unexperienced teachers, make the success of the implementation of case studies and group discussions challenging.

Another challenge that comes along with the case-study teaching format is that the teacher *assumes* the facilitator role. It means that apart from selecting a 'good case' material and carefully adapting it to the current one, he must have other abilities such as: start discussions if they do not arise, show active listening to what is and also to what is not articulated or when necessary, the teacher should let the students lead the learning process. Therefore, the success of case-based learning will depend on student participation and engagement to a greater extent than in other teaching activities (Rienecker et al., 2015).

The case-study method will further allow students to keep focused on the learning and the academic content, by which students can develop metacognitive and reflective academic competences.

My approach

The FBCPQ Master course received 5 students. All of them had different backgrounds, and the same nationality (Denmark).

Two subjects were selected for this project: 'Fruit Quality evaluation' and the practical exercise that is a continuation of the lecture: 'Fruit thinning, sorting and Fruit Quality'. The first oral lecture included 2 digital response systems (*Socrative* and *Padlet*) and a case study. *Padlet* is an interactive way to share opinions online and the *Socrative* assessment tool was used to receive immediate feedback of my teaching at the end of the lecture. The second lecture focused mostly on a practical exercise that students performed out in the apple orchard (the Pometum) and at the laboratory. The discussion that followed up the case study was included at the beginning of the practical exercise in the second teaching day. In addition to this, three senior lecturers were interviewed to provide additional insight on good quality discussions in Science Courses for MSc students. I assigned 25 minutes for the oral presentation and 15 minutes for the introduction and realization of the case study. The contents of the oral presentation were reviewed and reduced. Where possible, the text of the slides for the oral presentation was summarized or replaced with info-graphics .The case study 'One Bad Apple' (Appendix B), that originally addressed a statistic problem developed by H. (n.d.), was reviewed, edited and adapted to my course materials content. It was presented in the last 15 minutes of the lecture, so that students had the possibility of solving it in groups and deliver their an-

swers at the end of the lecture. A short evaluation quiz was finally presented during the last 2 minutes of the exercise.

At the lecture, I assessed the background of the students, announced the basic rules for my teaching (regarding interruptions, questions, ILO's) and proceeded with the presentation and explanations of the slides that I prepared for the lecture, including the digital tools. There were no questions asked at the end of the oral presentation and the timing worked well. In respect to the use of *Padlet* to collect their reflection of the case work, a few students wrote very short comments to the questions. However, the students took the case study positively and participated actively with the evaluation quiz that was delivered at the end of the lecture (Appendix A). The answers of the case-study were re-visited at the beginning of the practical lecture, that took place in Thursday of the same week. For this I used the first 10 minutes for the discussion of the results in plenum. I tried to encourage student participation by asking them to elaborate more on their reflections and tried to dig more into the main questions of the case study. As student responses and new questions came along, I elaborated more on the different concepts of the questions and finally I did a wrap up by linking the take home messages to the practical exercise that they performed in groups afterwards.

My perception is that for non-experienced teachers, subtle pedagogic details in the start of the discussion can make big differences in a case-based lecture setup, especially when the contact with the students is limited, the teacher had little instruction before the teaching or if the communication between the different teachers that participate in the same Course and the course leader is not optimal. For the case study in this project, I chose questions that encouraged students' reflections on concepts that were part of the ILO's in my oral lecture in 'Fruit Quality' (fruit maturity, quality control methods).

Although the case study exercise did sparkled the curiosity among the students and provided them with additional information to the concepts in Fruit Quality Determinations that were not part of the lecture, I investigated further about how I could have approached the discussion differently, and if so, what difference would it have made to the outcomes of the exercise, both for the students and for me. The opinion of three very experienced lecturers of Life Sciences, all of them with 10+ years of teaching experience in Science Courses for Bachelors and Master students and with high popularity among students provided valuable insight about quality discussions for non-experienced teachers.

Jens Streibig, Emeritus professor with 40 years of experience in teaching the subjects Weed, Pesticide and Crop Sciences, said that he used a mix of theory and practical exercises in his statistic courses. For him, including mid-lecture evaluations after 20 minutes oral presentations worked well to evaluate the level of understanding of the concepts that he explained during the lecture. Students had only 10 minutes to solve the statistical problem proposed. In this context, good discussions arose irrespective of the students had solved the exercise or not. The students who had solved the problems on their own were the ones who got the most out of the teaching material. 'Controversial students can be difficult to control but one has to be tough there', he said. Listening to the opinions and questions from students is also a good idea to adjust the terms used in the lecture and hopefully reach their different learning needs, 'sometimes what is obvious for me is not so for the students, so I had to change my presentation over time'. He recommends using provocation (what upsets students) and examples that connect the concepts used with the real world to engage students and startup good discussions.

For Eva Ronsenqvist, lecturer with 10-year teaching experience and course responsible of different MSc Courses, using data from her own research to discuss phenomena (physics) and theories behind it has given good results. At her lectures, students are given a scientific article related to the concepts they have to learn and in groups they discuss what they have understood about it. She defines an ideal discussion during a lecture as having a group of students discussing a specific topic, engaging in conversation and the teacher acting as an observer only- ' This rarely happens'. In her opinion, activities that can initiate good discussions include: telling students that they are welcome to interrupt the teacher's oral presentation so they don't get lost, introduce an unknown practical application and excursions to real research environments where students perform an exercise. One challenge in this type of setup is to get the Chinese students to talk, 'they participate under command and that takes an extra effort from the teachers'- she highlights. In the *Climate Management Course*, the teacher has to be knowledgeable about the different contents and the lab work do require someone who is an expert into the specifics and the lectures have to be integrated with each other. Therefore this course is only thought by senior teachers.

Controversial matters are dealt with honest communication, explaining for example ' the reasons why you have an opinion and acknowledge it based in competent background, facts'. If the presentations /discus-

sions in plenum are good, Eva does not interrupt them. Discussions should not be longer than 15 minutes and the wrap up at the end is no longer than 2 minutes. Eva has been responsible of the following MSc.Courses at Copenhagen University : Climate control in greenhouses, Gas exchange and chlorophyll fluorescence, Stress physiology, Climate Management in Plant Production and Research and Experimental Plant Science.

Vibeke Langer, shared her reflections from her 20 years teaching experience. She has been course coordinator of the following MSc Courses: *European Farm and Food Systems, Applied Ecology* and *Organic Agriculture* at the Faculty of Science, Copenhagen University. She considers that 'discussion' is a rare term to use. It can be many things 'joint making sense', 'conversation where participants are informed, enter with an open mind and are willing to listen and adjust'. For her the ideal discussion should not start with general questions such as 'what do you think of. . . .' , it should rather address the learning messages for students. 'The students leaving my classroom are wiser, and that means that they have to prepare before the class to be able to engage in meaningful discussions'. A proper discussion setup would be organizing the students into small discussion groups first, either guided or more free, then followed by a discussion in plenum in some way. To reach this, it is crucial to prepare very well in advance, be ambitious and do not limit the conversations to right and wrong answers. A challenge for non-experienced teachers that she points out is perhaps trying to cover too much. 'You should start with the little and stick to it'. 'Think about what is the end through, don't focus on closed areas and send signals of verbal ambition. A good way to deal with students with different needs is to identify them, by for example, asking the students to present a specific problem from their own countries. This exercise will make the needs, background and styles visible and explicit'. Controversial matters are dealt by relating topics to values and make them seeable, and by structuring discussion according to the end message. This also means that the timing must be also planned in extreme detail.

Discussion, reflections and conclusions

Active classrooms today are highly engaging, entertaining and deliver valuable knowledge of high quality that can be used in practice. At least that is the expectation of most Science students nowadays and the University educational programs try to satisfy these demands. In the Science Faculty,

Copenhagen University, teaching has a high degree of discussion, independence and self-reflection of the lecture contents. With the high diversity of students that we receive each year and the never ending teaching options available in the digital world, planning teaching sessions require more and more time to be able to cope up to the requirements of an education system which is in continuous development and is highly competitive. The exercise presented in this project illustrates how adding new elements in a teacher-based lecture can add value and potentially make a lecture more engaging. However, I think that to fully reach this goal the teacher should be competent to be able to do the transition from authority to facilitator. From what the senior teachers expressed in the interviews, this facilitator role requires years of practice and exposure to different student groups and conversational situations. New coming teachers can highly benefit from the support of seniors during the design, planning, implementation and adjustment of their teaching material. One way of doing it could be through a forum of discussion of the numerous situations that educators face in their teaching practice. This would enhance the quality of discussions in the classrooms. For Universities that have the dual approach: teaching and researching, additional assistance in teaching becomes absolutely necessary to be able to deliver the same or even improved quality in all the educational programs. The interviews also made it clear that contrary to what many young talents may think, good discussions in class does not 'just' happen, and yet although contents of a lecture are prepared in advance, high quality discussions require an extra effort from the teacher side. The teacher must be well prepared, attentive, know what to do if group conflicts arise, be persuasive and know how to properly improvise to maintain a nice teaching environment. Students on the other side, need to receive a common understanding and ground rules of the conversations that take place during the discussion, according to the topic, to feel comfortable enough to dare sharing their opinions in plenum (Brookfield & Preskill, 2012). This friendly environment is the responsibility of the teacher in charge. The art of showing students what a respectful and democratic discussion looks like, what they can get out of it so that they take it seriously, requires experience and dedication . Aspects around this may include: Recognizing the value of silence, of well framed questions, of democratic agreements, alternative perspectives, etc.

At the Master educational level, this also means that students must be well prepared before entering the class. This adds an extra value to the whole class and leads to fruitful outcomes for teachers and students. In

practice it may be that not all the senior staff would be willing to participate in training initiatives for the new generation of teachers.

In this context, digital tools are a fantastic way of engaging students without having to persuade them too much, because they can already use these devices. Using different tools during the lecture is enjoyable for both the teacher and students. I personally noticed a more engaging atmosphere after including the different digital tools in my lecture. Students are very familiar with smartphones and computers. For this exercise they preferred to answer the questions using their telephones. In bigger groups it would be worthy preparing additional material for reading and structure a more detailed conversation on topics that can stimulate their curiosity.

The case exercise presented in this project, would benefit from including other optics or literature review about the different implications for the juice/cider industry, to have a little more in-depth discussions. In general I think that the quality of discussions in Science Courses would greatly benefit from a joint Seniors and Junior's workshop where best teaching practices can be reviewed and discussed.

A limiting factor to introducing such tools in the different courses is the time and human resources available to do this job. This is a dilemma that Universities should take seriously to be able to shorten the gap between senior and new teaching staff, to keep up with the quality of education that the students expect to receive.

References

Anshari, M., Almunawar, M. N., Shahrill, M., Wicaksono, D. K., & Huda, M. (2017). Smartphones usage in the classrooms: learning aid or interference? *Education and Information Technologies*, *22*(6), 3063–3079.

Bonney, K. M. (2015). Case study teaching method improves student performance and perceptions of learning gains. *Journal of microbiology & biology education*, *16*(1), 21.

Brookfield, S. D. & Preskill, S. (2012). *Discussion as a way of teaching: tools and techniques for democratic classrooms*. John Wiley & Sons.

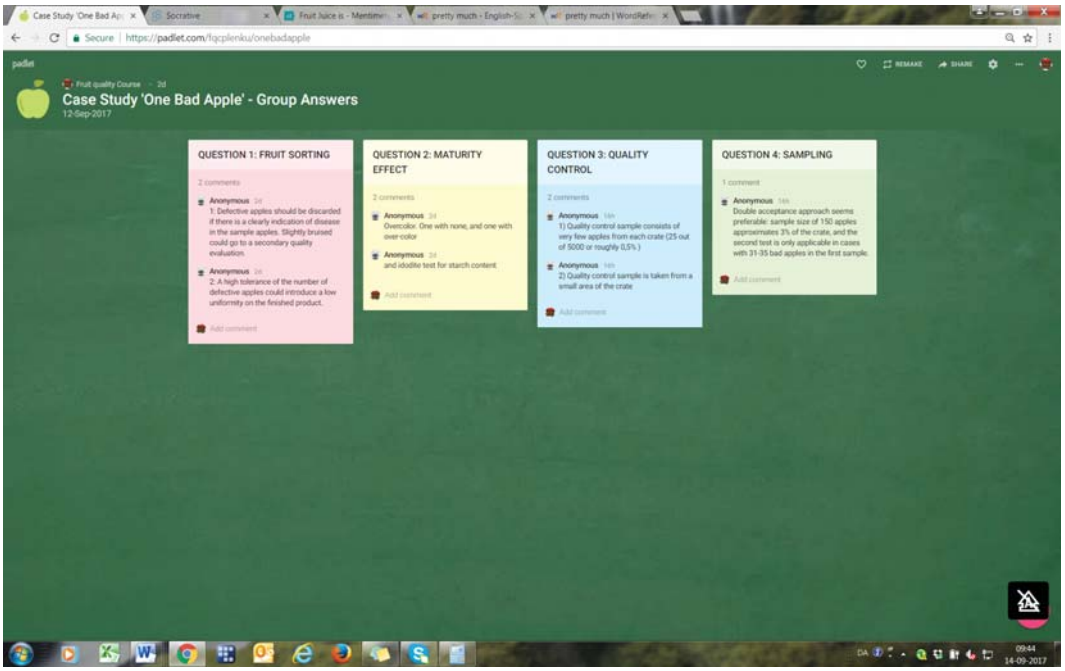
Furst, R. T., Evans, D. N., & Roderick, N. M. (2017). Frequency of college student smartphone use: impact on classroom homework assignments. *Journal of Technology in Behavioral Science*, 1–9.

H., J. (n.d.). One bad apple. National Center for Case Study teaching in Science. University of Buffalo. USA.

Rienecker, L., Jørgensen, P. S., Dolin, J., & Ingerslev, G. H. (Eds.). (2015). *University Teaching and Learning* (1st ed.). Samfundslitteratur.

Zainuddin, Z. & Halili, S. H. (2016). Flipped classroom research and trends from different fields of study. *The international review of research in open and distributed learning*, *17*(3).

A Padlet Responses Group Work – Case Study



B Case Study

CASE STUDY

One Bad Apple:

Designing Harvest Plans for Better Food Quality

ValleyTree Orchards, a large beverage company, has been working on improving the taste of their apple cider. Customers keep complaining that the taste of the cider is variable: one bottle tastes great, the next bottle they buy tastes sour or too sweet or stale. The research and development team can produce a bench-scale product that has the same flavor from batch to batch. So can the pilot-scale production team.The problem seems to be with the full-scale production line.

The quality assurance (QA) team has reviewed the quality control data of products tested before the product is shipped and did not see anything unusual. Sensory evaluation, viscosity, and microbial counts are all within acceptable ranges for all samples that have been shipped out.

One quality control technician mentions that some of the samples they test tasted a little different, but she admits that she's been tasting cider for years and might be more sensitive than the average consumer. Samples that taste different don't show up on particular days and don't seem to be correlated to any of the other quality control (QC) data collected.

The QA team has also gone over the process with several engineers and can't find anything that would cause variations in flavor. Cleaning and maintenance are performed as scheduled. Without any luck in finding any root causes in the process or the QC data, a frustrated member of the QA team, takes a look at the raw ingredients coming in. He watches a shipment of apples being received.

The apples are shipped in large crates, about a meter high, and a meter and a half wide and long. As each crate comes in, they are checked for quality. The QA team member watches as a worker collects about two dozen apples from the side of a crate that is closest to the worker. She takes them over to a nearby table, checks each one quickly, then puts the apples back in the crate.Curious, the QA team member walks over to the worker and asks her about the receiving process.

She explains that each crate needs to be checked before being accepted. Depending on the size of the apple, each crate will contain 4500–7500 apples. Too many bruised, punctured, broken, wormy or improperly matured apples mean that the crate is bad. If more than 20% of apples are flawed in this manner, the crate shouldn't be accepted. So she's been looking at two dozen apples per crate and rejecting crates with more than 5 bad apples in that set of two dozen. The QA team member asks how long she's been working. She's been at the company for several months. However, the customer complaints have only been showing up for the past 6 weeks.

When looking at the records of suppliers, he finds out that two farms have recently joined the list just few months ago. One of them is replacing one of their biggest suppliers. The QA team member may have found another dead end. Or maybe not.

Questions

1. FRUIT SORTING: Commercial apples are usually carefully selected at harvest. Here, damaged and wormy apples are removed. However for juice making purposes, whatever fruit available is used, normally those not meeting the standards, thus defective apples can be included in the lot that enters the process.
   - **What should be done with the defective apples?**
   - **Why is a good idea to reject shipments of apples that have a high number of defective apples?**
   - **Would maturity affect juice quality if there is considerable variation? how?**

2. MATURITY EFFECT. The QA team member wish to find out whether the variation in quality reported is coming from their suppliers, one approach is to test the effect of apples with different maturities in the fruit juice sensory quality. **Suggest a methodology to select 2 maturity groups from one cultivar, to make 2 types of juice in this experiment.**

3. QUALITY CONTROL: **Do you see anything wrong with the way the worker is checking the incoming crates of apples? Explain your answer.**

4. SAMPLING: Several members of the QA team are worried that the sampling plan is too strict. Traditionally they have been using a 'single acceptance' plan, now they want to try a 'double acceptance' plan. These sampling schemes consist on the following:

   Single acceptance approach: Under this plan, 150 apples per crate will be checked. The sample will be accepted if no more than 30 apples have bruises, punctures, or breaks and the sample will be rejected if the sample has more than 35 apples with bruises, punctures, or breaks).
   Double acceptance approach: If the sample needs to be tested again, 20 more apples will be tested. If the total number of apples with defects from both the first and second samples is greater than 35, the lot is rejected. Otherwise, it is accepted.

   Which sampling plan do you think is better to use, the single acceptance or the double acceptance? Or would you choose a different sampling plan? Explain your answer.