

## Research-based teaching intervention in Food Science

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### Introduction

Although relating research and teaching in higher education has been shown to have potentially mutual benefits for both (Healey, 2005), the opposite has also been reported (Dohn & Dolin, 2015), and the nature of the relationship has been characterised as complex and it is a topic of global debate (Tight, 2016). Opinions in academia deviate from supporting a tight link (“unity of research and teaching” suggested by Humboldt in 1809) to believing in complete separation (as suggested by Newman in 1852, who attributed education to universities and research to research institutes) (Tight, 2016). Not surprisingly, in their meta-analysis of the literature, Hattie & Marsh found models that advocate positive, negative, or no relationship between research and teaching at university level (Hattie & Marsh, 1996). They suggested that strategies to enhance this relationship are required.

The relationship between research and teaching can be multivariate. For example, Healey (2005) and Healey & Jenkins (2009) mapped the nature of the interactions in two axes, one relating to the role of the student (participant or audience) and the other to the research element that is emphasised (content or processes and problems). They therefore identified four research-related teaching designs, research-tutored (emphasis on content, students participate by writing and discussing papers/essays), research-led (emphasis on content, students listen), research-oriented (emphasis on processes, students listen) and research-based (emphasis on processes, students participate by undertaking research-based activities) (Healey, 2005; Healey & Jenkins, n.d.). Healey (2005) further expanded on identifying

specific ways to introduce research in teaching, one of which is “developing students’ research skills” (Healey, 2005) and it is relevant to this project. Development of “practical knowledge, practices or competences” has also been emphasised by Peters and Olssen (2005) as key in the observed “reorientation away from the knowledge society, which emphasizes the centrality of theoretical knowledge, towards the knowledge and learning economies” (Peters & Olssen, 2005). Brennan et al. (2019) described a dynamic framework of introducing research in teaching with 3 interacting phases: (1) teaching is enhanced by research; (2) learning research skills and competencies; (3) student engagement with research practice (Brennan et al., n.d.).

This project focused on introducing a research-based teaching session in a running course by inviting the students to develop their skills in (1) carrying out research experiments and (2) presenting their results through poster presentation. I will first describe the intervention and then discuss the outcomes.

## **Intervention**

“Plants for foods: processing and functionality” is a relatively new course at the Department of Food Science: this year (2021-2022) was the 2<sup>nd</sup> time that it ran, and the 1<sup>st</sup> time that I was contributing to teaching it, as a new academic at KU. It is an MSc course that ran with about 30-40 students in the past two years, and it is taught in English. It is expected that I will become the course responsible from next year onwards. In its current form, the course incorporates three elements of teaching: (1) “theoretical” (in-class) lessons, which are typically given in a lecture theatre and have a largely “lecturing” layout; (2) practical (i.e., laboratory) sessions, where the students are asked to follow a specific experimental protocol to produce results; and (3) a final project where the students are asked to design and perform additional laboratory work and produce a final report. Last year, there were two practical sessions, both concerning proteins. After reflecting on the content of the course and on students’ evaluations from last year, it was suggested (by the teachers involved in the course) and agreed to increase the number of practical sessions to three.

The present intervention was then agreed with the course responsible as the 3<sup>rd</sup> practical session. The intervention consisted of 2 stages: first, a 3.5h laboratory exercise, which took place on the 1<sup>st</sup> of March, and sec-

ond, an approximately 3h in-class discussion, which took place in the next day of the course, on the 3<sup>rd</sup> of March. It was expected from the students to perform the experimental part in the laboratory, analyse their data and send their results to me before the 3<sup>rd</sup> of March, and finally participate actively in the in-class discussion about how to present their data as a poster in a hypothetical digestion conference. My main roles were to produce the protocol, support the laboratory experiment, and facilitate the plenum discussion, which lasted from 8:30 to 11:15am. The experiment focused on determining starch digestion in different samples (so it was different from the other two, protein-focused laboratory exercises).

The plenum discussion started with the students presenting in groups their data to their peers. This took approximately 40 minutes. After a short 10 minutes break, we then discussed some elements of poster preparation. The discussion was guided/facilitated by few (4-5) slides that I had prepared with information on poster preparation extracted from literature papers. The objective of this part of the discussion was to motivate the students to acquire poster presentation skills by thinking about important processes and features of successful poster presentations. We discussed different elements of a poster, such as the layout, the text & font size, the sections, the figures, and how they can be used to attract the attention of the audience. At the end of this discussion the students were asked to take the role of the audience. They were shown two posters, one that was deliberately prepared as a “bad” poster example, and the other was a real poster that had been presented in a conference with reasonable success. The students were asked to comment on the two posters and make suggestions on how to improve them. In this part of the discussion, the students were acting as observants and critically evaluated how successful the two posters were in attracting attention. In the next part of the plenum session the roles switched, and the students were asked to prepare their own poster based on the laboratory experiment they have carried out and the skills/tools they had acquired in the previous discussion. First, the students were asked to decide, in a discussion facilitated by the teacher, on the different sections that the poster would incorporate, for example whether it would contain an abstract or how many figures it should present. They then explored layout options and discussed topics such as what portion of the poster should be dedicated to the title. This was followed by a padlet session, where the students were asked to post, in dialogue with their neighbouring peers, what information they consider relevant to include in the poster for the different sections. The last element of the plenum session was to discuss the comments in the padlet

and decide the title and text of the poster. On occasions, where the class disagreed on what to include in the poster, the final decision was based on an open vote and the majority's opinion was adopted. The final output of the plenum session was a power point slide with largely copy-pasted text from the padlet, which would form the basis for the final poster.

The overall aim of the intervention was to introduce the students to research methodologies, including production and interpretation of data, and presentation of the obtained information in a poster setting.

## **Intervention outputs & evaluation**

The output of this intervention was a poster that the students had to attach to their practical sessions' reports. The layout and text of the poster was prepared by the teacher (myself), and it was based on the discussion and outcomes of the plenum session. The students were expected to add their own results and attach the poster as an appendix to their report. Carrying out the intervention, including the experimental part and participation in the plenum discussion, was a prerequisite to qualify for the exams in this course.

To evaluate the outcomes of the intervention and increase potential benefits, I asked for feedback the students, a colleague (the course responsible), and the two supervisors (departmental and pedagogical) of the University's pedagogical course.

Immediately after the plenum session I held an oral evaluation discussion with the students about the intervention. Overall, it was well received. Most of the students had never prepared a poster before and were appreciative of the effort to teach research-based methodologies and poster presentation skills. I was asked whether the results would be presented in a real conference, which shows motivation from the students' perspective, and it can indeed happen in the future. The course responsible and UP supervisors also agreed that the intervention was overall successful, and I should consider keeping it as part of the course's curriculum in the future.

I also asked the students for written evaluations of the intervention, and I received two responses, which are included in the appendix. I also include in the appendix the overall student evaluation of myself as a teacher, completed by 21 students, as this intervention formed a large part of my teaching contribution in this course, and I therefore consider it relevant to

this project. However, the overall evaluation should be treated with care as it also includes feedback from few other teaching elements.

Student evaluations of the course, of me as a teacher, and of the intervention project were overall positive. The students mentioned that they enjoyed the project and they considered it useful, as they had never prepared a poster before. One student wrote: "I think it was valuable with the experiment and the poster preparation". The students agreed that the contents of the project, both the lab exercise and the poster preparation session, were relevant to their studies and aligned with the course's learning outcomes.

However, several students remarked that they would have preferred to prepare a poster themselves, within their groups, instead of having it prepared by the teacher. This would give them more time to think and create. One student wrote in the evaluation form: "make us work in groups and make our own poster with more time". Similar feedback was also mentioned by the course responsible and both supervisors. Another student suggested to split the poster sections between the groups in preparation of the plenum discussion of the poster: "So maybe each group should have prepared one section in the poster and write it in the padlet, and then in class everyone could contribute with something to all sections in the padlet, and then at last we could discuss the poster sections". Some students also mentioned that they felt unprepared with regards to the topic of the experiment, and they would have liked more information about it. This is reflected in the evaluation: "However, I think it would be nice to have some more reading materials about  $\alpha$ -amylase and starch hydrolysis for preparation of the experiment and the poster presentation, so that we were a bit more prepared. It was difficult to write something for the background part in the poster". The departmental supervisor gave me similar feedback to introduce the laboratory exercise during the lab section in more detail. I also noticed that during the exercise in the lab many students asked for clarifications to understand the method and each step of the experiment. This is therefore something to consider in the future.

In their overall teacher evaluation one student wrote that "the poster lecture was a mess", however without any further elaboration. Another student appreciated the approach "to let the students engage with each other during the lectures", however they suggest "some more guidelines to it, in order to get faster results during the "in plenum exercise"". A third student commented that they liked "the poster session [...] even though it was not as successful as planned. Well done – and nice work with the poster draft. Think we never told you that".

The two supervisors also encouraged me to consider taking more breaks – the plenum session essentially ran with one break after the results’ presentation and without any further breaks for the next about 2.5h. The educational supervisor noticed that the in-class discussion was largely dialogue-based, where students were often prompted with questions or ideas to discussed. It was observed that overall, the students were actively involved in the discussions and activities, including in group work and in open dialogue. During the padlet session, the educational supervisor encouraged me to engage with a certain group of foreign (Chinese) students who seemed that they could benefit from some support.

## Reflections & Discussion

One element that needs to be considered with regards to this intervention is how it aligns with the learning outcomes of the course as they are framed in the online course description. Looking closely at the online description, it appears that a directly related learning outcome is lacking. However, the intervention contributes towards the following intended learning outcomes: the skill to “Apply basic knowledge of food source composition and nutritional quality for development of new foods and ingredients [...]”, and the competences to “Collaborate and contribute effectively in teamwork” and “Contribute with scientific evidence towards public recommendations and policy”. Following the successful outcome of the intervention and the decision to keep it as part of the curriculum, it appears that the course may benefit from an additional intervention to revisit the intended learning outcomes to include an element relevant to communicating information.

Introducing a “research mode” in teaching has been reported as a possible way to enhance student learning in higher education, where “all undergraduate students [...] should experience learning through and about research” (Healey, 2005; Healey & Jenkins, n.d.). This is also supported by Baxter Mangola (2008), who reported that “knowledge acquisition is no longer sufficient for adults to keep pace with rapid change” and sees a transformation of higher education from “knowledge to wisdom” as key in “supporting adults to meet the challenges of adult life effectively” and “build the ability to defend one’s beliefs, identity, and social relations”, which she termed “self-authorship” (Magolda, 2008). Communication skills, such as poster presentation skills, are expected to support “self-authorship”. It should be noted, however, that there are also critics of research-based ed-

ucation, advocating that combining research with teaching essentially reduces the level of both and negatively impacts education (Dohn & Dolin, 2015).

There are studies that investigated the students' perspective of introducing research elements in teaching. Jenkins et al. (1998) reported that the students can identify clear benefits from this integration, such as increased enthusiasm and engagement from the teachers. However, they also reported disadvantages that included "reduced availability of the teachers for the students" and "lack of identification of themselves as "stakeholders" in staff research". They suggested that effective management of how research is introduced in teaching is required to enhance benefits and address disadvantages (Jenkins et al., 1998). Similar findings were reported by Stappenbelt (2013), who concluded that "a revisited research-teaching nexus could be more effective in benefiting student learning than current practice (Stappenbelt, 2013).

The present project includes introducing the students in poster preparation. Posters are a popular method to disseminate efficiently information (Miracle, n.d.) including scientific findings (Rowe & Ilic, 2009), which has prompted the publication of literature papers dedicated to poster preparation (see for example Gundogan et al., 2016; Halligan, 2008; Moore et al., 2001; Rowe and Ilic, 2011). In poster preparation, presenters are invited to be creative in visually communicating their findings within a constrained space, which has been reported as an important challenge of the poster process (Halligan, 2008; Moore et al., 2001). Developing poster skills has been associated with graduates who are "more multiliterate" (Bailey et al., 2008b), as such skills provide "a way of integrating critical thinking, retrieving information and improving communication skills in diverse subject and content areas" (Halligan, 2008). It has also been argued that "teaching and learning methods need to incorporate visual forms of communication and assessments" (Bailey et al., 2008a), and that poster presentations can form "education tools to prepare adults for their professional roles" (Halligan, 2008). However, it has been reported that "while efforts are made to teach the elements of writing a journal article in many graduate school curricula, much less attention is paid to teaching those skills necessary to develop a good oral or poster presentation" (Chopra & Kakar, 2014). Some researchers suggest that developing poster preparation skills is particularly lacking in university curricula as poster presentations are often considered "inferior to oral presentations" (Halligan, 2008). The present intervention

aimed at specifically introducing these skills that are often neglected in university education as part of the curriculum of the course.

## **Final thoughts and Future perspectives**

This intervention aimed at introducing a research-based activity in an MSc course that included a laboratory exercise combined with a plenum discussion on poster preparation and a final poster design. This is in line with the Danish University Act of 2011 and the University of Copenhagen's strategy to strengthen research integration into teaching, and it aligns well with the extensive literature that supports mutual benefits from linking research with teaching activities (Copenhagen, n.d. Dohn & Dolin, 2015; Healey, 2005). Reflecting on the evaluations and feedback from students and peers, the intervention is deemed overall successful and beneficial for the students by enhancing student learning and creating a dynamic environment where students in groups were involved in research-based activities and in developing their skills and competences on creating and presenting knowledge. It is an intervention that started as part of the pedagogical course and, in full agreement with all other teachers involved in the course, it will continue in the years to come. Acquired feedback also included constructive suggestions and practical recommendations on how to improve student experience in the future and these have been reflected on and will be interpreted to an implementation plan for next years' course. For next year I plan to keep the same format of the intervention (laboratory exercise followed by in-class lesson) and keep the in-class discussion open and dialogue-based. Responding to the various feedback that I received, I further plan to (1) better prepare the students for the exercise by written material and elaborated oral introduction in the laboratory practical; (2) increase the number of breaks in the plenum discussion; (3) assign the students to prepare the final poster in groups themselves rather than preparing it myself. To motivate the students further, I will also consider introducing a poster presentation session, where students will showcase their posters to colleagues from the department, with the possibility of having a small prize for the "best" poster. If possible, and with the students' permission, I will further consider the option in the future to prepare a conference poster based on data collected from different years, which will be authored by all students involved and will be shown at a digestion conference.



Overall, this project has set the basis for a research-based intervention that includes the usually neglected subject of communicating information using visual methods and it has now become part of the course's curriculum.

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## A Written student evaluations

### Evaluation as a teacher in the “Plants for Food: Processing and functionality” course

Results for Plants for Foods – Processing and Functionality B3-3F22 - Block 3, 10  
 2021/2022 - Department of Food Science  
 Evaluation period: 14-03-2022 - 03-04-2022

#### B Teacher evaluation (Ourania Gouseti)

38 could answer this evaluation schema.  
 21 have answered this evaluation schema.  
 The answer percentage is 55.26% : 21 / 38

##### 1 In my opinion, the lecturer was good at communicating the course content in a clear and precise manner

Strongly disagree	0 / 21	0.0%	
Disagree	0 / 21	0.0%	
Neither agree nor disagree	0 / 21	0.0%	
Agree	7 / 21	33.3%	
Strongly agree	14 / 21	66.7%	

##### 2 In my opinion, the lecturer took an interest in the students' learning outcome from the course

Strongly disagree	0 / 21	0.0%	
Disagree	0 / 21	0.0%	
Neither agree nor disagree	0 / 21	0.0%	
Agree	2 / 21	9.5%	
Strongly agree	19 / 21	90.5%	

##### 3 In my opinion, the lecturer was good at expressing him/herself clearly in the language of instruction (Danish/English)

Strongly disagree	0 / 21	0.0%	
Disagree	0 / 21	0.0%	
Neither agree nor disagree	0 / 21	0.0%	
Agree	2 / 21	9.5%	
Strongly agree	19 / 21	90.5%	

#### 4 Additional comments:

- The poster session you did, even though it was not as successful as planned. Well done - and nice work with the poster draft. Think we never told you that
- I really like her positive attitude and willing to teach
- The poster lecture was a mess
- Really helpful and supportive with knowledge and practical suggestions. Loved Ourania's approach to let the students engage with each other during her lectures, but I wouldn't mind some more guidelines to it, in order to get faster results during the "in plenum exercise".
- She has a very good energy and Ourania did so well.
- none

**Evaluation for the Practical 3 exercise on *in-vitro* starch digestibility:  
Experiment & poster preparation.**

This was overall a useful exercise (please add comments if any, for example do you think we should keep the two parts of experiment & poster preparation next year):

I think it was valuable with the experiment and the poster preparation.

I liked these elements and/or I suggest you keep them next year:

I think it was good that each group had different samples/conditions in the laboratory and it was a fine exercise to present our results for the other group in plenum.

These elements could be improved:

I think it worked well with the padlet and brainstorming. However, I think it would be nice to have some more reading materials about  $\alpha$ -amylase and starch hydrolysis for preparation of the experiment and the poster presentation, so that we were a bit more prepared. It was difficult to write something for the background part in the poster. So maybe each group should have prepared one section in the poster and write it in the padlet, and then in class everyone could contribute with something to all sections in the padlet, and then at last we could discuss the poster sections.

**Evaluation for the Practical 3 exercise on *in-vitro* starch digestibility:  
Experiment & poster preparation.**

This was overall a useful exercise (please add comments if any, for example do you think we should keep the two parts of experiment & poster preparation next year):

I think the idea of a poster was nice but it should be done in groups and have more time.

I liked these elements and/or I suggest you keep them next year:

The experiment, although we could test more conditions or test other enzymes. Also maybe just focus on one type of cultivar if what you want is for the class to compare all the results.

These elements could be improved:

Have replicates to actually have statistical power, improve the protocol, make us work in groups and make our own poster with more time.