PROCEEDINGS: TEACHING@ST AUTUMN 2019

17 DECEMBER 2019

AARHUS UNIVERSITY
SCIENCE AND TECHNOLOGY LEARNING LAB

Teaching@ST celebrates the end of the Teacher Training programme and the Science Teaching programme with a mini conference on teaching at Science and Technology. The purpose of the conference is to inspire exceptional teaching.

The conference is held by ST Learning Lab, the educational development centre of Science and Technology, Aarhus University.

For more information visit: stll.au.dk

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CONFERENCE PROGRAMME

12:45-14:15 **Poster presentations and discussion of teaching at Science and Technology**

14:30-15:00 **Franziska Eller, Assistant Professor**
Can the laboratory exercises be strengthened by reducing the number of assignments?

15:00-15:30 **Jacob Arnbjerg, Associate Professor**
Experience and reflections on how to actively include students in teaching activities and planning

KEYNOTE BY FRANZISKA ELLER, ASSISTANT PROFESSOR

Franziska Eller, assistant professor at the Department of Bioscience, has since 2017 progressively altered the Bachelor's course Plant Structure, Function, and Adaption in order to streamline laboratory teaching and allow students to use the feedback they receive in their laboratory reports. The course changes have also focused on active lectures, peer feedback using certain criteria, continuous assessment, and a connection between teaching and exam form.

The rationale for strengthening laboratory exercises is that it is essential to generate more interest in plants as an academic subject and to promote understanding of the biological processes. Learn more about the course changes as well as what considerations and challenges it has given.

KEYNOTE BY JACOB ARNBJERG ASSOCIATE PROFESSOR

The transition from upper secondary school to university can be rather overwhelming for the students. At the university, there are no class teachers that control if the students are present and have done their homework. Often the students are expected to read numerous pages before each lecture and prepare for the theoretical exercises (TØ). If a student finds it challenging to administer the increased levels of responsibility for their learning, there is a risk that they drop out.

We have decided to ease the transition for students at molecular biology by using an e-learning system that makes it possible to monitor the progress of the students, including their preparation for the lectures and at theoretical exercises. We have also allocated senior researchers for all theoretical exercises. When we combine our observations from the theoretical exercises in the classroom and the information from the e-learning system, we are at a very early stage able to identify the students that are behind schedule. These students will be contacted by the course coordinator and will be supervised to make up for lost time.

TEACHER TRAINING PROGRAMME POSTERS BY ASSISTANT PROFESSORS

Design of Multi-phase Assignment for Course Plasticity: Theory and Modeling

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Assistant Professor, Engineering Department

Keywords: *Mechanical Engineering; Small class teaching,STREAM model, Theoretical, virtual and physical lab exercises*

Context and course facts

Plasticity: Theory and Modeling is a 5 ECTS elective graduate course which was developed and taught for the first time on fall 2018. Following students demand, this course has been repeated three semesters in row. Oral exam with an external censor is applied.

The course objective is to strengthen the students' understanding of the physical origins of materials nonlinearity and various mathematical models to describe plasticity behavior in metals. By performing experimental tests and computer simulations, students will learn to apply their theoretical understanding into practical engineering problems.

Learning outcomes and purpose of learning design

My experience interacting with students enrolled in our Master's program in Mechanical Engineering is that they come with big challenges to reflect and apply their theoretical knowledge into real-life engineering problems. This often demotivates them to learn fundamental theories behind physical phenomena. Here, I would like to design a multi-phase assignment to highlight the use of theoretical knowledge in solving an engineering problem. The idea for this assignment was shaped after considering last year students' feedback where the integration of practical engineering problems into course assignments were suggested.

The assignment combines several learning activities including out-of-class preparation, a laboratory experiment, theoretical analysis and computer programming. Students will find an opportunity to conduct a lab test, obtain experimental data and continuously work on the data during different phase of the projects (e.g. apply available theories to explain the data and develop a finite element code to reproduce excremental data.

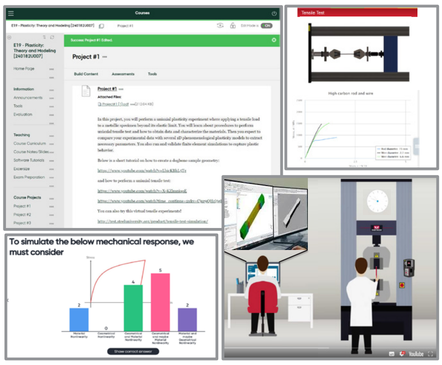

Figure 1: A *brief project description in Blackboard with some links, preparing students for the lab day. Snapshots of learning activities including mentimeter questions, online tutorials and a platforms for virtual laboratory experiments [1].*

Learning design and Educational-IT

To design this multiphase assignment, we used the STREAM approach to make connections between students' in-class lecture/exercise activities and out-of-class learning activities. To meet this objective, several digital educational tools and learning methodologies are implemented with the following structure:

1) multiple-choice questions is used via mentimeter to stimulate student's thinking about the project (see fig. 1). Then the project will be introduced and discussed in the class.

2) A lab day is designed for students to perform a tensile test in a group of two and collect experimental results. As an out-of-class activity, students are asked to watch a few web tutorials about test standards, methodology and data collection and to perform virtual experiments via an available online platform (Fig. 1). For the lab experiment, samples from different materials will be prepared in advance. Each group will receive a sample with no information about the type and material properties.

3) In the next phase, each group develops a finite element computer code based on two in class lectures and exercises. As an out-of-class activity, students are asked to use the experimental data in the developed code to obtain certain mechanical properties of the tested samples and make a guess about the material. Each group asked to upload their experimental data and the outcome of their computer code as well as obtained mechanical properties in the Blackboard.

4) In the last phase, each group is asked to analyze the experimental data of another group with their own computer code and to comment on any disagreements. This task provides opportunities for students to re-evaluate their own results (self-assessment) and/or evaluate the other group results (peer feedback).

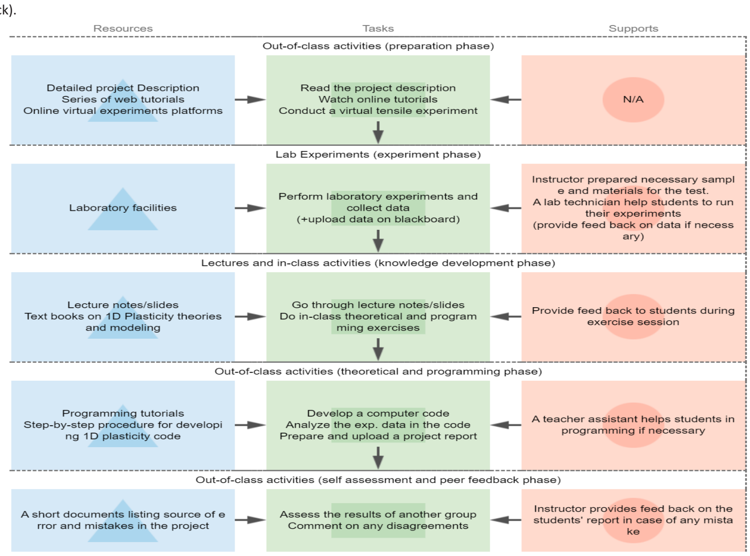

Figure 2. *LDTool representation of learning design used for an assignment design in "Plasticity: theory and modeling" course*

Pedagogical challenge

Design a multi-phase assignment to help students combining series of learning activities into a unified and coherent course assignment.

In this assignment, students are supposed to step-by-step apply their knowledge into practice. This includes performing a laboratory experiment and data processing, making theoretical analysis and developing a computer code to reproduce experimental results.

Indicators of impact

Students learning outcomes were monitored and assessed at multiple stages: **1)** The impact of the preparation phase is evaluated during the laboratory day. It was clear that the provided web tutorials and the use of virtual experiment platform significantly help student to smoothly run their experiments and collect data. **2)** The proposed added activities to this assignment (a lab experiment and programming) had a clear positive impact to motivate students toward further engagement in theoretical lectures and activities. **3)** The most significant outcome of this learning design was the impact of the last phase where students compare their results and comment on each other project reports. According the final course evaluation, most students found this new assignment an added asset to the course (Fig. 3). An improvement in the students performance in the final exam is expected!

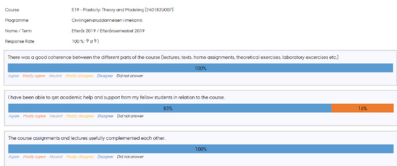

Figure 3. *A part of the course evaluation, December 2019*

EDU-IT role and benefits

Several digital education tools were used to design and implement this assignment (fig. 1). These include 1) the use of mentimeter application for pre-assessment of student knowledge, 2) a virtual experiments platform for enumerating common mistakes in lab experiments, and 3) the learning management system, Blackboard to provide content such as text, video, and links, and activities such as sharing material and providing peer review feedbacks. Overal, students found the online virtual experiment activity and the peer feedback very beneficial in their learning process.

Lessons learned and looking forward

Observation of student performance during this multi-phase assignment, I could clearly see that students helping other students learn is a powerful classroom technique. Designing multi-phase assignment by following the order observation-theory-project and the use of Digital Education Tools significantly improve students' learning achievements, motivations and problem-solving skills. Based on my this year observation, I would like to develop more online materials to reduce traditional lecturing and to dedicate more time for in-class discussions.

References

GodskM . STREAM: a Flexible Model for Transforming Higher Science Education into Blended and Online Learning (2013)

[1] http://test.steeluniversity.org/product/tensile-test-simulation/.

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Industrial visit as a replacement of a lab exercise for Modern Chemical Process Technologies course

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Keywords*: process engineering; industrial visit; webcast; peerwise; streamcast; peer feedback; learning design model*

Context/course facts

The new learning design was developed for the Modern Chemical Process Technologies (MCPT) course (10 ECTS) for the MSc students of Chemical and Biotechnology Engineering program at the department of Engineering. 21 students were enrolled in the course. The aim of the course is to give the students a comprehensive understanding of modern highly efficient chemical process technologies and provide in-depth knowledge on key topics within design and scale-up of chemical processes. The course has a focus on process simulations, process integration, process intensification and optimization.

Learning outcomes and purpose of learning design

The course had originally three lab exercises as part of its activities. Two of them were related to process intensification and optimization while the 3rd one was related to flow properties of non-Newtonian fluids such as biomass. While the first two lab exercises are directly related to the learning outcomes of the course, the idea behind the 3rd lab exercise was that since many future sustainable chemical technologies will directly or indirectly involve biomass as a staring feedstock it would be beneficial for the students to understand the non-Newtonian properties of such feedstock. However, the course curriculum was not sufficiently supporting the background knowledge for this lab (shear stresses, shear rates, etc).

It was therefore decided to replace this 3rd lab with another activity that would be more relative to the CLOs. Students in this course are required to design a highly efficient chemical process and make an assessment of it (group design project running throughout the semester). The activity proposed in this learning design is the replacement of this 3rd exercise with an industrial visit. It aims to enhance the students understanding on how the designs are eventually scaled up and implemented in practice as well as to show how complicated they can be. After this, students will have put all course curriculum into context (from basic process design by linking all necessary unit operations together, integrating them to take advantage of their synergies, intensifying and optimizing, safety and environmental issues to economic considerations). The intended learning outcomes are:

- **Understand how process designs are scaled up and implemented in practice**
- **Evaluate the designs and propose alternatives**
- **Develop and critically evaluate questions**
- **Present suggestions through screencasts**

Learning design and Educational-IT

The proposed learning activity is based on STREAM model and partially on Flipped Classroom. It is a combination of in- and out-of class activities. The learning activity can be split into six steps (Figure 1). The students will be asked to watch a series of videos (3 to 4 videos about 15-20min each) on oil and gas engineering, after which they will have to formulate and answer questions formulated by their peers on peerwise, prior to the industrial visit (oil refinery). On the day of the industrial visit, students will have a guided tour, by a plant engineer, on the plant facilities where they can ask for clarifying questions for the different processes/unit operations. Students are asked to take a photo of an individual process or unit operation that they find interesting during the visit. Afterwards they are asked to make a short presentation on suggestions on how to intensify/optimize the process or unit operation they found of interest. This presentation can be recorded as a screencast.

The new learning design is supporting the teaching activities in a way that new elements are included such as webcasts, peer feedback, self study and critical evaluation of the students learning all found in the STREAM theme.

Indicators of impact

Close monitoring of the online activities will be carried out and a lot of informal feedback is expected during the activities (both for out- and in-class activities). The final screencasts of the recorded presentations will be shown in class to evaluate the students performance and learning outcomes.

Pedagogical challenge/purpose

The idea of the new learning design is to enhance the students understanding on how the designs are eventually scaled up and implemented in practice as well as to show how complicated they can be.
The new design is based on the STEAM model and includes online activities and IT tools (webcast, peerwise, screencast) to help creating and designing tasks and refection on others.
Thereby bringing students to a higher learning level.

Lessons learned and looking forward

The present learning design has been produced for implementation during the next semester. Since it has not been applied yet no outcomes can be made at this point. However, a lesson learned by implementing peer feedback as a learning activity in other courses, is that it should not replace proper feedback by the academics. Peer feedback can improve students' performance and strengthen their ability to assess their own work, but at the same time is incomplete without proper academic feedback and can lead to misconceptions.

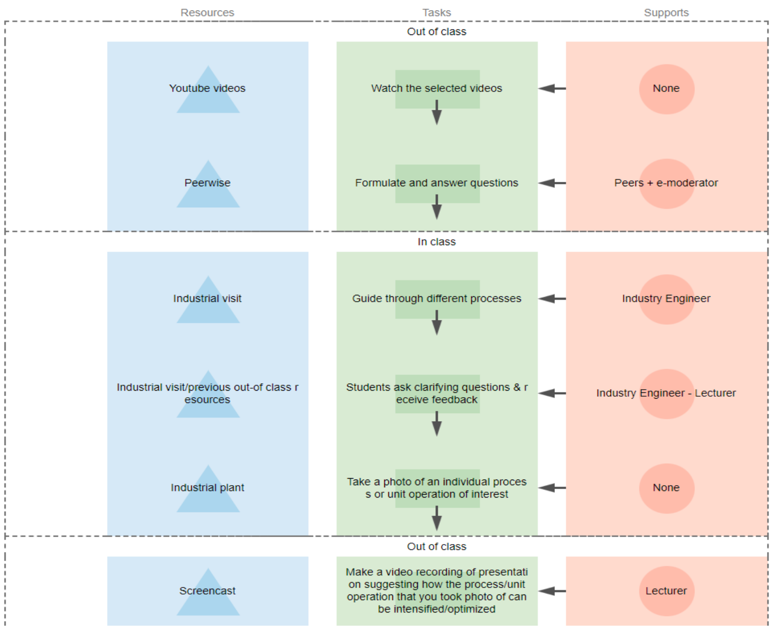

Figure 1. *LDTool representation of learning design used in MCPT*

EDU-IT role and benefits

The main use of IT resources will be the introduction of:

- *Webcasts*

3-4 videos on oil & gas engineering prior to industrial visit at oil refinery

- *Peerwise*

Formulate and answer questions from the peers based on the webcasts

- *Screencast*

Make a video recording of presentation suggesting how the selected process/unit operation can be intensified/optimized

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Simulation of multi-party cryptographic protocols using online forums

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Keywords: *cryptographic protocols; exercises and practical project; STREAM model; online forum; transformation from individual to social/collaborative learning.*

Pedagogical challenge/purpose

Teaching cryptographic protocols in practice is challenging, especially due to networking aspects.
This activity transforms programming work from a lonely task to collaborative activity by ***decoupling*** communication from implementation, and *employing online forums as a communication channel.*

Context/course facts

I proposed this activity for conducting small class teaching in my ongoing MSc. elective 5-ECTS course "*Fundamentals of Computer Security*", in which we have a module on Cryptography. Although the course is being offered as an elective at the MSc. level, currently with a class of just 4 students, the intention is to prototype an elective at the BSc. level. For it to be engaging and useful in a professional setting, this means the course should be as hands-on and practical as possible. This is usually performed by asking students to *implement* cryptographic protocols as a way to deepen their understanding about them. However, different implementation choices regarding the networking (representation, transport layer, programming language) limit interoperability, which further limits the collaboration possibilities among students.

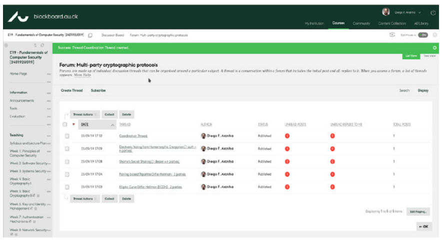

Figure 1. *Screenshot of prototype implementation of online forum, showing different threads for each cryptographic protocol under evaluation.*

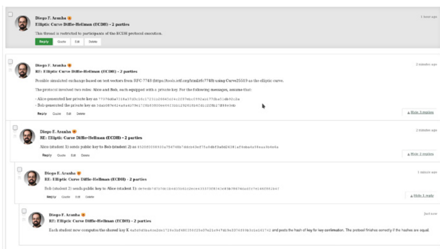

Figure 2. *Screenshot of online forum thread in the prototype implementation, simulating two students performing the roles of Alice and Bob in a cryptographic key exchange protocol*.

Learning outcomes and purpose of learning design

The purpose of this activity is to exercise some simple cryptographic protocols involving multiple parties by using the course's online forum embedded in Blackboard as the underlying communication channel. By abstracting the communication channel, students can focus on the critical parts of the cryptographic protocols. In particular, the activity contributes to achieving the following *learning outcomes*:

1. Analyze a cryptographic protocol from the scientific literature involving multiple parties, with respect to its security against passive adversaries.
2. Build a working implementation of portions of a certain cryptographic protocol.
3. Simulate a cryptographic protocol step-by-step using a working implementation.
4. Report detailed findings and conclusions obtained in the experiments, even when negative.

Learning design and Educational-IT

This learning design is based on the work initiated in Module 2 of the Teacher Training Program, following the STREAM model [1] of constructively-aligned [2] in-class and out-of-class learning. In-class preparation is designed to bootstrap the activity (splitting the class in groups and assigning a cryptographic protocol for each group). Out-of-class preparation consists of reading background material about the assigned protocol, determine and distribute roles in the protocol among the students in a group, as per defined in the in-class preparation.

The main activities happen out of class and consist of implementing a portion of the cryptographic protocol and execute the resulting implementations jointly using the online forum as the communication channel. Students should then analyze the security of the protocol and write a report summarizing the findings. A final in-class 15-minute presentation gives the opportunity for discussion and students to engage with different groups. Beyond providing the typical learning materials (references to paper and software), the teacher provides support by monitoring the forum to provide feedback.. Regular in-class contact serves as synchronization point. Figures 1 and 2 present a prototype implementation in Blackboard.

EDU-IT role and benefits

I will use Blackboard forums as the main supporting technology, as illustrated in the screenshots. The out-of-class implementation work is tracked online through the forum and by in-class interaction (as per the STREAM model). The instructor is thus able to give timely and relevant feedback.

Indicators of impact

Unfortunately I did not implement that activity in my course this semester. With such a small class and long 4-hour teaching sessions, there was a much more pressing need of facilitating *in-class* collaborative work, which motivated the project conducted in Module 3. My project consisted of collaboratively *designing and analyzing* simple cryptographic protocols. However, this activity could have been useful for increasing engagement and transform implementation work into a collaborative effort. To measure impact of this activity in a future course offering, I will ask a specific question about this activity in the course evaluation, and measure engagement in the forum as an indicator of success.

Lessons learned and looking forward

I learned that educational technology can be used in interesting new ways, *even in technological courses*, and look forward to apply in the concept in future opportunities.

References
[1] Godsk, M. (2013). STREAM: a Flexible Model for Transforming Higher Science Education into Blended and Online Learning. In T. Bastiaens & G. Marks (eds.), Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2013, (pp. 722-728). Chesapeake, VA: AACE.
[2] Biggs, J. (2012) , What the student does: teaching for enhanced learning, High. Educ. Res. Dev. 31, 39–55.

Figure 2. *LDTool representation of learning design, illustrating the interplay of in-class and out-of-class activities.*

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Do ONLINE GROUP MEETINGS increase individual participation in semester projects?

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Assistant Professor

Keywords: *electrical engineering; semester project, supervision, assessment, mentoring; online / blended learning, online meetings, virtual project team, asynchronous students; individual participation*

Context/course facts

This exercise is aimed at students in a fourth semester course (EE4PRJ4). In this project course, the students are expected to define a project problem, and to work on it throughout the semester, both within the group and individually.

The project development follows a standard process: problem definition, requirements definition, system architecture, design, implementation, test and validation, and reporting.

There are typically 30-40 students in the course and groups are typically between 4-6 students. This is an 10 ECTS course, with the project part accounting for 5 ECTS and the rest being taken by lectures.

Learning outcomes and purpose of learning design

The challenge appears during the semester, when the project evolves from group work towards more individual work, during the design and implementation stages.

We have observed during weekly group meetings that even though the focus of the work shifts from group work to individual contribution, not all group members take ownership of their tasks.

During the group meetings, it is difficult to 'individualize' the discussions; often, only a few people carry the conversation with the supervisor on behalf of the rest of the group members.

The question we are trying to answer is do online meetings increase the ownership and the individual contribution and participation of each group members during their project and in the group meetings? The learning outcome here is to help students develop skills and tools to increase their project communication skills beyond their individual comfort zone.

To increase the individual participation in the group meetings for reporting progress and defining new tasks, I split the focus of the project and group meetings in 3 parts:

- First part of the project focuses on problem definition, roles and responsibilities of each group member, requirements definition, timelines, and system architecture. This part of the project is better done as a group, which typically takes about one month
- In the second part of the project, during the design and implementation phase, overall tasks are distributed individually and work proceeds less as a group and more as individual contribution. This is the stage when not all group members step up to contribute, either from the project execution standpoint, or as participation in weekly group meetings. This part typically takes about one month.

Figure 1: *Digital learning materials such as online meetings and screen sharing*

I have changed the usual format for the group meetings (face to face) and moved the meetings online. This way, I wanted to see if the online setup helped each student focus more on their individual assignment

- In the third part of the semester project, which is test and validation and reporting, I bring back the group in the old meeting format, face to face, and continue the integration of the project and also reflect on the different meeting styles.

Learning design and Educational-IT

The project takes place within the semester project and the online part starts in the second month of the project.

I have four to five group meetings online during the project, which followed four group meetings in the first part of the project, and which were followed by another face to face meetings with the entire group at the end of the project.

After the four online sessions, we regroup in the old group meeting format and discuss and collect feedback from the online experience, lessons learned, etc.

Indicators of impact

From the data provided, it appears that the students could see the difference in the weekly meetings with the supervisor between the face-to-face meetings and the online meetings.

I had captured the feedback in two ways: using MENTIMETER and face-to-face feedback.

I divided the MENTIMETER survey in four categories:
Interaction: this set of questions focused on understanding the difference in interaction between online and in-person group meetings. The types of interactions considered were between the group and the supervisor, each team member and the supervisor and interaction inside the group

Contribution: this category reflected the increased focus on the individual contribution during the online meetings, compared to the in-person group meetings

Outcome: two questions in this category, to reflect on the individual focus

Roles and responsibilities: questions describe the individual versus group focus on the online and in-person group meetings

Opportunity for comments has also been included in MENTIMETER. The comments received online addressed the technicalities of the online meetings, such as taking notes, logging in online for the meeting, etc. The results of the survey are as follows:

EDU-IT role and benefits
ZOOM: online conference tool, superior to Skype and preferred by students over Adobe solution or others.
ZOOM Rooms: separate meeting rooms in ZOOM conference facility
Mentimeter: online survey tools
MATLAB, Simulink, screen sharing

Pedagogical challenge/purpose

Group-think during tin the face-to-face group meetings between the group and the supervisor in the mid-stages of the semester project.
It is difficult to 'individualize' discussions in group meetings and focus on individual contribution. Typically, one or two persons carry the conversation for the rest of the group. Actively communicating results must be habit developed early in everyone's career.

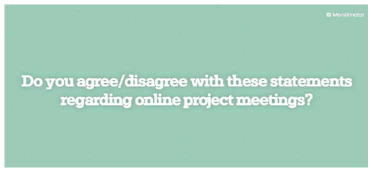

Figure 2: setup for the Mentimeter survey

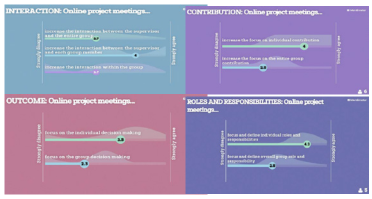

Figure 3: results of the survey

Figure 4: additional feedback and comments

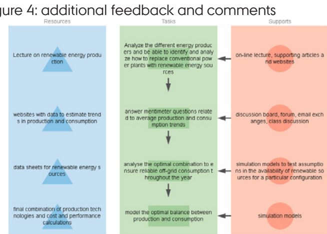

Figure 5: LDTool representation of the learning design

Lessons learned and looking forward

I have collected face-to-face feedback in open discussions and dialogue during the first meeting back in the traditional format after the four online meetings, for about 20 minutes discussions.

The feedback received during the meeting has been similar to the feedback received in the online survey. Overall, the experience with the online meetings has been positive and different compared to the in-person group meeting.

The group recognized the need to develop the required skills to conduct effective online project group meetings, to complement the already existing tools. The group also recognized the challenges to conducting the meetings online, but also the fact these challenges became less of a concern after a couple of meetings.

The group dynamics to hold online meetings has been somewhat awkward. The group had already scheduled meetings before the weekly supervisor meetings, and they had to split and find separate rooms to hold the online meeting. However, considering that this has been done only four times, as an exercise for online meetings, the extra effort was accommodated

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How to get more of reading scientific papers?

Carlos Duque
Assistant Professor

Keywords: *Geoscience; lecture/small class; flipped classroom; increasing the outcome when reading scientific literature*

Context/course facts

This learning design was used in the Master Course "Hydrogeology and groundwater modelling", a 10 ECTS course with 10 students. The final examination is a written exam. It is intended as a practical course where students learn about a tool that can be highly relevant in their professional future: Groundwater modelling.

Learning outcomes and purpose of learning design

Scientific literature is one of the keys in any science but student are rarely trained in how to search/read scientific articles. They should learn by themselves in the hard way, trying to understand advanced scientific papers that are not made with a pedagogic viewpoint. I want to explore how to use a set of pedagogic tools to progress towards a better way to introduce students in reading scientific literature. The specific aims are:
i) Develop students skills in independently finding research articles
ii) Train students skills to interpret the papers main findings and implications.
The advantages of this method is that students can find their own motivation and develop their independency by searching scientific literature that fits better into their interest. From a content perspective students will have a broader view over in the application of numerical models studying groundwater and techniques used during modelling.

Learning design and Educational-IT

One of the goals is to convert an individual experience as reading a paper into a social activity changing the section in which traditionally reading literature is framed (Conole et al., 2004). This will be accomplished by the use of IT technology where studetns will have to give answer to questions applicable to all the papers (Wikitable-Figure 1). My intention is to modify the way teaching is done based on the SAMR (Substitution-Augmentation-Modification-Redefinition) model (Puentedura, 2006).

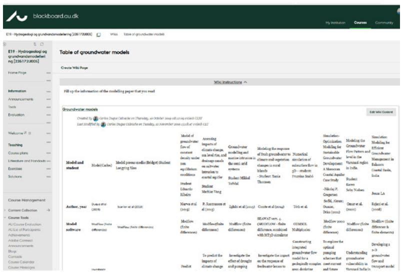

Figure 1: *Wikitable with student replies, each column belong to the answer of one students while the first column is provided by the teacher as an example.*

With this new system, students will have the possibility of interaction by seeing what others are reading and get inspired about what they should look for on their own paper. It would a type of flipped classroom (Rosenberg, 2013) where students develop the hardcore activity at home under the guidelines provided by the teacher and the class time is used for discussion once the students have enough knowledge to foster the exchange of information.

Indicators of impact

Quantitative indicators:
All the students completed both deadlines on time. The inspection of the wikitable was indicating a clear engagement in the activity as they replied what can be considered challenging questions in a quite successful manner.
The majority of the students evaluate the activity in the course evaluation with a very great outcome or at least significant outcome (Figure 3)

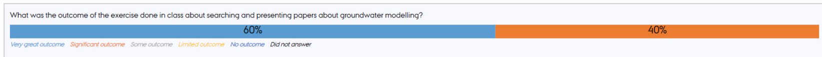

Figure 3. *Evaluation of the activity in the course evaluation*

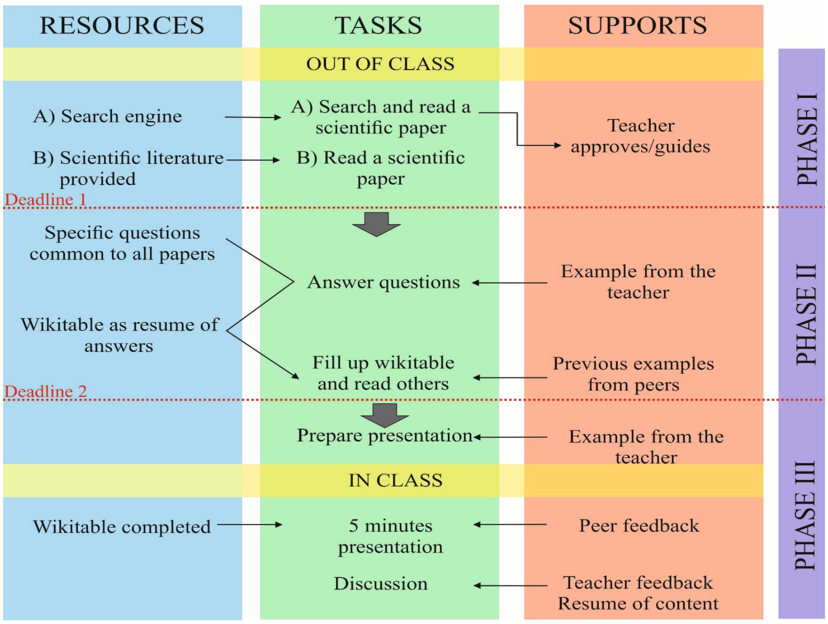

Figure 2. *LDTool representation of learning design*

Pedagogical challenge

Scientific literature reading is essential in any discipline but often, students should learn by themselves trying to understand advanced contents that are not made with a pedagogic viewpoint. I want to explore how to use a set of pedagogic tools to progress towards a better way to introduce students into the reading of scientific literature.

From a content perspective:
It was discussed different type of groundwater models, a variety of objectives (climate change, water management, contamination), in different settings (islands, inland and coastal areas, dry and wet regions) and the research methods/data used.

Teacher observations:
I recognized a much more active attitude in class that normal. I identified multiple body language approval signs when I was analyzing the presentation or when we were reaching conclusions about it. At the end of the activity, two students raised their hands spontaneously to say that: "I just wanted to say that this was a very good exercise, it was very good, I liked it a lot" followed by another student saying: "I wanted to say the same!"

Lessons learned and looking forward

The activity exceed all my expectations, students were active and engaged. To activate the most passive students, some modifications can be added (i.e. make mandatory the participation during discussion). I will apply this exercise next year again and maybe I should start applying this learning design in other courses too.

EDU-IT role and benefits

Each student will have to reply a number of specific questions that have to be identified while reading the paper. To facilitate the support from other peers, an IT tool implemented in blackboard will be used: a Wikitable where students can write their answers (Figure 1). This played a double role: as an indicator of deadline completed (for the teacher) and to see the progress of others students to promote that the activity is done on time (for the students). This activity converts what is usually considered as an individual experience (reading a paper) into a social activity.

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Activating students in Animal Science by the combination of in- and out-of-class activities with educational-IT

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Keywords*: Animal science; lecture; STREAM model; learning through case reports*

Livestock Diseases and Disease Prevention (10ECTS)

.The course Livestock Diseases and Disease Prevention aims to summarize and explain etiology, risk factors and pathophysiology of common livestock diseases in cattle, pigs, poultry and mink. In this course, students should learn to work with tools for monitoring the risk of diseases, and tools for analyzing possible causes and effects of diseases and disease complexes. Finally, the objective is to teach the student to prepare and formulate strategies for especially prevention, but also relief of diseases.

Learning outcomes and purpose of learning design

One of the sections of this course is about metabolic diseases in dairy cows. Most of the metabolic diseases occur due to an energy or nutritional imbalance around parturition. Therefore, most of them can be prevented with an appropriate feeding management. The main problem is that these metabolic diseases are explained individually (e.g. definition, consequences, prevention). However, it is common that the prevention strategy for one metabolic disease increases the risk of suffering another metabolic disease. For instance, feeding cows with concentrates rich in starch after partum can prevents intense fat mobilization, which reduces the risk of suffering ketosis, but increases the risk of suffering ruminal and metabolic acidosis.

The activity proposed in this learning design aims to enhance the understanding of the students about two specific metabolic diseases (Ketosis and Ruminal acidosis) in dairy cows in order to create a better alignment between the objectives of the course and the learning outcomes (Biggs, 2010)

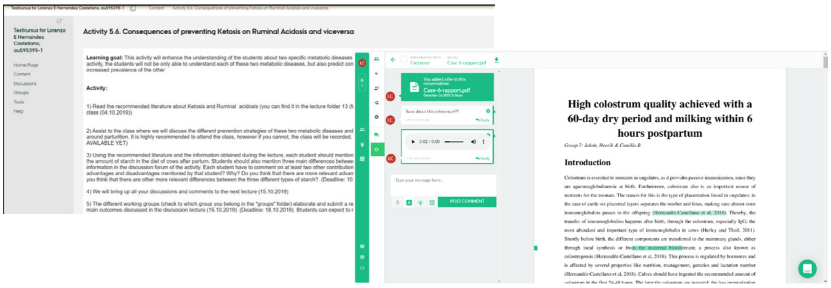

Figure 1: Activity proposed in Blackboard as well as feedback on one report using Kaizena.

Learning design and Educational-IT

Figure 2 shows the learning design proposed in for this specific section in the course Livestock Diseases and Disease Prevention. This learning design is based on the STREAM model (Godsk, 2013) and it is structured as follows:

- ✓ In the first step (out-of class) students need to read the recommended literature about ketosis and ruminal acidosis.
- ✓ In the second step (in-class) the students receive a more focused and targeted lecturer about ketosis and ruminal acidosis (in deep explanation of the metabolic mechanisms involved in this metabolic diseases, novel strategies to prevent them, …).
- ✓ In the third step (out-of-class), the students use the knowledge acquired from the recommended literature and the lecture to discuss in the discussion forum (blackboard) advantages and disadvantages of increasing the starch content in the diet around parturition as well as advantages and disadvantages of using different types of starch (maize, wheat and barley).
- ✓ In the fourth step (in-class), the lecturer bring the main outputs from the discussion forum and discuss them in class with the students.
- ✓ In the fifth step (out-of-class), the students in small groups (3-4 students) submit a report (1-2 pages) with the main outcomes discussed in the discussion lecture from the fourth step and the lecturer provide feedback on that report (if necessary).

Indicators of impact

After the implementation of this learning design, the students will not be only able to describe each of these two metabolic diseases, but also predict consequences of prevention of one of the diseases in the increased prevalence of the other. According to previous studies performed on the effect of implementing a learning design based on the STREAM model (Deslauriers et al., 2019), it is expected that learning are assessments improve (Figure 3).

EDU-IT role and benefits

All of the out-of-class material, along with reading guides, was provided on the digital platform Blackboard (Figure 1). After an in-class activity based on the discussion performed in the discussion fourm (out-class activity), students submitted a report through the link provided in Blackboard. Feedback was provided as text messages and voice messeges using Kaizena (Figure 1) . Blackboard was an easy tool to use and the students were familiarized with it already. The use of Kaizena was positively evaluated by the students, specially the voice messages which were considered very helpful.

Pedagogical challenge/purpose

With this learning design students are challanged to work in small groups and share their own ideas with the rest of the students about the use of different types and amounts of starch in dairy cows and it connection with the prevention of ketosis and ruminal acidosis in these animals. This pedagogical challange promotes active-learning, which in turn increases learning by the students

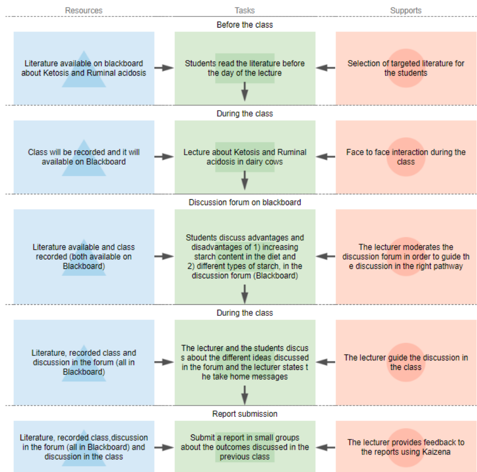

Figure 2. *LDTool representation of learning design used in Livestock Diseases and Disease Prevention*

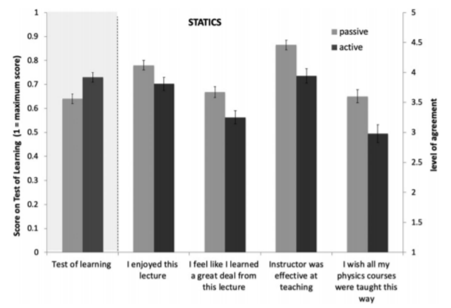

Figure 3. Learning level before and after implementing a learning design based on the STREAM model. Figure obtained from Deslauriers et al. (2019).

Lessons learned and looking forward

The inclusion of out-class activities will prepare the students for the lecture. In addition, the discussion activity that will take place in Blackboard after the main lecture will make the students to think and formulate their own thoughts about what has been explained in the lecture. The discussion forum allows the student to exchange ideas without the requirement of being present in an specific place and specific time which increases the flexibility of the student schedule. Finally, the feedback provided by the lecture to the case report will correct some misunderstandings (if any).

In the future the use of Mentimeter or Kahoot could be included in the learning design as part of the second in-class activity in order to test the level of understanding of the students on that specific topic. .

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Deslauriers et al. (2019). Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom. Proceedings of the National Academy of Sciences 116 (39) 19251-19257

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TEACHING BIOCATALYSIS AT BACHELOR LEVEL USING STREAM MODEL

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Assistant Professor

Keywords: *Enzyme catalysis; Enzyme discovery and engineering; Small-class teaching; STREAM model; Learning management system; Student engagement; Efficient feedback*

Pedagogical challenge/purpose

This is a transitional course from basic knowledge to more profession-based applied skills. Thus, it is important to increase participation of all the students as well as to make sure that students learn the concepts in the right way and if not so, corrected by timely feedback.

Context/course facts

The course is a bachelor 3rd semester course with 25-30 students. The name of the course is "Cellular Metabolism and Biocatalysis" and I am responsible for teaching the "Biocatalysis" part of the course (corresponding to about 50% of the lectures). This is a 10 ECTS course with 4 hours of lectures and 4 hours of practice (theoretical and experimental). The assessment is with a 20 minute oral final examination. In addition, students will have small assignments and projects, which won't be taken into account for their final grade.

Learning outcomes and purpose of learning design

Key Learning outcomes of this learning design can be summarized as:

- All students are engaged in reading literature articles related to the course content and able to summarize/present the main points of the article
- Students gain the skill to critically evaluate/assess others' research related to their profession (point out limitations, propose better ways, relate to the importance in community)
- Students provide some type of peer-feedback
- Students are involved in an active group study that will be concluded with a group presentation.

My motivation in this project is to design activities (out-of-class/in-class) with the aim to engage all students into the lecture content and to promote active learning and high-level engagement. Although I actively ask questions throughout my lectures to examine the understanding of the topic, it is in general a few number of students that answer those questions. So, I want to design an activity that will cover the topic of a number of lectures (students should learn the basic points of 2-3 weeks of lecture content and integrate the topics well in order to complete this activity). This way I will promote all of the students to study and practice their learnings before the end of semester and support their studies with in-class and online feedback. I will also observe whether my teaching is effective and whether the students can integrate different topics coherently rather than just memorizing knowledge. The activities are designed as a part of the theoretical exercise sessions.

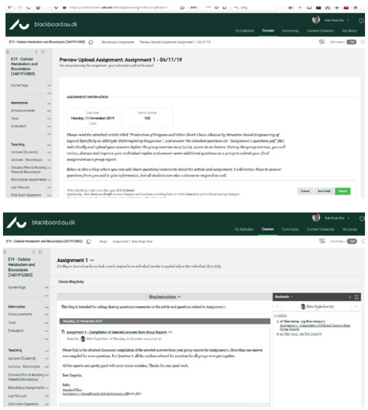

Figure 1: Digital Tools (LMS screenshots) used for assignments and for feedback.

Learning design and Educational-IT

Based on STREAM model[1], my initiative included a integrated out-of-class and in-class activities with individual and group work and extensive feedback. These activities were aimed to promote active learning and high level engagement of students[2]. In Grainne Conole's diagram[3], these activities more correspond to an area of active, social and experience part, although individual and knowledge aspects are also integrated.

In summary, with the aim of engaging all students, the initiative started with out-of-class individual activity that included literature reading and answering a set of questions based on course content. This was followed by in-class group activity where student groups discussed their answers, gave critical peer feedback and finalized an improved group report. In the following activity, student groups were given a task to propose how to design an enzyme for biocatalytically synthesizing an assigned product. Students referred to research articles and used computational tools (e.g. protein structure analysis) in their task. There were a set of questions to guide students. After this task, students presented their design as 10-minute presentations.

All communications with students were performed through LMS (Blackboard). Feedback were given both in-class (face-to-face) and through LMS. This teaching activity was tested during module 3 of the teacher training program.

Indicators of impact

In the first part of the initiative, all students read a scientific article, answered a set of related questions and uploaded answers on Blackboard. I have read all answers and provided individual feedback to all students through Blackboard, thus evaluated all students in terms of their understanding of the critical course concepts and perception levels. In addition to on-line feedback, I also gave a general in-class feedback on most common mistakes. I gladly observed that students were mostly good at reading a scientific article and analyzing the hypothesis and results of the study. However, I also observed that many students were deficient in some key concepts of the course that needs some improvement in teaching methods/feedback. This individual activity was followed by a group activity where students discussed their individual answers and prepared a final report. In this follow-up type group activity:

- By systematic evaluation, I could see the improvement in the answers by assessing group reports.
- Selected answers were posted in a Blackboard blog to motivate students for reading other reports.

In the second part of the activity, students completed a small project in the class to design biocatalysts for production of high-value chemicals. Once I explain a certain question, students quickly spread the solution between themselves through peer-instruction. Finally, in 10-minute presentations, students faced questions by students and instructor. The presentations gave me the chance to evaluate the improvement in student understanding from the start of the activity to the end.

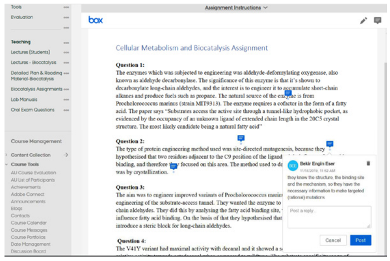

Figure 3: *Feedback to student reports through LMS.*

Lessons learned and looking forward

I believe that I succeeded to get all students engaged to the core course content. I had the chance to evaluate all students by written reports and by oral presentations. This gave me the opportunity to see the weak parts of my teaching for further improvement. One thing that didn't work quite well is that I could not motivate students well enough for online peer-feedback.

If I repeat this project, I will make sure that students read other groups' reports and comment on them in a blog by making it mandatory. I will also decrease the number of students in groups. I will also perform a quantitative assessment (a survey) on the student improvement to observe the changes.

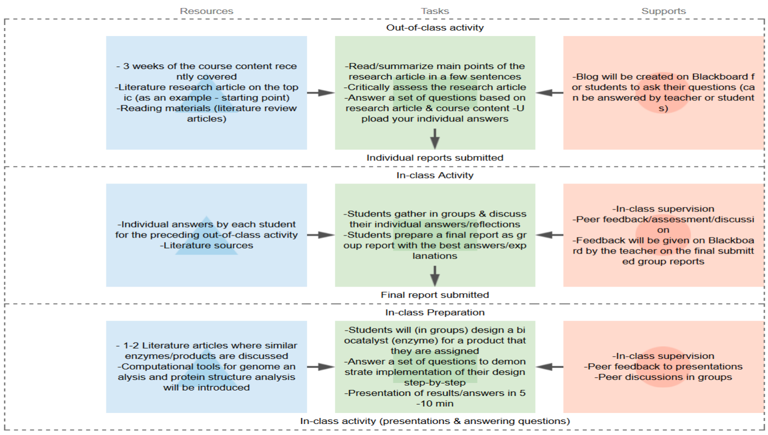

Figure 2. *LDTool representation of learning design used in this course. URL: https://needle.uow.edu.au/ldt/ld/9JoadFOC*

EDU-IT role and benefits

I have extensively used Learning Management System (LMS) "Blackboard" for my Learning Design. Assignments and related materials were all uploaded on Blackboard and students submitted their reports through Blackboard. Feedback were also given through LMS. A blog was created for students to ask questions and selected answers from reports were also posted in the blog. LMS made design and execution of the Learning Design very easy and smooth.

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Group supervision in project-based course

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Keywords: *Peer instruction; lab exercises; Group supervision; Peer feedback;*

Pedagogical challenge/purpose

The goal of this project-based course is to familiar students with lab instruments, learning how to write a scientific report and motivate them by using their acquired theoretical knowledge during the first and second semester of their study in a real world project.

Context/course facts

The course name is “Electrical Engineering Project 1”. This is a 5ECTS course designed for new achelor students at 2nd semester at department of Engineering section Electrical Engineering. Number of students in this course is 32 that will be divided in 16 individual groups (2 students in each group). The general topic of the project is similar for all groups which is designing the most intelligent room control system that you can using the given devices (e.g. sensors, microcontrollers, output devices and etc.). Hence, they have freedom in chosing the method and the level of difficulty/complexity of the project.
I am the course responsible and another Assistant Professor will help me as a co-lecturer for this course.

Learning outcomes and purpose of learning design

Learning outcomes for the conducted study can be listed as follows:

1. Team work: students will learn how to divide tasks between each other in a way that tasks can be done in parallel.
2. Lab instruments and experiments: students will learn how to work with lab instruments, how to use datasheets and how to conduct experiments without daily guidance of the main supervisor.
3. Presentation of the work: students will learn how to present their work.
4. Scientific report: students will learn how to write a scientific report.
5. Peer feedback: students will learn how to criticize other student’s projects and provide feedback through online tools (e.g. Peergrade).

Learning design and Educational-IT

The overall structure of the course is depicted in Figure 1. For the midterm presentation, the following steps will be taken:

1. The instructor will give a lecture on how to do a scientific presentation and how to prepare a report as well as providing some sample presentation/report in Blackboard.
2. Each group will submit their presentations as well as a 5-page report to the instructor in Blackboard.
3. The instructor will assign each presentation/report to two other groups for review and providing feedback.
4. In week 7, a presentation session will be held and two other groups provide some feedback f2f and through Peergrade by answering to some questions about the presentation.
5. The instructor will read/optimize the provided feedbacks for each presentation, add his own feedback and upload in Blackboard.
6. The instructor will consult an in-class session (W8) and discuss the feedback and evaluate the learning approach.

Indicators of impact

There are three observations before final report including feedback on the project plans (W3), peer-feedback and lecturer feedback on midterm presentations (W7), and Peer-feedback and lectrurer feedback on the final demonstration/competition (W13). In week 3, each group will send the research plan and receive instructor feedback. In week 7&8, the project progress of each group will be monitored and the presentations/reports will be evaluated/assessed by instructor.
In week 13, the final demonstration of the project will be run where the performance of each project will be evaluated by other students (Peergrade) as well as instructor. Finally, each group will be submitted the final report of the project that will be assessed by instructor.
It should be noted that the students have the chance to come to the instructor’s office one day per week in order to talk about their projects.

Evaluation of the course by students will be done twice. First, after in-class presentations in week 8 and the second run will be after demonstaration/competition in week 13. Considering the fact that this course is going to be run for the first time in the next semester, there is no evaluation data of the course from previous years.

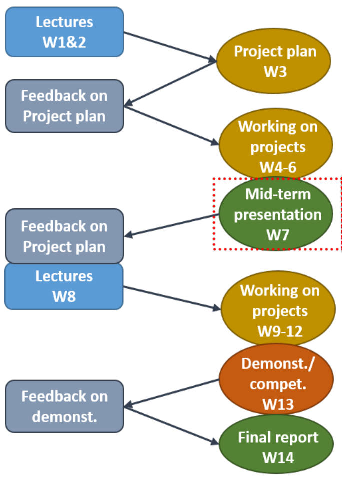

Figure 1. *The general structure of the course.*

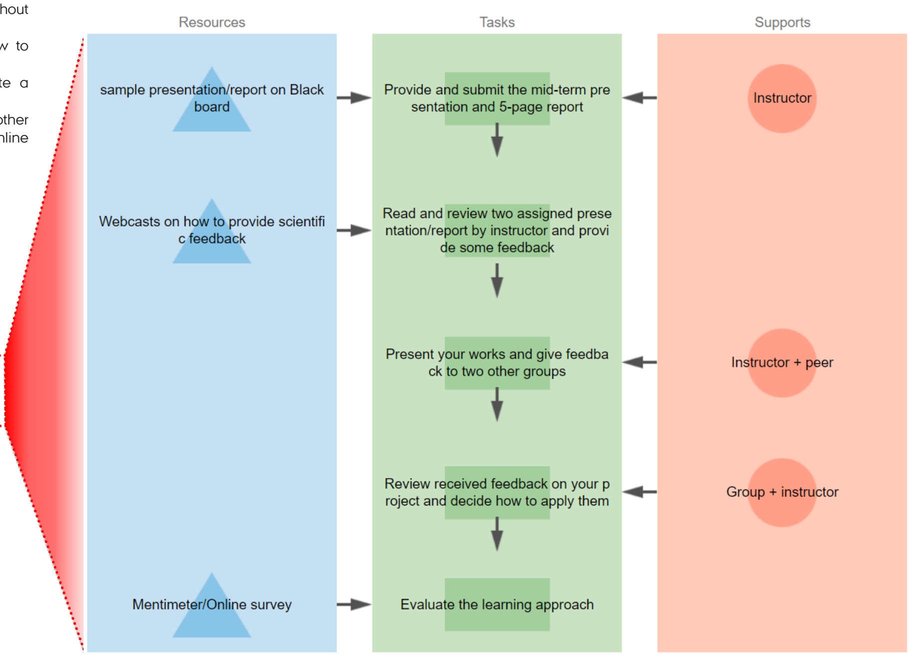

Figure 2. *LDTool representation of learning design used in mid-term presentation*

EDU-IT role and benefits

Before students start to work on their projects in the lab, some learning videos about how to use different instruments/equipments will be provided on the Blackboard. For the mid-term presentation session, some sample presentations and reports will be provided on the Blackboard. Moreover, for the peer feedback of mid-term presentations and peer garding of other project demonstrations, the Peergrade tool on the Blcakboard will be used. Finally, for the evaluation of the learning approach used for the mid-term presentation session , the Mentimeter tool will be used.

Lessons learned and looking forward

Considering the fact that this course is going to be run in the next semester, I cannot state what is realy useful in this course. However, I think the students will enjoy the peer feedback session because it will give them the chance to experience the instructor point of view and they will learn how to perform scientific criticism/evaluation.

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Using STEAM Model to Enhance Students Learning for a Chemistry Course

Xinming Hu
Assistant Professor

Keywords: *Chemistry; Small class teaching; STREAM; Deep learning*

Pedagogical challenge/purpose

Previous experience of the course let me know that the students were not always well prepared for the lectures in the class, which made the learning inefficient. In future, I am aiming at maximizing the learning outcomes by adapting both the out-of-class and in-class activities in my learning design according to the STEAM model.

Context/course facts

This was a joint course among the Nordic universities with the title of 'Mechanisms for CO_2 activation'. It was organized by Researcher Ainara Nova and Associate Professor Kathrin H. Hopmann with me and other researchers as guest lecturers. This course was a three day intensive course equivalent to 1 ECT consisting of lectures, exercises, and discussions. 22 PhD students attended this course. For the exam the student did a presentation of CO_2 reactions followed by questions from censors.

Learning outcomes and purpose of learning design

The learning outcomes is to provide students the following abilities at a high taxonomic level.[1] (1) To **compare** and **explain** the mechanistic similarities and differences among thermochemical, electrochemical, and photochemical ways for CO2 activation. (2) To **evaluate** the performance and **reflect on** the mechanisms of catalysts with different structures. (3) To **propose** a new catalyst structure and **hypothesize** its mechanism. As such, the students can arm themselves with theoretical foundation for catalysts discovery in their research. To achieve the learning outcomes, I am planning to rely on both out-of-class and in-class activities in my learning design, including reading text materials and Webcasts, interactions on PeerWise, lectures, theoretical exercises, and real case discussions.

Learning design and Educational-IT

Figure 1 shows my learning design, which is constructed according to the STREAM model.[2] For out-of-class activities, I will continue to use the selected Review paper, but also to produce Webcasts presenting part of the previous lecture content (Figure 2). The Webcasts will be designed to cover the basic concepts with a duration of approximately 10 min for each. This will hopefully help student get better prepared for in-class activities and spare some time for theoretical exercises and discussions on real cases coming from our research. During the in class session, I will lecture on the mechanism theories and provide opportunities for students to do exercises.

For the next round of out-of-activities, the students will have the chance to construct their own questions based on provided materials through PeerWise platform. Their peers will answer these questions accompanied with further comments from peers and the instructor. From these activities, I can have a knowledge of the students' learning outcomes. In the following in-class activities, I will recap the content where students have not well understood, and finally to give real case examples coming from our research for discussions and guide students to propose new catalyst structures and hypothesize their mechanisms for CO_2 activation. This is to bridge the gap between theory and practice.

In doing so, we can expect a good alignment of different activities and a positive feedback loop to enhance students learning.[3]

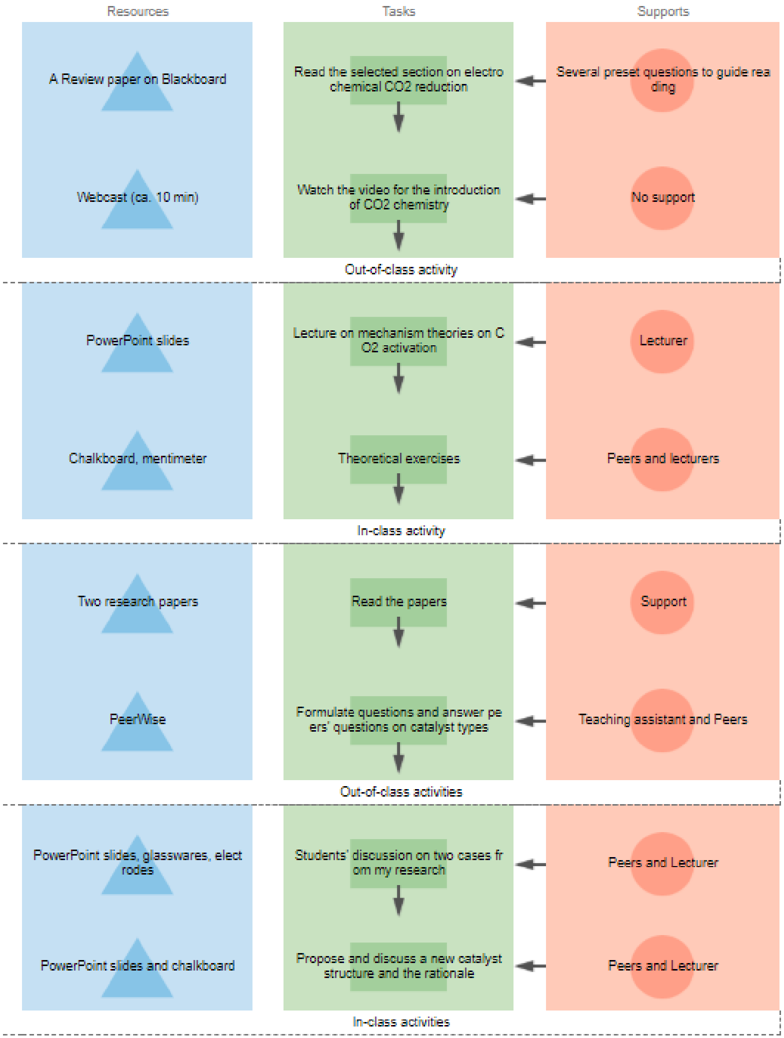

Figure 1. *LDTool representation of learning design to be used in 'Mechanisms for CO_2 activation'.*

Indicators of impact

I will have the first assessment of the students' learning outcomes through theoretical exercises in class. Second, will look at how the students propose, answer, and comment on questions on PeerWise platform. Letting the students to propose a new catalyst structure and hypothesize its mechanism for CO2 activation during class is another way to evaluate the learning outcomes. I have not yet got the results to see the impact of my new learning design.

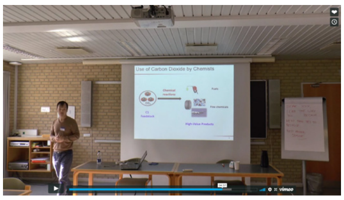

Figure 2. *Screenshot for a webcast.*

Lessons learned and looking forward

I have not had the chance to test my learning design. But through the systematic considerations of such design, I have got myself new understanding of the teaching/learning process. I feel more confident that the students will have better learning outcomes. I am always prepared to make new adjustment to enhance students' learning.

EDU-IT role and benefits

I like Webcast and PeerWise. Webcast is an ideal media for out-of-class activities. It not only displays text and pictures but also offers video and audio functionalities, which help students to better understand and remember the subjects. PeerWise is a good platform for students to design, answer, and comment on questions. This motivates students' engagement and improves their self-reflection abilities.

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Supervision of groups:
Alignment of expectations within the student group and with the supervisor

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Keywords: *Group supervision, bachelor project, engineering students, workshop, alignment of expectations.*

Pedagogical challenge/purpose

For their final project engineering students are assigned a main supervisor. This poster gives an example on how expectations for the supervision process can be aligned between the student group and the supervisor.

Context/course facts

This poster shows a learning design conducted as part of the teacher training program at Aarhus University. The focus is supervision of bachelor projects at the engineering college. These student projects are the final project that students conduct during their educations as diploma engineers. The projects span one semester and count 20 ECTS points. The projects are normally done by student groups consisting of 2-3 students. The students choses a topic themselves, which is often a case done in cooperation with a company. A typical project could deal with design optimization of an industrial product, or development of new concepts to solve a technical challenge. The normal method to supervise bachelor projects at the engineering college is to have one-hour weekly meetings between the student group and the supervisor. The students document their bachelor project in a project report. The bachelor project is assessed at an oral group exam, where the students do a 20 min presentation of the project and afterwards the students are examined based on the project report. The poster is based on a mini project [2] conducted as part of module 3 in the teacher training program.

Learning outcomes and purpose of learning design

The goal is to align expectation between the student group and the supervisor. I would like to develop a tool for aligning expectations, which I can use when a student group approach me and ask if I would like to be their supervisor for their bachelor project. The aim is to support the "match making" between the student group and the supervisor.

Learning design and Educational-IT

The learning design is based on a workshop where the expectations between the students and the supervisor is discussed and (hopefully) aligned. The workshop is based on a questionnaire, see example of question in figure 2 and 3.

The alignment process is done two-folded: First the students in the groups align their individual expectations. Secondly, the group align their common expectation with the supervisor.

Figure 1 show the schematics of the workshop:

- First, the students answer individually on a questionnaire.
- Secondly, based on the individual answers to the questionnaire the student group spend approximately 15 minutes to discuss their individual answers, and they are asked to answer on the questionnaire again. However, this time the group must agree on the common answers.
- Once the students has filled out the common questionnaire, these results are used as an initiator for an alignment dialog with supervisor, who has also filled out the questionnaire.
- As the student group and the supervisor discuss alignment, notes are taken on action points. This could be things to adjust in the supervision, things to follow up on later in the project, or things that needs to be addressed separately due to time limitations in the workshop.

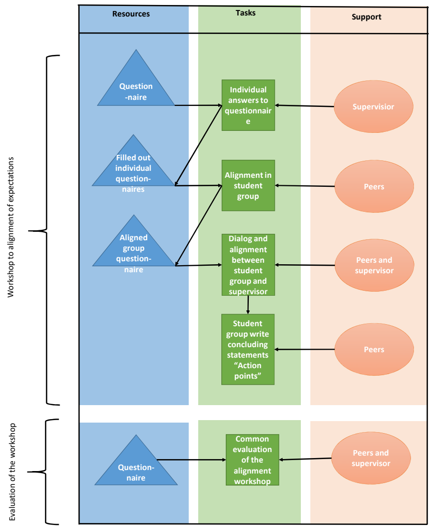
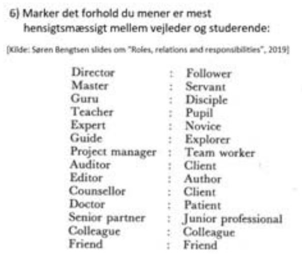


Figure 1: Learning design representation of the alignment workshop and evaluation of the process.

7) Marker det billeder der bedst beskriver den proces du gerne vil følge i dit projekt:

A:	B:
Fra første dag er der en klar plan for hvordan jeg kommer fra start til mål. Projektet kan planlægges i nøje detaljer, og retningen frem mod den endelige aflevering er tydelig fra starten.	Projektet kan ikke planlægges i nøje detaljer fra starten. Undervejs opnår jeg nye indsigter, som ændrer retningen på projektet. Det er usikkert hvordan projektet ender, og hvilke veje der betrædes frem mod mål.

Figure 2: Example of questions asked in the questionnaire (in Danish):
In questions 7 the students are asked to circle the picture that describes the process they would like to follow in their project:
A) *From the first day there is a clear plan for how I come from the beginning to the goal. The project can be planned in careful details and the direction towards the final hand-in is clear from the start.*
B) *The project cannot be planned in details form the beginning. During the project I discover new things, which changes the direction of the project. It is uncertain how the projects ends and what paths I will follow.*



6) Marker det forhold du mener er mest hensigtsmæssigt mellem vejleder og studerende:

[Kilde: Søren Bengtsen slides om "Roles, relations and responsibilities", 2019]

Director	:	Follower
Master	:	Servant
Guru	:	Disciple
Teacher	:	Pupil
Expert	:	Novice
Guide	:	Explorer
Project manager	:	Team worker
Auditor	:	Client
Editor	:	Author
Counsellor	:	Client
Doctor	:	Patient
Senior partner	:	Junior professional
Colleague	:	Colleague
Friend	:	Friend

Figure 3: Example of questions asked in the questionnaire (in Danish):
In questions 6 the students are asked to circle the relationship they find most appropriate between the student and the supervisor

Indicators of impact

The overall results of the workshop was good. The questionnaire worked as a good initiator for a constructive dialog about the supervision of the student group. The workshop was evaluated together with the students. The evaluation was based on a questionnaire. In the questionnaire, the students are asked to rate (on a 1 to 5 scale) weather they agree or disagree to statements.

The overall rating of the 10 questions in the questionnaire was 4.4 out of 5.

The students all agree fully to the following statements:

- The overall outcome of the workshop was good.
- The workshop can help to align expectations in the group.
- The workshop can help to align expectation between the student group and the supervisor.

Lessons learned and looking forward

After the teacher training program, I expect to try the following for future use and applications.
This is based on the evaluations done together with the student and my adjunct mentor:

- Make a simpler (shorter) workshop, which can be used in the very beginning of new student projects.
- Make a similar workshop in the middle of coming bachelor projects in order to adjust the supervision.
- Ask colleagues to try the workshop on other student groups, and discuss their experiences.
- Consider to involve the company in the alignment process.
- Invite colleague to sit-in during supervision.

EDU-IT role and benefits

In the presented learning design (module 3 experiment) EDU-IT did not play a role.
The project was carried out using analogue tools (print-outs) as this was what I find made most sense. (In my module 2 project I used video features in Blackboard and quizzes via MentiMeter).

References

[1] Lotte Rienecker, Peter Stray Jørgensen, Jens Dolin og Gitte Holten Ingerslev (red.) Universitetspædagogik, 1. udgave 2013.
[2] Morten Fogtmann Kristiansen, Supervision of groups: Alignment of expectations within the student group and with the supervisor, Mini project for module 3 in the teacher training program, 2019.
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Analysis of data mining algorithms

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Keywords: computer science; data mining; algorithms; data management; theory and practice; lecture; tutorials; exercises; hand-ins; blackboard questions

Pedagogical challenge/ purpose

Algorithms are typical abstract concepts which, if not properly understood and applied to real-world data are hard to remember. The proposed activity tries to supply this deficiency by using STREAM [1] to improve the overall understanding.

Context/course facts

2nd semester Master in Computer Science – 20-40 students, 10 ECTS

Data Mining (DM) is a 10 ECTS course for master students taught in the Spring semester. This course introduces the main algorithms and techniques to find patterns and statistical signals in a large amount of data in an efficient manner.

Data Mining is a master course; as such, it assumes that students have successfully passed the Machine Learning course (bachelor level). The students should be able to **describe** and **define** different algorithms, compare their limitations, **apply** and **theorize** on new possible solutions for known problems. The course is divided into three parts corresponding to three major topics and three different instructors. I am responsible for the part regarding graph (network) analytics.

The presented activity is a lecture, with the preparation material and the exercise session in which Teaching Assistants (TAs) provide guidance to solve the exercises in special TA sessions. A typical lecture provides the description and discussion of 1-2 algorithms followed by theoretical and practical exercises and feedback session.

Learning outcomes and purpose of learning design

The learning outcomes of the proposed activities are:

- Evaluate and reflect on data mining algorithms' pitfalls and advantages
- Analyze the performance of such algorithms and their main characteristics
- Relate the algorithm to the one studied in the course
- Describe data mining algorithms and classify them based on the data and the problems they deal with. Define new algorithms that combine methods studied in the course.

Learning design and Educational-IT

The design follows the **STREAM [1]** model and is based on feedback and experiences learned in Module 2 of the Teacher Training programme. The Learning design is presented in **Figure 1**.

The use of STREAM allows a preliminary preparation out-class, followed by in-class lectures and exercises and consequent out of class feedback. The out-class activities provide me feedback to take actions and improve slides and exercises, by using the **JiTT** model.

Furthermore, students are required to provide feedback and can optionally benefit from peers answers in the blackboard forum. The Peer feedback is mediated by the teaching assistants and myself. The activity maps in the Conole's 3 dimensions [2] as mostly Individual and Active, although the lecture is mediated by in-class explanations, followed by Mentimeter questions. And in-class discussion.

Activity Description

The activity presents an ensemble of in-class and out-class tasks. In particular, the students should:

- The week before the lecture a small (1-2 pages) description of the presented week algorithm/ techniques is posted into black board.
- The student reads the description and answesr some preliminary question in blackboard. An example of such questions is represented in **Figure 2**.
- The lecturer presents the techniques and a real case of use of them in class
- In half-hour discussion, the students should argue what results could be found with such techniques, what are the assumptions and which other technique could be used instead.
- After the week lectures, the students participate in exercises sessions with TAs and optionally ask for clarifications during the study cafè activities.
- If a topic is still unclear or the exercises are not well understood we will provide short videocasts to explain the critical part.

Indicators of impact

The activity has not been proposed yet, as such there is no clear evaluation. I have implemented a similar activity with preparatory questions and received positive feedback. Moreover, from my experience students tend to be very involved in the exercises and they appreciate the practical aspect and the application of the theories studied during the course. The impact will be measured by feedback on quizzes and the percentage of completion of the exercises. Moreover, there will be three hand-ins in which the student have to elaborate and combine notions learned during the exercises sessions. This will allow the students to generalize over the methods seen in class. The hand-ins are evaluated individually and feedback will be provided. Hand-ins are mandatory to pass the course.

About the peer-part of the course, I have not much experience but we will try a simple scheme using blackboard forums. This should ensure a fairly solid environment for students to answer questions.

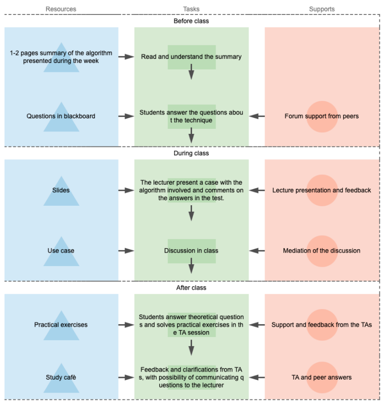

Figure 1. Learning design for a DM lecture and exercise session

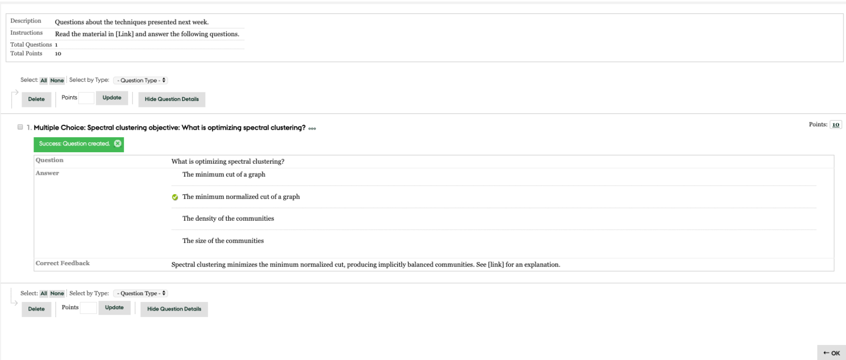

Figure 2. Example preparatory question before the lecture.

Lessons learned and looking forward

The proposed activity has an interesting mixture of online tools and traditional teaching. There is the potential that the students will feel overloaded, but also, in the end, each week they should be able to have a thorough understanding of the presented techniques. The teacher training programmed allowed be to reflect upon the practices and make a step forward in the design of the courses and the integrations with digital learning

EDU-IT role and benefits

The EDU-IT framework will be completely integrated in the Data Mining course by means of **quizzes in blackboard, exercises in Github, Mentimeter question** in-class. The digital learning material consists of pdf files with the algorithm to be presented 1-2 weeks later. The Blackboard forum will be used to ask questions and have peer answers. Blackboard will also be used as a platform to upload the solutions of the Hand-ins by the students. I expect that the students will engage more and being able to compare and analyze the main topics when they are explained rather than later in the exam.

References

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Active Class - Protein and Carbohydrates Biotechnology

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Keywords: *Active Class, Carbohydrate chemistry*

Pedagogical challenge/purpose

Totally Active lecture

- To create and prepare a totally active lecture were the students and teacher are in constant interaction.
- To verify if the learning outcomes are reached in time, meaning the students are constantly evaluated during the development of the lecture.

Context/course facts

Protein and Carbohydrate biotechnology (10ECTS) for MSc students covers theoretical aspects of protein and carbohydrate production using different biomass and natural as well as recombinant expressions and production systems. The course gives the students a solid theoretical insight into methods used in Protein and carbohydrates Engineering. Methods relying on selection and high-through put screening are covered. In addition, several modern physical and chemical analytical methods are presented, such as x-ray crystallography, protein-NMR, SAXS, CD and mass spectrometry. An integral part of the course deals with the optimization of industrial proteins and carbohydrate production and applications. 42 students participate in this course.

Learning outcomes and purpose of learning design

At the end of the course, students are able to:

- Recognize and define a carbohydrate polymer, oligosaccharides and sugars. This Include the classification and production.
- Explain and predict the consequences of using polysaccharides in different industries
- Describe methods allowing protein and polysaccharides optimization with respect to properties such as stability, catalytic properties, including food quality.

In order to achieve the mentioned learning outcomes: two lectures (3 hours each) and one session of experimental lab work were organized. Lectures were designed to cover first: the principles and theoretical information on carbohydrate chemistry including the physic chemical characteristics. In the second lecture properties of carbohydrates and their application on Material, Biomedical, and Food science were developed.

The lab work covers the process extraction of polysaccharides and their physical and chemical characterization. The work organization consisted in three experimental works:

1) Starch extraction and purification
2) Morphology analysis of two different Starches
3) Reducing end Analysis

The challenge here were to organize 42 students: Therefore, I divided the lab work in two session first a group of 21 students subdivided in mini-groups of 5 students. The mini groups start two work in parallel and all rotate for all the experiments. Everything is possible with a good organization !!

Learning design and Educational-IT

The learning design described in this poster, relates only the carbohydrates topic of the course. The design is based on the STREAM model (out of class and in class activities). The students use as well internet as a tool to complement the learning outcome, to do that a selected online videos are proposed to watch out of class.

A detail design are demonstrated on Figure 1, were can be observed that a specific lecture are divided in out-class and in class. The out class task is optional, which means that only an interested student will watch the video. The in class tasks are developed as an active lecture where the students and teacher are in permanent discussion. The Lecture time is when the theory and principles will be presented in maximum 2-5 slides (5-10 min) after this time immediately a discussion starts to relate the theory and principles to the everyday life. During the discussion, the students are evaluated on their understanding of carbohydrate chemistry and their implication in their life. The video time can relates fundamental theory or application of carbohydrates on different industries. As mentioned before after the video, an analysis and discussion are animated by the teacher.
On the other hand, after class the students are invited to see a selected videos that can reinforce the lecture. The videos are provided by teacher.

Indicators of impact

As mentioned before apart of the formal evaluation which relates 4 hours written exam, the students are evaluate during the development of the lecture.

This evaluation have a purpose to inform teacher if the learning outcome were reached during the class time. Outside of this time the students are invited to reinforced their knowledge. The evaluation relates to answer a series of questions during the lecture. During this time the student does not feel evaluated, this time seams as discussion where all students mention their ideas or reflect on the proposed question or topic. As evident, not all the students are active to answer or participate during the discussion (many reasons can be argued). Although, half of the class does not answer the question, because several reasons, they will have indirectly the answer as it is discussed immediately.

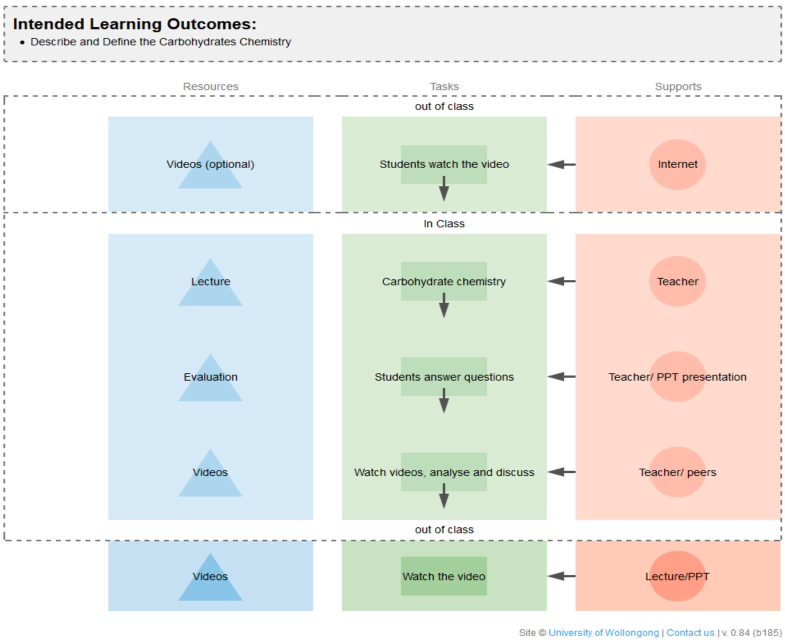

Figure 1. *LDTool representation of learning design used in carbohydrate lecture*

EDU-IT role and benefits

- *Webcasts*
  Selected videos related to the chemistry and application of carbohydrates are proposed
- *Peerwise*
  Formulate and answer questions from teacher and peers
- *Screencast*
  Short videos related to the lecture are available for the rehearsal of the students learning

Lessons learned and looking forward

Definitively the technology used during the development of the teaching lectures or experimental work have an impact on the learning of students. These tool helps, motivate and increase the students interest of the course or topic. What I plan for the future is to complete the Screencast of a complete lecture. This can increase as well the performance of the students during the discussion or they can asses by their selves and peers, including teacher.

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Improving student preparation in mathematics

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Keywords: *civil engineering; mathmatics; lecturing; student preparation; learning design*

Context/course facts

'Mathematics, Physics and Material Science' a basic skill course for 1st semester civil engineering, academy profession. 10 ECTS distributed on 28 four hour sessions, typically two sessions a week. 40-60 students in a class room.

At the School of Engineering, there is a relatively high degree of in-class time. In and out-of-class are roughly 50/50. In my opinion, this is a huge advantage for student learning and motivation.

Learning outcomes and purpose of learning design

The learning outcomes emphasize application of mathematics and natural sciences for problem-solving, which is inherent to engineering.

At 1st semester, many students have great difficulty in exhibiting the necessary rudimental skill from their secondary education mathematics and physics. In average, the students have two gap years after finishing their secondary education. If this fact is ignored, a lot of student are left behind from day one, since they do not have the basic skill prerequisite to learn a new skill. On the other hand, if time is spent on repetition of basic skills, this will be at the expense of the time required to learn the new skill.

The purpose of the learning design is to

- Help students perform meaningful out-of-class preparation and revise rudimental skills
- Motivate and inspire students in-class
- Allow for students to influence the teaching
- Transparent expectations and self-evaluation

Learning design and Educational-IT

The learning design can be seem in figure 1. The design Is divided into before, in and after class. Educational-IT is used for communication and subtle augmentation.

Before class, preparation is made easy. References on blackboard are exact and prioritized. A typical preparation could be to watch a couple a videos of 10 min and review 5 pages of the text book. In the beginning of the course, I made sure to address their preparation numerous times. After that, I experienced that the students made a habit of preparing because it was easy and rewarding.

I put a lot of thought and effort into designing and executing good teaching. Above all I want to engage the students. My lectures are pretty active and I love bringing psychical models and experiments into the class room. The real thing unfolding before their eyes is superior to any other representation.

I typically divide a long lecture with a small relevant exercise. I use a simple survey tool called socrative.com and ask the students to answer a digital questionnaire. The progress can be followed in real time, see figure 2.

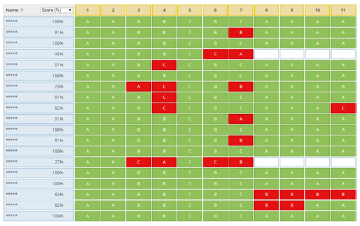

Figure 2: *Survey overview, student progress and results*

The primary learning activity is clearly working with exercises, which take up about 2/3 of course time. This aligns directly with exam and learning outcomes.

Indicators of impact

During to course, there are two mandatory assignments in the form of the exam. The assignments are grated and common feedback is given. To improve formal individual feedback, I have made a couple of somewhat successful experiments with peer feedback using rubrics.

Pedagogical challenge

Historically, many students do not prepare for class. How can this be changed?
Forced preparation kills motivation. Preparation should be easy and meaningful.

During the course, I asked the students to answer questionnaires about their learning. The process of answering such questionnaire forces the student to self-evaluate their performance and effort, while the results were valuable to me as a teacher. After working to improve student preparation, a majority said that they always prepared for class (figure 3) and that they experienced a sizeable payoff of it.

Figure 3: *Survey: 'How often do you prepare?': 59% Every time, 39% Almost every time, 2% seldom.*

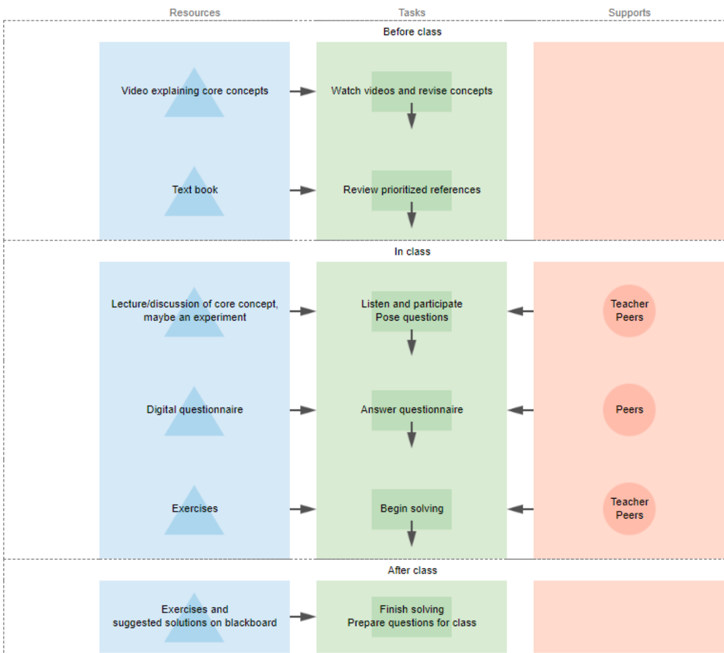

Figure 2. *LDTool representation of learning design*

EDU-IT role and benefits

Out-of-class, good videos can explain subjects better than text books. In-class, surveys can be used for the teacher to have a real time overview of student progress and understanding. Screen annotation are used to save lecture notes.

Lessons learned and looking forward

Steps have been taken to start a revision of the course material in 2020. I am just one of three lecturers teaching this course and changes have to be agreed upon.

I would like to improve the resources for preparation even more and to introduce the formal feedback for learning, e.g. as tests.

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Learning Design for Presentation Skills

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Keywords: *presentation skills, lecture, STREAM model, flipped learning, peer-feedback*

Pedagogical purpose

This learning design trains the students in presenting scientific information in an effective and engaging manner. This is an essential skill for the students, since they will have a Bachelor project in the next semester, which will be assessed based on an oral defense.

Course facts

- 3rd year Bachelor program in Biotechnology (13 students, 5 ECTS)
- Students perform 2 experiments in the lab
- 4 group sessions to improve written and oral presentation skills
- 'pass or fail' (two reports, one presentation)

Intended learning outcome

Students are capable to present scientific information in an affective and engaging manner during an oral presentation.

Learning design (Figure 1)

1) The students watch a Youtube video on the design of effective slides and presentation skills and take notes on the key messages of the video (at home) (Figure 2)

2) The video is discussed in class, followed by a short lecture on some aspects not covered in the video

3) The students prepare a presentation on their experiments (at home)

4) The class repeats in a group discussion what are good presentations. Each student presents his/her work, while students and teacher write down peer-feedback.

This design follows the STREAM model (Godsk M. STREAM: a Flexible Model for Transforming Higher Science Education into Blended and Online Learning , E-Learn (2013)), as it contains repeated cycles of home activities and face-to-face sessions, including feedback. The video and its discussion follows the flipped learning concept.

Figure 1: LDTool representation of the Learning Design (https://needle.uow.edu.au/ldt/ld/wUxlhu5B)

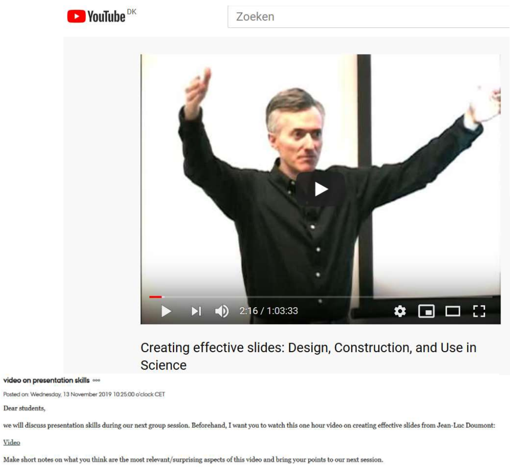

Figure 2: Implementation of the video in Blackboard

Indicators of impact

The outcome of the course was assessed by a online course evaluation and in-class discussion. 84% of the students found they received good feedback and guidance of their academic performance (Figure 3). In addition, the students indicated the course helped them to really improve their communication skills.

Figure 3: Element of online course evaluation related to feedback/guidance.

EDU-IT role and benefit

This learning design includes a Youtube video (lecture by Jean-Luc Doumont given at Stanford University) on creating effective slides. The video allows the students to learn from a renowned expert and engages them to critically evaluate presentations and improve their own presentations.

Lessons learnt

- Not all student presentations were as good
- Only 5 min presentations, likely not enough time to bring proper story
- Not clear if peer-feedback was useful to students

Looking forward

- Grading could be introduced to motivate students to bring good presentation
- Presentations of 10 min
- Use of rubric for peer-feedback

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Long Distance Supervision (LDS) at MBG

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Keywords: *Genetics, Plant science; Bachelor thesis supervision, EDU-IT*

Pedagogical challenge/purpose

Long distance supervision faces extra challenges due to lack of direct contact. Issues are more likely to go under the radar and there's a higher risk of misunderstandings and miscommunication.

Context

Our research group is located in Flakkebjerg 2 ½ - 3 hours from Aarhus, which offers some challenges when it comes to supervision and contact with students. Some of our students are in Aarhus during the entire or parts of the supervision period. This is particularly true about literature based projects or writing phases of thesis projects. I based the example on individual co-supervision of a bachelor thesis project in Agrobiology in the spring 2019. The student project was literature based only, so the supervision focused on progress updates and text feedback.

Learning outcomes and purpose of learning design

Optimize how long distance supervision can be carried out in order to address the problems described above. Develop a toolbox that can be used for long distance supervision also for future students.
Specific learning outcomes for the student:

1) Develop the ability to identify relevant problems of the chosen topic
2) Prepare and present problems and topics from the thesis topic using relevant online tools
3) Train the ability to aquire academic knowledge and writing skills

Learning design and Educational-IT

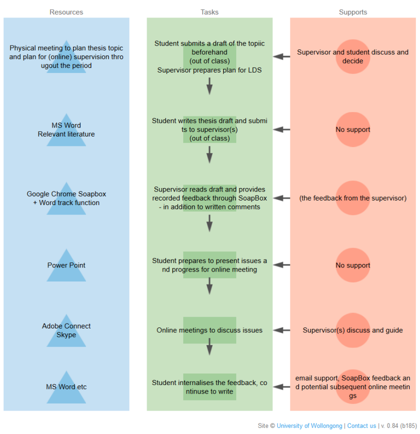

Figure 1. *LDTool representation of learning design used in the LDS* *https://needle.uow.edu.au/ldt/ld/FzFlqczE*

The learning design is using both in-class and out-of-class elements. The in-class modules are the online supervision meetings using/testing Adobe Connect and Skype (Figure 1). The out-of-class activities include preparations for the meetings, incorporating ideas and feedback given during the in-class session, and independent work on thesis writing. The student is asked to present either a Power Point or pdf at the meeting, via shared screen function in either of the video tools. Feedback was also provided via the shared screen function and the hand drawing tool in Adobe Connect. Additionally, SoapBox was used to provide oral feedback on the thesis drafts.

Impact or expected outcomes

Meetings using Skype and Adobe Connect

In this experiment, I wanted to evaluate to what extent the share screen function could improve the supervision session. I would therefor ask the student to summarize how she experienced it.
Conclusions: Compared to only using the video function in Skype, I expect the shared screen function to be an improvement. It helps the student visualize and point out specific issues. It is also helpful that the meeting form requires the student to prepare and think about how to communicate her progress and problems. It is useful to keep in mind that it is relatively easy to implement this in Skype

Text feedback with SoapBox

I have good experience using Track changes in Word from my own work, also with long distance co-authors (but with my own supervisor close). On the other hand, it is true that the communication can get unclear, the number of comments can be large, and meta-communication about the text is difficult. For a graduate or undergraduate student who is inexperienced with academic writing, this part can be very important. I.e. WHY did the supervisor ask me to do this? I expect that recorded feedback with SoapBox (Figure 2) can contribute to solving this problem.

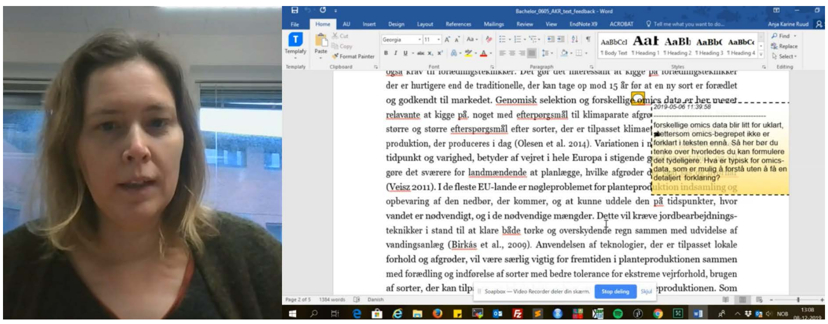

Figure 2. *Screenshot from a text feedback video recorded with SoapBox* (https://wistia.com/soapbox)

In a real case with students, I would ask them to evaluate how useful they find the different tools. Particularly upon testing new tools or approaches, I expect it to be very useful in order to improve how I use the tool. The feedback can even inform decisions on whether we should continue to use a tool, choose ('similar') alternatives or consider a different approach.

Lessons learned and looking forward

Compared to my previous supervision, the biggest change I wanted to implement was the increased use of 'formal' video meetings, and the more conscious use of the interactive possibilities. This requires more planning from the student's side, who gets more experience in presenting important pieces of her work – which in turn helps her fulfill the first two learning goals (see above) for the bachelor thesis. Through the preparations and more active, continuous discussion of the project, the student gains ownership and deeper, more integrated understanding of her project than if the supervision and feedback is more fragmented. My experience was that Skype and Adobe Connect are equally useful. For some students, or some meetings involving external collaborators, Skype may be the best option. SoapBox can be a nice additional tool to give a context to written text feedback.

I plan to ask future students to evaluate the learning design, so the use of the tools can be continiousley revised and improved.

A potential issue that might need more attention, is the more informal part of the situation for a remote student. In particular the feeling of not belonging to the group. One tool I want to implement in the future is Slack (https://slack.com/intl/en-dk/). Slack works like a newsfeed/blog for the whole research group or subpopulations of the group (specific projects etc.), and can be a channel for frequent updates, inspiration , and a vent for frustrations.

EDU-IT role and benefits

LDS depends on EDU-IT in order for the supervision to be carried out in the optimal way. Online supervision sessions are most effectively carried out with Adobe Connect or Skype. Adobe Connect has the advantage of hand drawing tool which is useful for writing equations or visualizing, but is not necessarily available for external project partners. Both tools have the possibility of using shared screen, which is also useful. For text feedback, a video recording tool like SoapBox can provide a nice supplement to written comments (https://wistia.com/soapbox)

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Facilitating article-based learning with the use of webinars and interactive tools in out-of-class study

Samuele Soraggi

Facilitating article-based learning with the use of webinars and interactive tools in out-of-class study

Keywords*: bioinformatics; theoretical lecture, presentation; STREAM model, out of class activity, peer feedback; deepened cognitive skills*

Pedagogical challenge/purpose

Activate the students cognitive skills through flipped class with reading at home and support with videos and online tools, so that discussions and feedback are more productive in class. The basis for this challenge is the STREAM model.

Context/course facts

Course "Advanced topics in genomics" with 6 students enrolled for 10 ECTS. Each week two topics are presented in a 3-hours session. The form of final examination is a project that uses the tools discussed in the course on a specific topic of biological interest.

Learning outcomes and purpose of learning design

Intended Learning outcomes:

- Understand the basic of advanced methods
- Translate theory in potential applications
- Criticize results from state-of-the-art studies
- Connect the use of methods in an analysis framework

Problems:

- the topics are quite difficult
- standard class presentation is not successful
- Students' focus decreases over 3 hours
- there is not enough time to discuss deeper technical aspects of the topics.

Aim of the project:

- Use the STREAM model (Godsk, 2013) to support students learning of bioinformatics methods through flipped class
- Activate students deeper cognitive skills (Biggs 2012) through students' presentations and more fruitful discussion supported by online tools
- enable peer feedback and moderation from the teacher
- Enrich learning experience creating more connections to real world applications already in class (Fink 2003).

The course themes are potentially applicable in a Master's project or Master's thesis, therefore this type of understanding will be pivotal.

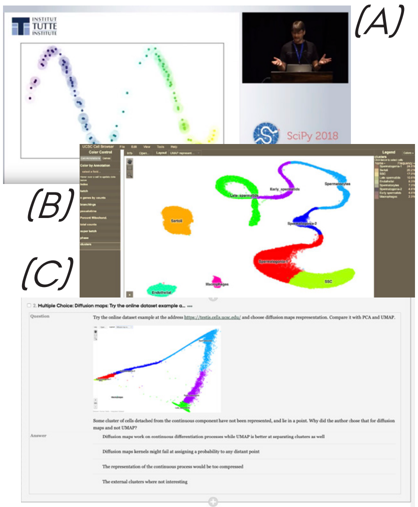

Figure 1: (A) open source/open access tools are almost standard in Bioinformatics – often as accessible as conference talks from their authors providing insightful clarifications. (B) Publicly available methods and data exploration is common in the analysis of biological datasets, and allows for direct practice with real data. (C) A Quiz combining interactive tools and technical questions can be of great help when studying.

Learning design and Educational-IT

A paper from each topic is assigned to two students, that will make a short presentation in class at the lesson. The other students will as well have read the papers at home to be prepared for discussion.

The teacher provides also explanatory videos to introduce the topics before reading the paper.

Difficult concepts can be discussed in class and fellow students can ask questions or add comments to the presentation.

The presenter student answer questions and moderate the discussion, together with the teacher, that uses its expertise to supply the conversation with the necessary additional content.

The teacher provides example of real application and links to online tools for data and methods exploration. This stimulates the discussion even more and provides inspiration to understand the behavior of different algorithms.

Indicators of impact

It is difficult to define a survey-based or any type of statistics to evaluate the effect of the teaching approach, when there are only six students enrolled in a course.

I collected my observations during the lesson where I participated as a teacher/moderator. I observed what follows:

- the students that presented were not always completely prepared on some aspects of the topic, because the article was often very technical. However, they succeeded to reflect and provide good explanations.
- The presentations helped the other students, often answering some of their doubts, but also creating new questions.
- The end of the presentation has been followed by a surprisingly active and self-sustained discussion by the students.

Moreover, I asked the students about some of the things I have been implementing during the lessons:

- The videos helped understanding how things work in practice, making the theory easily understandable, and creating a good background knowledge to read the article.
- The other students felt better activated when looking at practical applications of the data. It gave also rise to a more varied discussion.

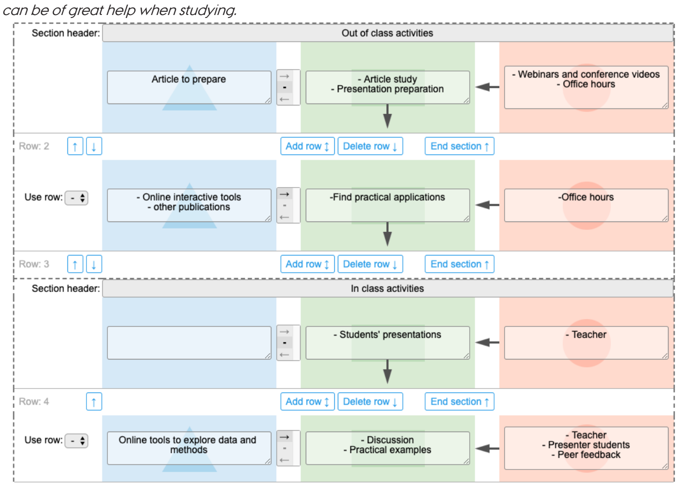

Figure 2. *Representation of the teaching flow in Ldtool. Url https://needle.uow.edu.au/ldt/ld/ey4PHBxh. The out of class activity consists essentially on preparing the article, and additionally the presentation for part of the students. Support material helps tackling the hardest parts of the papers. Future development of the course includes other activities (expert knowledge of parts of the paper, preparation of practical application from inactive students). In-class activity is driven by the presentations and the supporting interactive tools for application of the methods. The presenter students act also as moderators together with the teacher.*

EDU-IT role and benefits

Digital learning material consists of online videos/webinars, interactive tools for data exploration and methos application on real-world or simulated datasets. Further improvements might be coding exercises with provided code examples. URL for a blackboard class with example activities: tiny.cc/samuele

Lessons learned and looking forward

Flipped class has been successful, but not all students were active. A future implementation will include a presentation with sections assigned to different students, and some students will have to find example applications to show in class. In this way everyone has a role as an expert in its own section.

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A synergy of lectures and application in industrial context

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Assistant professor

Keywords: *Flipped classroom; lectures, theoretical exercises, fieldwork, report and oral presentation; peer-feedback*

Pedagogical challenge/purpose

The main aim of this learning design is to allow students to apply their gained knowledge in a context that is close to to a real job situation of a water treatment engineer. Therefore, the students get the opportunity to apply their knowledge on real data received during a visit of a wastewater treatment plant.

Context/course facts

The course “Water treatment technologies” was completely redesigned this year. The course is organized primarily for the 1st master for the biological and chemical engineering students. In addition, several students from the school of engineering with a background in biotechnology and students from the department of chemistry and bioscience take the course. The course has 10 ECTS and the lectures are organized along 2 main topics: biological and physical/chemical water treatment technologies. This year, 20 students subscribed for the course. The number of students may increase in the next couple of years.

Learning outcomes and purpose of learning design

The main learning outcome of this learning design is to apply the theory and skills learned during the lectures in a context that is close to a real job situation of a water treatment engineer. This includes understanding the water treatment processes, analyzing (quantitative) the performance of the processes and improving the processes. The presented learning design (Figure 1) covers the structure of the whole course and is a variant of the Flipped Classroom learning design. The learning design can be divided in 2 main parts: (1) lectures in combination with theoretical exercises and (2) a project including a visit to a wastewater treatment plant, report and presentation by students. The lectures start with the in-class activities (theoretical lectures) and end with out-of-class activities (theoretical exercises). The project starts with out-of-class activities (visit wastewater treatment plant, produce a report, give peer feedback, receive peer feedback and feedback from teacher) and end with an in-class activity (oral presentation of project followed by a guided discussion).

Learning design and Educational-IT

The learning design follows the Flipped Classroom learning design. For the first part where lectures are combined with theoretical exercises, the out-of-class theoretical exercises are a continuation of the in-class activities and are therefore perfectly aligned. One week after the theoretical exercises are provided, the students receive the solutions to the problems together with an explanation (Figure 2).

For the second part in which the students perform a project including a visit to a wastewater treatment plant, report and presentation by students, the student provide peer feedback. The students receive a rubrics (Figure 3) that they need to use to provide peer feedback on the project reports of other students. My experience is that the quality of the peer feedback correlates with the quality of the reports. That means that students with a report of high quality give valuable peer feedback, whereas students with a poor performance provide poor feedback. It is therefore important that the teacher provides feedback to each student in addition to the peer feedback.

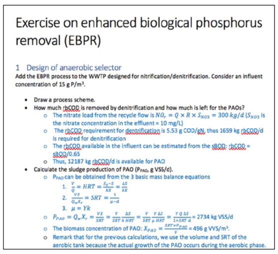

Figure 2. *Example of the theoretical exercises the student need to solve out of class and the solution and explanation is provided after one week (in blue).*

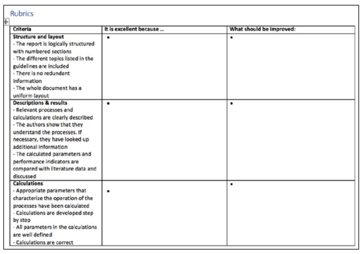

Figure 3. *Example of a rubrics provided to the students to provide peer feedback.*

Indicators of impact

During the lectures, the student learning is evaluated regularly by including short theoretical exercises that cover the theory. Based on how well the students perform the exercises, I can decide to repeat some of the theory or to continue. The midterm course evaluation showed that this approach is effective. I received answers from 9 students out of 20 and 8 of them mentioned that the combination of exercises and lecturing was effective and helped them to understand the theory and concepts.

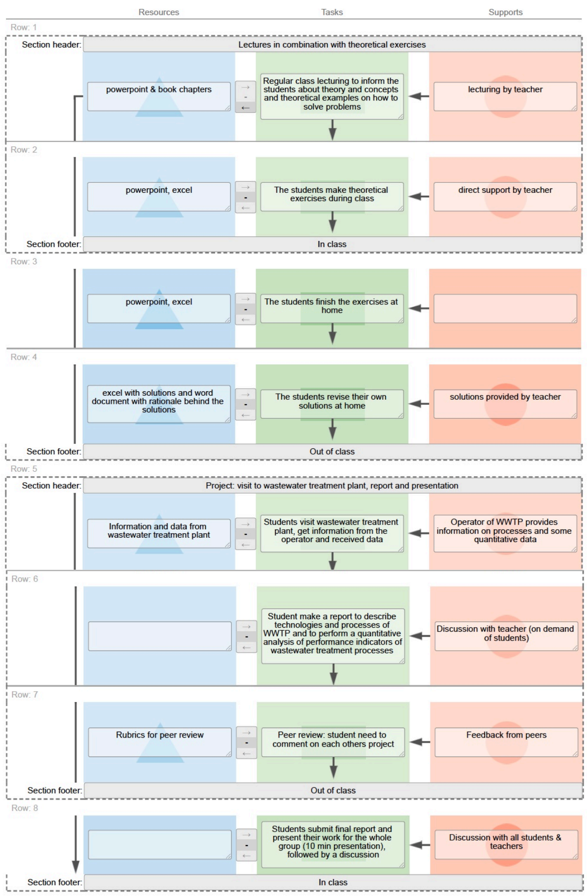

Figure 1. *LDTool representation of learning design*

EDU-IT role and benefits

Rubrics were for peer feedback and online Google forms for midterm evaluation. The Rubrics is a practical tool for peer feedback for several reasons. The Rubrics make it very clear for the students how their project will be evaluated and the Rubrics provide a structured way to provide peer feedback.

Lessons learned and looking forward

Considering that this is a new course, the presented learning design worked quite well.

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Solar photovoltaic installation: learning by doing

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Keywords*:* engineering; renewable *energies; solar photovoltaics; lecture; lab exercises; active learning; flipped classroom; just-in-time teaching; increase motivation; relate content from different sections of the course*

Pedagogical challenge

- *Increase students' engagement into the course by proposing a practical activity that resembles a real-life problem for a researcher or engineer.*
- *Give the students the opportunity of having a lab experience, although we don't have a proper solar energy laboratory yet.*
- *Ask the students to perform a large task that requires using different parts of the course content so that it can help them structure the different topics that they have learnt.*

Context/course facts

"Renewable Energy Technologies" is a 5 ECTS course at the master level. There are 10 students in the course since it is an elective course and it is the first time that it is being taught. The course deals with renewable technologies but focuses mainly on solar photovoltaics and wind energy. For most of the students, this is the first time that they approach these topics. Because the course is new, we don't have any laboratory facilities. Hence, I propose to use the solar photovoltaic panels installed on the rooftop of building where I teach as laboratory.

Learning outcomes and purpose of learning design

The learning outcomes of the course related to this project are the following:

- *Enumerate the main elements in a solar photovoltaic installation and their function.*
- *Identify the available databases for solar radiation.*
- *Model the power produced in a rooftop solar installation with hourly resolution.*
- *Formulate hypotheses on the possible causes of errors and uncertainties when modeling a solar photovoltaic installation.*

This project has two main objectives: (a) to enhance students engagement in the course and (b) to help students achieve high-level of understanding in the SOLO taxonomy such as being able of evaluate the results of a model, reflect on them, compare to measured data, and hypothesize on the possible sources of discrepancies.

To motivate students, they are asked to perform as real researchers or engineers by implementing a model that combines different contents within the course and to close the loop by comparing the model with measured data and estimating the errors. This, together with the lab activity, i.e., visiting and modelling a real installation, is expected to increase students' motivation. I hope that the students are able to carry out the complete project independently, and I expect them to participate actively in the final face-to-face discussion in which we compare the results.

Figure 1: *Photovoltaic installation on the rooftop of the building that will be used in this project.*

Learning design and Educational-IT

The learning design includes both in-class and out-class activities as shown in Figure 2. Three of the activities are performed online. They include two forum where students can ask questions, and provide feedback to their peers, at two different stages of the project. Moreover, in the second activity of the project, students co-create a wikilist with available databases for solar radiation, the name of the databases, the links and their main characteristics. In this case, the role of the teacher is to provide the categories for the wikilist in Blackboard and to provide online support if needed.

Indicators of impact

The learning outcomes of the students and the expected outcomes of this project are observed and analyzed via three different criteria:

- *The ability of the students to carry out the complete project, proving that they can connect content and work independently.*
- *The participation in the online activities: wikilist on solar resources databases and forum.*
- *A survey that students answer, and which aims at collecting information regarding their learning activity, e.g. the main challenges, if they think that they have learnt, if they have enjoyed the full process, etc. (see for instance Figure 3)*

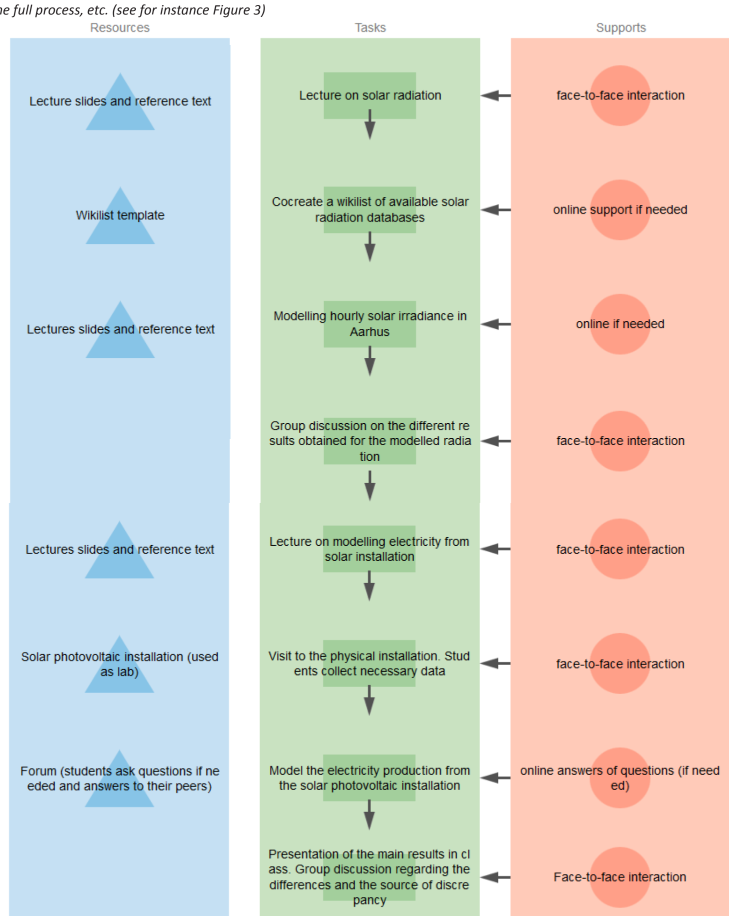

Figure 2. *LDTool representation of learning design used in the learning project "Modelig a solar photovoltaic installation"*

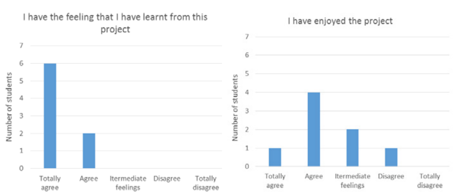

Figure 3: *Selected results from the online survey using a Google form and filled by students.*

Lessons learned and looking forward

The objective of increasing student's engagement was partially fulfilled. The last learning outcome (*Formulate hypotheses on the possible causes of errors and uncertainties when modeling a solar photovoltaic installation*) was achieved by some groups of students but not all of them. In the future, I will:

- Provide a list of questions to guide students in the last activity so that they can attain the learning outcome.
- Set up clear deadlines for participation in the online activities.

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Design of a STREAM model for the course "Numerical Analysis in Civil Engineering"

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Keywords*: Civil Engineering; Theory and programming; STREAM model/online vedios/mentimeter quizzes;*

Pedagogical challenge/purpose

In the previous year, traditional classroom lectures (theory) + homework (Matlab programming) format was used. The students found it difficult to follow the lecture because of the abstract mathematics and numerical schemes. Then, they also found it difficult to start doing their homework and mini-project using Matlab after the lecture .

Context/course facts

(i) **Numerical Analysis in Civil Engineering**, (ii) number of students: 68, (iii) 5 ECTS-points, (iv) Oral examination based on a report.
In this course, we will go through the theory of a number of different topics within numerical mathematics, and try to apply them on practical problems with in civil engineering. The use of Matlab will play a large part in the course, for both small exercises and mini-projects.

Learning outcomes and purpose of learning design

In the previous year, traditional classroom lectures (theory) + homework (Matlab programming) format was used. The students found it difficult to follow the lecture because of the abstract mathematics and numerical schemes delivered to the students during the approximately 2.5-hour lecture time. Some may follow from the beginning, but get lost at one point when they can not understand that part. Then, they also found it difficult to start doing their homework and mini-project using Matlab after the lecture (1.5 hour in class and afterwards out-of-class activity). It seems that the time in the class is not very efficiently used by giving heavy theoretical lectures. Therefore, a similar model as the STREAM is implemented this year, to see if out-of-class activity (before the class) can improve students' learning outcome in class.
The purpose is that the students can have a better understanding of the theory (the mathematics and the numerical schemes) and a better Matlab coding skill before they start doing their homework, so that they don't waste time struggling to figure out how to relate the theory to what they need to code.

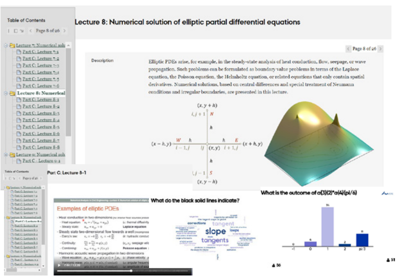

Figure 1: *Digital learning materials: blackboard course design, online videos, Mentimeter quizzes*

Learning design and Educational-IT

Out-of-class activities:
(1) The main lecturer recorded series of webcasts explaining the theories, and the students need to watch the corresponding online webcasts (for the topic of that lecture) before each lecture. Therefore, the students can make their own learning plan to understand the theory, and they can pause/repeat the contents where they found difficult until they fully understand. The resource is the pre-recorded series of webcasts explaining the theories.
(2) Moreover, since quite a lot of skills in Matlab are needed in this course which is quite challenging for some new students, the students also need to do self-study of Matlab programming using the online materials. Actually, Mathworks provides excellent online interactive learning environment, i.e. *Matlab Onramp* and *Matlab Fundamental*, which contains tasks, quizzes, answers and explanations. This already designed interactive learning environment is extremely useful for beginners to get familiar with Matlab programming.

Out-of-class activities:
(1) Online quizzes with well-designed questions regarding the theory and the Matlab coding skill (using *Mentimeter*) for each lecture, to evaluate the learning outcome of the out-of-class activity. Based on the answers, more detailed explanations will be given by the teacher.
(2) Guided matlab programming for solving small exercises related to the theory covered by this lecture.
(3) Group work on mini-project (approximately 2 hours). Each group will have a mini-project related to one of the real civil engineering problems (determined at early stage of the course), and need to use many numerical algorithms to do the mini-project in Matlab. The mini-project is divided into several sub tasks, and the groups are supposed to work on one of the tasks during each lecture. The support is the supervision and help from the teacher and the teaching assistant (who are walking around the classroom).

Figure 2. *LDTool representation of learning design used in* ***Numerical Analysis in Civil Engineering*** *course*

Indicators of impact

(1) Comparing with last year', the out-of-class activity (2) obviously improves the students' Matlab skill a lot.
(2) The out-of-class activity (1) improves the students' understanding of the theoretical parts of the course. Comparing with last year, it takes less time for them to do the coding exercise for each lecture.
(3) The Mentimeter session improves the teaching outcome. I can see the students enjoys this activity and they are much more active (answering in their laptop or cell phone, peer discussion, reflection after seeing the correct answer)

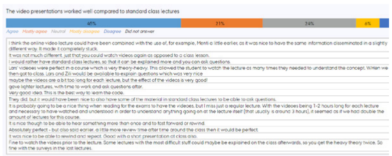

Figure 3: *A part of the course evaluation 2019*

EDU-IT role and benefits

Several digital education tools have been used, some of which are shown in Fig.1. These include: (1) The learning platform, blackboard, providing the teaching plan, course materials, relavant links, et al. (2) Online videos (recorded by the teacher) explaining theory for each lecture, which the students should watch before each class to get a good understanding of the theory. (3) Mentimeter quizzes carefully designed for each lecture (~5 questions for each lecture), in order to evaluate the students' out-of-class activity, to give them opportunity to do peer discussion and to deepen their understanding of the theory.

Lessons learned and looking forward

Up to now, I think the initiative succeed in reaching the aims as intended to a large extend. Next year, I think he out-of-class activities should be continued. If we were to repeat the project, we will do the Mentimeter session from the beginning of the course. The design of the mini-projects needs be improved next year, e.g. adding some more relevant topics, a better definition of sub-tasks, etc.

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SCIENCE TEACHING COURSE POSTERS BY PHD STUDENTS

Crop pest biology and management

Help students to understand

Learning Lab

Abstract: Teachers knows that it can be difficult to keep students attention especially in a course with student of different knowledge background. For instance, course “crop pest biology and management” covers three crop pests including insects, disease and weeds. Students often don't have enough knowledge of all three crop pests together to achieve the learning outcomes fully. I planned my teaching activity in a way that I will make students more attentive by providing them more relevant reading material containing strong theoretical background, by teaching relevant tasks, teaching at understandable level, and providing forum for group discussions to make learning more interactive. Students will be asked to read reading material covering basic concepts of all three crop pests which will provided beforehand. After lecture deliver by lecturer I will ask students to split into groups where they will discuss all the lecture points. After group discussion each group will be asked to make summary of the discussion. Lastly summaries from each group will be discuss on floor to encourage the interspecific group discussion. This course will help students to learn about the biology of three pests and application of pest biological knowledge to identify best pest control strategies.

COURSE FACTS

- Course name: Crop pest biology and management
- Level: Master level
- ECTS credits : 10
- Language: English
- Number of students: 20
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

Experience with last year course accentuated me to think that “crop pest biology and management” is relatively a general course covering three crop pests, and students often loose their concentration due to lack of background knowledge about all three crop pests together. This lack of background knowledge leads to ineffective learning outcomes. Feedback during the course showed that student need to strengthen their core concepts of crop pests. So instead of more general reading material, in the upcoming course it will be make sure that student will have basic theoretical background knowledge to keep holding their attention, to fully understand the biology of pests, their interrelationship, and application of biological knowledge to find best pest management strategies.

2. Planning a teaching activity

Students will be provided reading material including basic concepts of all three pests containing biological knowledge.
Student will listen the lectures, take the notes. Students will be assigned a specific group, where they will discuss lecture key points and write a lesson summary within group. The basic idea for this summary to put the things together and engaging every student in the active learning.
Lastly intergroup discussion will be arranged where summary from every group will be discussed to make the learning more active.

Learning outcomes of teaching activity:

- To build the background knowledge of biology of three crop pests.
- To make sure active learning for student from different background
- To encourage every student take part in the class discussion.
- To find the interrelationship among three crop pests biology.

3. Trying it out in practice

Reading material will be provided six weeks before start of the course. Students will be recommended to understand the provided reading material, students with different background will be arranged in specific groups to facilitate the interrelation learning of biology of three crop pests. Firstly course lecture will be deliver by the lecturer and then course conceptual points will be discuss in small group. Students will be asked to discuss the course points and make summary within each group. Then the whole class will be involved on floor discussion to discuss the summaries to encourage the intergroup discussions to clarify the concepts of student where they don't understand.

Learning Assessment:

Inter and intra group discussion will be used to assess the learning; students will present their group work on floor, other groups will be asked to give feedback, this on floor discussion and group feedback will also be used to for the learning assessments.

This assessment will constitute 25% of marks of students final grade.

MAIN POINTS

1. **Main problem/challenge:** getting student attention and keep it holding
2. **Teaching activity**: I will use small “group teaching” to make sure students concept clarification and keep holding their attention
3. **How did it go?** Activity expected to work with 100% active learning outcome.
4. **What to do next?** The activity expected to be continued with future useful addition based on student feedback

Students expected to learn the basic theoretical knowledge of crop pests and its practical implications. Students expected to actively participate in inter and intra group the discussion.

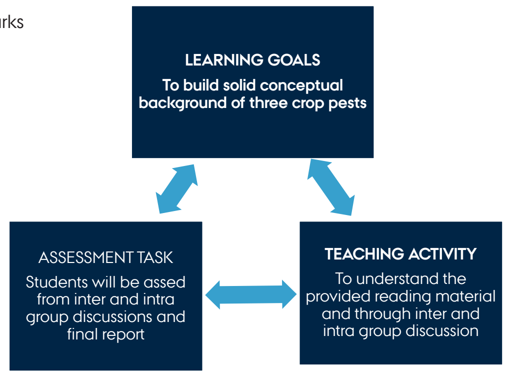


Figure 1: Constructive alignment

4. Looking forward

This teaching activity will expected to work in maximum percent of active learning achievement from this course. Students will be expected to be active in the class than previous coerces. Inter and intra group discussions will expected to encourage the coordination among the students which will lead students to device innovative ideas and students will generate the interrelationship among the biological knowledge of three crop pests. Lectures will expected be more motivated after observing inter and intra group discussion. I am looking forward to implement this proposed teaching activity in upcoming course.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Muhammad Javaid Akhter
Crop Health
Department of Agroecology

DIY Lake Ecosystem Conceptual Model

- Ensuring a working knowledge of lake ecosystems

Learning Lab

Abstract:

The Master course 'Environmental Modelling and Management' is offered cross-disciplinary and therefore some students have no or limited knowledge of lake ecology. To fully benefit from the course's lake model exercises, it is important to have a working knowledge of lake ecosystems. The exercise 'DYI Lake Ecosystem Conceptual Model' was created and implemented to solve this problem. In groups, students created their own figure of a lake ecosystem by recalling their previous knowledge on lakes. Their figure was then discussed in relation to the lake model that is used in the course. Most students found the exercise beneficial and they created figures that satisfied basic lake ecology knowledge. In next years teaching, the introduction to the exercise will specify in more detail the use of model terms in relation to lake conceptual figures.

COURSE FACTS

- Course name: Environmental Modelling and Management
- Level: Master
- ECTS credits : 10
- Language: English
- Number of students: 15
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

As the course 'Environmental Modelling and Management' is a cross-disciplinary course, some students only have very basic or no knowledge of lake ecosystem functioning. A basic understanding is necessary for students to properly evaluate lake model results and application, which is one of the main learning outcomes of this course. Therefore, this exercise aimed at ensuring all students would have the necessary understanding of lake ecology.

2.Planning a teaching activity

Through this teaching activity, the students would recall knowledge from previous courses and from a video lecture on introduction to lake modelling*, watched before class, on a basic lake ecosystem functioning by creating their own conceptual lake ecosystem figure. To create the conceptual figure, the students would have to recall, relate and discuss basic lake ecology in- and between groups (through peer feedback). The structure of the exercise forced the students to both consider biology and physical processes. At the end of the exercise, the students also had to compare their figure with the lake model they would work with in future classes.

* The screencast '**Video lecture on the concept and core components of WET**' (36 min) was produced by Dennis Trolle, Anders Nielsen, Karsten Bolding and Jorn Bruggeman.

3. Trying it out in practice

Before class, the students had watched a video lecture on lake modelling*. In class, the students was introduced to the purpose and aim of the exercise. Then students was divided in groups of 2-3 students and guided in steps through the process of creating a conceptual lake ecosystem figure.
Then 1-2 team members visited other groups to perform peer-assessment on their figure. After, all group members did a self-assessment of their work based on the new knowledge from the other groups. The exercise was planned for a duration of 20 minutes.

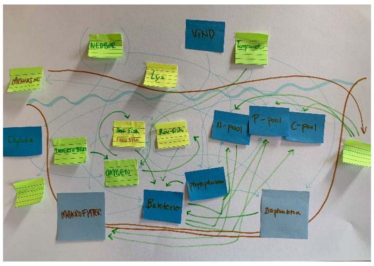


Figure 1: Example of end product from the exercise created by 3 Master students (October 2019).

The students have benefitted from the teaching activity if the newly created conceptual lake models consisted of the most important pools and processes in a Danish lake ecosystem and the students understood the need to understand the system before evaluating a model.
This was assessed by evaluation the newly created figures and from the student discussions.

MAIN POINTS

1. **Main problem/challenge:** Different levels of knowledge beforehand and lack of understanding of lake ecology
2. **Teaching activity**: Conceptual map
3. **How did it go?** All students completed the exercise satisfactory and most students and teacher found the exercise to be beneficial.
4. **What to do next?** Improve the activity by applying more model terms and narrow the scope.

The usefulness of the exercise was evaluated by the students in an out-of-class activity 4 days after the teaching activity by filling out a Socrates questioner with one questions being *"Did you benefit from the group work where you created your own conceptual lake ecosystem?" (YES/NO). "Why?"*

70 %

of students stated that they benefitted from the exercise.

4. Looking forward

Most students and the observing professor stated that they found the exercise to be beneficial to their understanding of the lake model. Although, there are room for some improvements. The exercise was planned to go on for 20 minutes, but when trying out the exercise in practice the students were so involved in creating the figure, that I allowed the exercise to continue for 30 minutes. Also, there were some doubts about the application of some model terms, which should be easy to clarify in the introduction.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Tobias Kuhlmann Andersen
Section of Lake Ecology
Department of Bioscience, Silkeborg

Pymol recall "map"

- A learning activity to give students an overview of Pymol commands

Learning Lab

Abstract:

Pymol is an indispensable tool when studying protein structures, which is in the center of the course Biomolecular Structure and Function. It is known from previous, that using commands and writing scripts in Pymol is one of the tasks that the students find most difficult. This activity, where students sort Pymol commands and actions, aims to help the students get an overview of the commands they have been introduced to, and to recall how they are used. Overall the students liked the activity and found it useful. For future applications, it would be optimal to increase the time used on the activity to improve the learning outcome.

COURSE FACTS

- Course name: Biomolecular Structure and Function
- Level: Bachelor (3rd semester)
- ECTS credits : 10
- Language: Danish
- Number of students: 20
- Your role: Teaching assistant in theoretical exercises

TEACHING IN PRACTICE

1. Identifying a problem

In the course Biomolecular Structure and Functions the students learn about the basic properties of proteins, nucleic acids, carbohydrates, and lipids, including their structures and dynamics in the cell.

Pymol is an indispensable tool when studying protein structures, and in this course, it is the first time that the major part of the students are introduced to this program. It is furthermore used in most of theoretical exercise sessions. However, it is known, from previous and from student evaluations on the learning platform "curriculearn", that many students find it challenging to use the program and especially using commands and making scripts. Therefore, I decided to design an activity, where the students can practice and recall the Pymol commands they have learned in the course.

2. Planning a teaching activity

In order to solve the above stated problem, I have developed an activity called "Pymol review map", where the students will sort Pymol commands and actions, and figure out which action the command performs and vice versa. A command could e.g. be "color orange ss s", and an action could be "show residues 1-10 as as sticks".

The activity aims to help the students review and get an overview of the Pymol commands they have been introduced to in the course, and to practice how they are used. The activity is mainly meant as a recall activity, but can also be useful for the students when preparing for the exam, where they might be asked to write a Pymol script.

3. Trying it out in practice

In the last 30 minutes of the session the teaching activity was carried out. The activity was introduced, and the students were provided with a list of Pymol commands/actions, a list of categories, a piece of A3 size paper, post its, and colored marker pens. They were allowed to use all resources, like course materials, Pymol, and "pymolwiki.org". The students were working in the groups they were divided into in the beginning of the session. Figure 1 show an example of a recall "map" in progress, constructed by students.

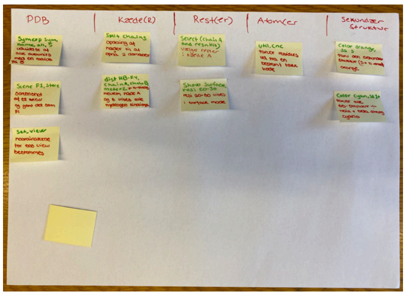


Figure 1: Recall map. An example of recall "map" in progress. The commands/actions are sorted in relation to the level their act on: PDB (entire structure(s)), chain(s), residue(s), atom(s), secondary structure element(s)

While the students worked on the maps, I was walking around in the classroom to assess how they solved the tasks, and to guide them if they had any problems.

It was intended that the groups should switch map with another group and review their map, followed by revision of their own map, but unfortunately time did not allow this. However, I observed that the students worked very actively during the activity and all students contributed to the maps.

In the following session the teaching activity was evaluated using Mentimeter. The results can be seen in figure 2.

MAIN POINTS

1. **Main problem/challenge:** Students finding it difficult to use commands in Pymol
2. **Teaching activity:** Construction of a recall "map"
3. **How did it go?** The students liked the activity
4. **What to do next?** Adjust the activity to fit the schedule of the theoretical exercises

Figure 2: Evaluation
Evaluation results. From top: "Did you gain something from the activity?, "Was the level appropriate?", "Was it worth the time to do the activity?", "Do you feel better prepared to use commands in Pymol?". The questions were rated on a scale from 1 to 5 (1= Not at all, 5 = To a large extend).

Furthermore, I got positive feedback from the students. However, they would have liked to spend more time on the activity.

Figure 3 shows the alignment between learning goals, the teaching activity and the learning assessment.

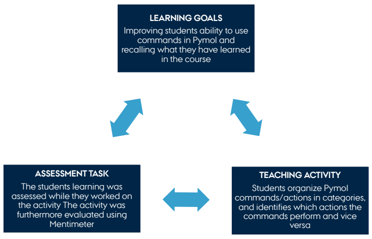


Figure 3: Constructive alignment
The figure shows the alignment between the learning goals, the teaching activity, and the assessment.

4. Looking forward

In general the students were very positive about the activity. However, they would have liked to spend more time on it. If the activity is going to be used in the future, either the content of the activity needs to be reduced, or more time should be set aside, in order for the students to finish the map, and have time enough for reviewing each others maps.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Marie Bech Andersen
Esben Lorentzen's group
Molecular Biology and Genetics

How to talk Quantum Mechanics

- A practice in the mathematics of Quantum Mechanics and relating two courses

Learning Lab

Abstract:

Nanoscience students follow the course Linear Transformation simultaneously with Quantum Mechanics. Often, we will use concepts from Linear Transformation as tools in Quantum Mechanics which means that the students have to keep an overview of the courses in a busy schedule. The teaching activity helped the students to reflect on the relation between the two courses and practice the use of terminology from Linear Transformation in the world of Quantum Mechanics. The results show student improvement, but also that this relation needs to be practiced more in the future.

COURSE FACTS

- Course name: Quantum Mechanics for Nanoscience
- Level: Bachelor (3rd semester)
- ECTS credits : 5
- Language: Danish
- Number of students: 20
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

"The natural language of quantum mechanics is linear algebra" [1]

It is therefore clear that for the students to be able to learn Quantum Mechanics, they will have to understand the math behind called linear algebra.

For the Nanoscience students, the course program is designed so that these two subjects are taught in parallel in two 5 ECTS courses on the 3rd semester – *Quantum Mechanics for Nanoscience* and *Linear Transformations*. This provides option to clearly state the relation between the two courses during the semester, but the students will need to keep an overview of the curriculum in a busy schedule. For some students this overview has been missing.

2. Planning a teaching activity

The purpose of the teaching activity is to give the students an opportunity to reflect on the taught material in the two courses and discuss with their peers how they relate. The activity consist of two parts – a word association/identification exercise and a quiz. For the exercise, the students are given a sheet with different concepts from linear algebra and box to fill out for each one. In the box, the students are asked in small groups to fill out where the concept appears in quantum mechanics. The teaching activity will then be a practice in using the terminology from Linear Transformation in the world of Quantum Mechanics. The mentimeter quiz is then testing the use and understanding of this terminology.

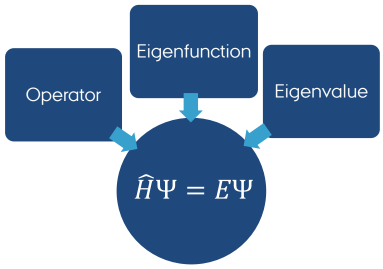


Illustration of the challenge for students in the course. In the middle, we find the time-independent Schrödinger equation which is fundamental in the course. It is an eigenvalue problem, and concepts such as *operator, eigenfunction* and *eigenvalue* known from Linear Transformation are crucial in its use.

3. Trying it out in practice

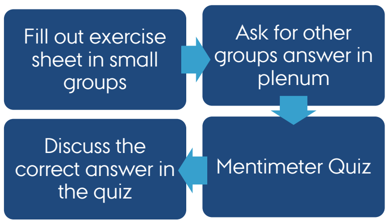
Before the teaching activity was started the students was asked anonymously to rate their own level in relating the two courses and using the terminology of Linear Transformation. After the activity, similar questions were posed to get a measure of improvement among the students. The results suggest that the students think they have learned some.

The exercise sheet was not something to be handed in, but something the students could use as notes for themselves. There was not enough time to go through each concept in plenum, so the students was given the opportunity to ask their peers on specific concepts in plenum. I could then contribute to the student discussion.

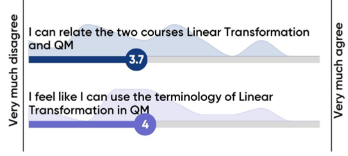
The quiz was based on simple quantum mechanics tasks, so the challenge for students was to decipher the formulation of the question which drew heavily on the concepts from the sheet. In general, the concepts and questions are of the basic type for the two courses. Still many students found the activity in total challenging. This suggest that this has to be trained further.

MAIN POINTS

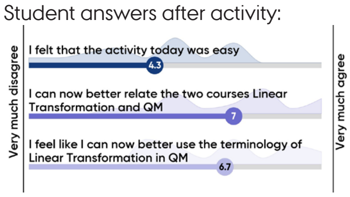
1. **Main problem/challenge:** Students find it difficult to relate the two courses in Quantum Mechanics and Linear Transformation
2. **Teaching activity**: Word association/identification exercise and quiz
3. **How did it go?** Students gained more confidence in the use of math terminology
4. **What to do next?** Make sure to address the relation of the two courses repeatedly during the semester



Student answers before activity:



Student answers after activity:



4. Looking forward

The teaching activity helped the students to reflect and practice the use of terminology taught in Linear Transformation in the Quantum Mechanics course. Even though, the students has improved keeping an overview of the two courses still remain a challenge. This activity could then be expanded to several activities of this theme, so it becomes a reoccurring thing during the entire semester. This could hopefully lead to further improvement for the students.

References

[1] D. J. Griffiths, "Introduction to Quantum Mechanics", 3rd Edition (the course book)

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Cluster Dynamics Group
Department of Physics and Astronomy

Understanding animal play and welfare

Learning Lab

Using a common Word Cloud and Strip Sequences to improve the understanding of why animals play and the relation to welfare

Abstract: Students struggle to pin point the function of animal play behaviour and relate this knowledge to animal welfare. A two-part teaching activity was implemented. First, students were asked to supply answers to "Why do animals play?" in a word cloud using Menti.com. This was used as a starting point, followed by a discussion and lecture on play and welfare. Then, students were asked to organize a strip sequence, which allowed for students to revisit the links between play and welfare. At the same time it allowed the lecturer to assess their understanding of the topic and clarify where needed.
Students had their initial misconceptions, as shown in the Word Cloud, clarified and performed very well on the Strip Sequence.

COURSE FACTS

- Course name: Animal Behaviour and Welfare
- Level: Bachelor
- ECTS credits : 5
- Language: Danish
- Number of students: 10
- Your role: Guest Lecturer

TEACHING IN PRACTICE

1. Identifying a problem

Play is a well-known behaviour to most people, but very hard to define and explain. It likely has multiple functions and adaptive benefits. These functions are related to the welfare of the animal in several ways, both indicating and inducing good welfare. There are however pitfalls as play behaviour can both increase and decrease due to unfavourable conditions. The students should be able to define, explain, discuss and reflect on play behaviour, its function and its relation to welfare.

2. Planning a teaching activity

The following learning outcomes are touched upon in the lecture:

- Describe and distinguish between different types of normal behaviour in selected domestic animals.
- Define animal welfare and discuss the application of behaviour in animal welfare assessments.

The teaching activity consists of two parts. From the first part they will recall the pre-lecture reading materials and assess their own understanding of why animals play (and get inspired and maybe provoked by other's ideas). The second part will help them use, structure and revisit their knowledge on the relations between play behavior and animal welfare – as well as discuss it with their peers and afterwards with me in class.

Both parts of the teaching activity will allow for identification of areas where clarification is needed.

3. Trying it out in practice

Students were asked to submit their thoughts to the question "Why do animals play?" in a common Word Cloud using menti.com. This was followed by a discussion and lecture on play and welfare. After this, statements and connecting phrases were handed to the students along with the overall structure of a strip sequence.

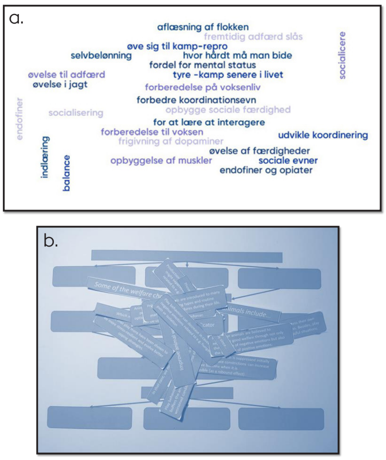


Figure 1. a. The result of the word cloud "Why do animals play?" b. The given strip-sequence on play and welfare.

Students were asked to fill in the sequence in groups. During group work students had the opportunity to ask clarifying questions and were, if needed, pointed in the right direction. Lastly, the correct result was shown.

Towards the end of class students were asked to write one positive and one negative thing about todays lecture and hand them in as they left.

In conclusion, students had initial misconceptions on the subject but solved the Strip Sequence very well. Thus, students showed an increased understanding of play and were able to successfully relate this to animal welfare while successfully considering typical pitfalls.

MAIN POINTS

1. **Main problem/challenge:** There is a misconception on the function of animal play behavior and how it relates to animal welfare
2. **Teaching activity**: Word cloud with following discussion of function and a strip sequence to relate play and welfare.
3. **How did it go?** Students had their misconception clarified and successfully related statements on play with welfare.
4. **What to do next?** Have students present the strip sequence in class to further elaborate the discussion.

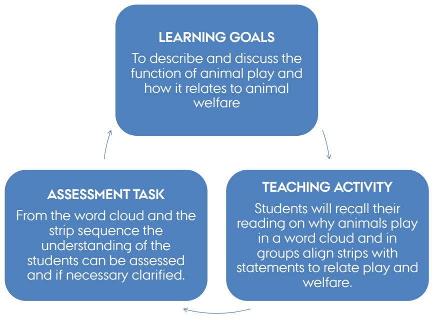


Figure 2: **Constructive alignment**

4. Looking forward

Students were engaged and used their own words to argue among each other as to how the strip sequence should be organized. They solved the activity quicker than expected, with less help. Their feedback on the teaching included positive statements on the use of varying teaching activities and being active themselves. For the word cloud, choosing from predefined terms might be useful to avoid slightly different but essentially identical answers, which confuses the cloud. In order to elaborate their arguments used and possibly further clarify any misunderstanding, a more detailed presentation of their strip sequences on class would be useful in future lectures.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Maja Bertelsen
Behaviour and Stress Biology
Animal Science

Wrapping up with a quiz

- Encouraging participation with friendly competition

Learning Lab

Abstract: Before the teaching activity, the students gave short presentations about parts of the curriculum in groups of 2-3. The lecturer was not sure that they paid attention to and understood each other so to make sure they did, I made a quiz for them. The quiz had questions prepared by myself, the lecturer and the students. In general, the students answered correctly but we also discussed every question in plenum to make sure everybody understood. This is a good way to sum up the semester and I will consider doing this in future courses. In the future, I would like to add a few more questions to cover a bigger part of the curriculum.

COURSE FACTS

- Course name: Stars and Planets
- Level: Bachelor (2nd year)
- ECTS credits : 10
- Language: Danish
- Number of students: 9
- Your role: Help with theoretical exercises

TEACHING IN PRACTICE

1. Identifying a problem

As a part of the course, the students work in groups on different projects that cover parts of the curriculum. They present the projects to each other at the end of the semester. The lecturer informed me that in previous years he has had trouble telling whether all students understood everything. My teaching activity is meant to test if the students have understood the necessary physics and can explain it to each other.

2. Planning a teaching activity

Based on the problem described above, I designed a quiz for the last TØ class. I asked the students to provide 2 questions per group about their presentation. I did this to make them think about what they present and what is important for their topic. If the questions were too easy/hard I changed them a bit. This also meant that if they asked good questions, they would already know the answer and would be rewarded with easy points at the quiz. I also asked the lecturer for questions and made some myself. The quiz itself was made with mentimeter and consisted of 12 "real" questions and a few trick questions to make it more entertaining. I chose the quiz format to make it more fun for the students so they would want to be involved. I also got a prize for the winning team to make them more enthusiastic. The overall idea with the teaching activity was to get a good constructive alignment (see fig. 1)

3. Trying it out in practice

In class, I started by splitting the students into the four groups that they had worked with for the presentations. The students were put in groups to give them a chance to discuss the questions with each other. I explained the rules of the quiz i.e. the questions were mainly multiple choice and without a time limit while a few where typing questions and/or they would get more points the faster they answered. From the students who answered correctly, I would ask them to explain their answer and make sure everybody understood why that was the correct answer. Only three out of twelve questions had only two or fewer teams answering correctly out of the four teams (see fig. 2). For the rest either all or three teams answered correctly. This shows me that they did pay attention to each other's talks and know the course material. In the end, the winning team got a small prize (chocolate) that they chose to share with the others.

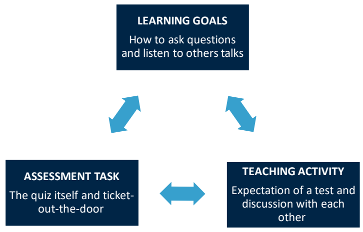


Figure 1: **Constructive alignment**

MAIN POINTS

1. **Main problem/challenge:** Make sure students understand each other's presentations
2. **Teaching activity**: Quiz
3. **How did it go?** Students were engaged and answered most questions right.
4. **What to do next?** Add more questions for next year

In general, they were having fun and I think it is a nice way to sum up a course at the last TØ. I handed out ticket-out-the-door notes and asked them if they paid more attention to the presentations because they knew there would be a quiz. Six of nine answered some variation of yes while three said no. Those who said no, said they paid attention for other reasons such as respect. When asked what they thought of making a few questions themselves, they all agreed that it was a good and fun idea which helped them think about what was important in their topic.

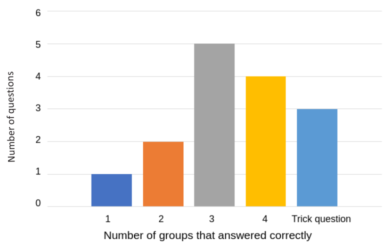


Figure 2: Graf shows how many groups answered the questions correctly. Total number of groups was four. Trick questions were added for entertainment.

4. Looking forward

I think the fact that the students had to make questions themselves worked well. Next time I might ask them to make three questions instead of two and then pick the two best ones. Maybe 12 questions were too few so I will try to make more next time. Lastly, there is the risk that since the students answer in groups, it is hard to know if everyone is part of the discussion or someone is just being quiet. Since I only had 9 students at this TØ, I had a pretty good overview of who got to talk, and it wasn't a problem this time. However, if the class is bigger, it might be worth considering splitting the students into groups of only two to encourage discussion even more.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Camilla Borre
Stellar Astrophysics Centre
Physics and Astronomy

Workflow for structured problem solving

- How to tackle difficult exam-like questions individually

Learning Lab

Abstract: Encountering long and difficult theoretical assignments generates an opportunity for students to learn how to tackle such obstacles before facing them at the exam. However, most students choose to solve such assignments in groups, which in it self is not an issue, but is non-representative of an exam situation. I here present a tool along with an activity for structured problem solving that should help the students to optimize their individual approach to exam-like questions. The teaching activity was well received by the students and based on their evaluations, reduced number of questions along with own observations it seamed to tackle a valid issue which was reduced.

COURSE FACTS

- Course name: Fysisk Biokemi
- Level: 1'st year Bsc. students
- ECTS credits : 5
- Language: Danish
- Number of students: 26 x 2
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

The students are introduced to chemical properties of physiological relevant elements, the correlation between structure and function of proteins, biochemical properties, enzyme kinetics and how to perform basic biochemical calculations. During the 7 week course the students encounters exam-like questions on a weekly basis during theoretical exercises. Based on observations conducted by myself and other TA's, it appears that students have difficulties individually applying knowledge obtained from lectures, reading material and previous TØ's for problem solving. The "problem" that I whish to tackle is the general tendency of students to solve the assignments in groups, which is non-representative of an exam situation, along with unorganized workflow when encountering difficult tasks or questions.

2. Planning a teaching activity

The goal of the activity is to get the students familiar with individual structured problem solving of difficult exam-like questions without relying on others. I have developed a workflow that should allow the students to identify the topic, generate perspective and extract information from the course necessary to complete the assignment.

The students are to study the workflow and implement it when preparing individually for a theoretical exercise session, before discussing their answers in groups and presenting for the class.

The activity is designed to give the students the tools and opportunity to practice their individual workflow for completing exam-like questions.

3. Trying it out in practice

The TA gives the students a short introduction and reasoning for the activity while handing out the Workflow (figure 1). The students are to prepare individually for the subsequent TØ session, answering exam-like questions while implementing the workflow for structured problem solving. At the next session the students are placed in groups of approx. 3 and each group appointed one of the prepared assignments. The groups are to discuss their answers along with their workflow before presenting at the blackboard.

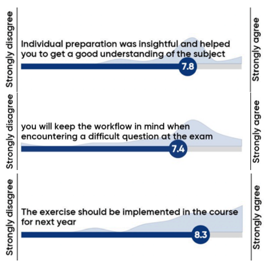
Workflow – How to tackle difficult exam-like questions

I. Read through the assignment. Be thorough in order to achieve the necessary overview. If the assignment is split into several questions, then read the entire assignment.
II. Pinpoint the subject(s) from the course/lectures that the assignment relates to.
III. Identify the relevant chapter and/or lecture slides.
IV. Search for information in the chapter, in slide shows or in previous TØ assignments, that could help to solve the question(s).
V. Note down/highlight relevant information given in the assignment description.
VI. Draft an answer for all of the (sub)-questions given in the assignment.
VII. Revise and add/correct your answer.

Figure 1: Workflow. The workflow presented for the students to help guide them through the exam-like assignments.

Compared to previous TØ's the exercise drastically reduced (~40%) the number of questions from students to TA during group preparation/discussions before presenting their assignment to the class.

Figure 2: Assessment. A subset of mentimeter evaluations with students grading statements about the exercise on a scale from 1 to 10.



MAIN POINTS

1. **Main problem/challenge:** Difficulties with individually structuring problem solving of exam-like assignments.
2. **Teaching activity**: Individual TØ preparation with tools for structured problem solving
3. **How did it go?** The students found the activity useful and a good exercise for exam preparation.
4. **What to do next?** Revise the timing and assignment for which the students are supposed to implement the workflow.

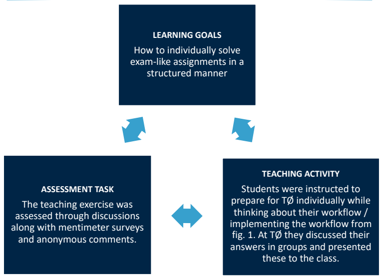


Figure 3: Constructive alignment.
The figure illustrates how the teaching activity is related to the learning goals and desired outcome of the theoretical exercises. It also includes a short description of how the activity was evaluated

Synes det var rigtig fint at prøve selv, fordi man godt kan komme til at hænge på andre, hvis man altid laver det sammen. Så ved man ikke hvor meget man egentlig selv forstår. Dette løser denne øvelse og jeg har selv lavet tø alene siden.

Det fungerer godt på den måde, at man får en ide om, hvad man selv kan og hvordan man selv kan løse det opståede problem. Samtidig rart med gruppearbejde så man kan sparre med hinanden.

God måde at teste sin evne til at løse opgaverne uden hjælp fra andre.

Figure 4:
Student comments: General positive feedback and some with constructive comments containing good ideas for improvement.

4. Looking forward

Own observations along with positive student feedback indicates that the activity addresses a valid issue. In the future student comments should be taken into consideration. These were mainly about the type of assignment for which the workflow should be implemented along with the timing of the teaching activity, which unfortunately coincided with a busy week due to student laboratory exercises. Also, the Workflow should be handed out electronically, since some students found the paper version to be unhandy and only used it for a subset of the assignments.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Mads E. Christensen
Poul Nissen's group
Department of Molecular Biology and Genetics

The relevant hypothesis

- Using real experiments to define and formulate

Learning Lab

Abstract: It is a challenge to learn students how to define and formulate research question and hypothesis. In order to learn this you have to combine different knowledge in different ways. Therefore, it can be a huge challenge for the students when they have to come up with hypothesis in relation to their own experiments. The aim of this teaching activity was to let the students try to define and formulate hypothesis using real experiments. The teaching activity is a group discussion, with students giving their answers on a blackboard. The activity has yet to be implemented.

COURSE FACTS

- Course name: Feedstuff Evaluation
- Level: MSc
- ECTS credits : 10
- Language: English
- Number of students: 10
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

Time limitations makes it impossible to go into depth in lots of different literature before you have to conduct an experiment. Therefore, it can be really hard to formulate relevant research question and hypothesis which makes sense. This have been found to be a generally problem. As it is a part of the learning goal of the course to be able to do this, I wanted the students to try it before they have to write their report and their exam.

2. Planning a teaching activity

To ensure that the students were properly prepared and inspired before coming to class, a document describing two experiments was uploaded to BB. Besides, reading the document should the students come up with two hypothesis regarding the experiments and send their replay on BB.

During the session will feedback from the handed in hypothesis be giving in plenum. Followed by an in-depth lecture about the two experiments. After which the students will work in small groups, coming up with new hypothesis and fetch up to a blackboard an write them. During this will the TA work around and help the students. The following up will be a plenum discussion, where students will elaborate their answers.

Hopefully, the activity will show how and hypothesis is defined and how it can be done, when you have to define them. And not least that hypotheses can be changed as more knowledge comes.

3. Trying it out in practice

Unfortunately, I have not been able to try it out in practice, so instead a detailed description follows;

1. Before class;
   a. Students read description of two real experiments (Fig. 1) with one example of hypothesis to each of them
   b. Write two hypothesis
2. At the session;
   a. Follow-up on the students hypothesis.
   b. Lecture about experiments and hypothesis
   c. Small group discussion about new hypothesis. Which they will write on blackboard.
   d. Follow-up on the new hypothesis. Asking if anyone wants to elaborate their answers.
   e. The real hypothesis regarding the experiments
   f. 5 Menti question as evaluation tool

The hole teaching activity, with reading of material, lecture about the experiments, following up and discussion will approx. take 2 hours.

Learning goal: Be better to formulate and define research question and put forward a hypothesis.

Evaluation of the activity is performed by the students going into Menti at answering few question, like whether *they liked the activity*, whether *they think it will be beneficial for them when they have to perform their own experiment* and *do they think it will be relevant for the students taking the course next year.*

The teaching assistant evaluates and notes during the activity, the quality of the discussion and the amount of active participation and which groups ends up writing on the blackboard. By this can the TA assess the students learning outcome.

MAIN POINTS

1. **Main problem/challenge:** Combine different biological mechanism in order to come up with hypothesis
2. **Teaching activity**: BB, small group discussion with blackboard
3. **How did it go?** It have not been implemented in practice yet
4. **What to do next?** Implement it.

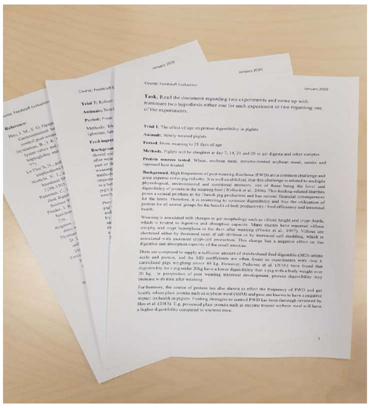


Figure 1. **Reading material**

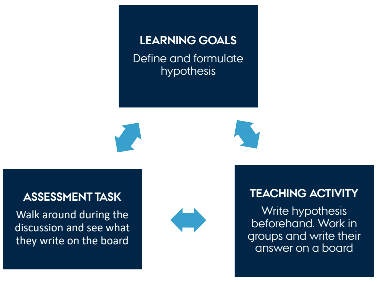


Figure 2: **Constructive alignment**

4. Looking forward

By using real experiments does the exercise become more interesting and real. Hopefully the students will find the activity interesting as they have to combine their knowledge from other courses and lectures. This teaching activity has yet to be implemented, but is expected to improve their ability to combine knowledge from different areas and prepared them for their own experiments.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Maiken Engelsmann
Animal nutrition and physiology
Department of Animal Science

Maximum Likelihood Expectation

- Mathematical implementation in Matlab

Learning Lab

Abstract: In machine learning and optimization, some efficient methods, such as clustering, had been taught to students. Then, students need to apply these theoretical methods in Matlab- which is a programming application- to visualize methods. Since TA class is immediately after the course, students sometimes find it challenging to implement problems in Matlab. Therefore, I first need to figure out theoretical parts which are still unclear for them. Afterwards, I assist them how to apply the method in Matlab. The implementation results will be included as main part of their assessment as well.

COURSE FACTS

- Course name: Optimization and data analytics
- Level: Master and PhD.
- ECTS credits : 10
- Language: English
- Number of students: 15
- Your role: Teacher Assistant

TEACHING IN PRACTICE

1. Identifying a problem

In the TA class, students are assisted to implement mathematical optimization and machine learning methods in Matlab. Understanding statistical methods such as clustering can be challenging itself. Moreover, the TA class is immediately after the main course. Therefore, it is important for me to figure out which parts of the main course are still unclear for students. Moreover, it is important that students apply methods correctly in the programming application.

2. Planning a teaching activity

My teaching activity was designed by two consecutive methods; Flash review and Structured problem solving.

The flash review method was considered to help me understand which parts of optimization method were still ambiguous for students.

On the other hand, the structured problem solving was utilized as the main method for exploring probable difficulties which students were facing to implement the optimization method in Matlab.

3. Trying it out in practice

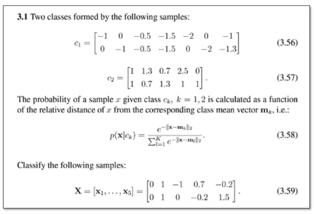
The teaching activity was planned in the following way:

1. Three basic questions were given to students relating to what teacher had taught them in advance to discuss about.
2. Students were divided into groups of 3 members to discuss about the questions.
3. The main problem was identified to students.
4. Students were divided into groups of 2-3 members to implement the main problem in Matlab.
5. I was walking among groups and gave them hints about how was their progress or what they should have done to gain better results.
6. The group with the best performance presented their method to other group.

The group with higher performance clarified how their method worked for other students. In this way, other groups became more familiar with both basic functions in Matlab and other's approaches.

Learning Assessment:

Group discussions and final results were used to assess the learning outcome. Also, homework was given to students related to the problem proposed in the class. Homework will consists the main part of their final assessment.



3.1 Two classes formed by the following samples:

$$c_1 = \begin{bmatrix} -1 & 0 & -0.5 & -1.5 & -2 & 0 & -1 \\ 0 & -1 & -0.5 & -1.5 & 0 & -2 & -1.3 \end{bmatrix} \quad (3.56)$$

$$c_2 = \begin{bmatrix} 1 & 1.3 & 0.7 & 2.5 & 0 \\ 1 & 0.7 & 1.3 & 1 & 1 \end{bmatrix}. \quad (3.57)$$

The probability of a sample x given class c_k, $k = 1, 2$ is calculated as a function of the relative distance of x from the corresponding class mean vector $\mathbf{m}_k$, i.e.:

$$p(\mathbf{x}|c_k) = \frac{e^{-\|\mathbf{x}-\mathbf{m}_k\|_2}}{\sum_{l=1}^{K} e^{-\|\mathbf{x}-\mathbf{m}_l\|_2}}. \quad (3.58)$$

Classify the following samples:

$$\mathbf{X} = [\mathbf{x}_1, \ldots, \mathbf{x}_5] = \begin{bmatrix} 0 & 1 & -1 & 0.7 & -0.2 \\ 0 & 1 & 0 & -0.2 & 1.5 \end{bmatrix}. \quad (3.59)$$

Figure 1: **The proposed question for the flash review**

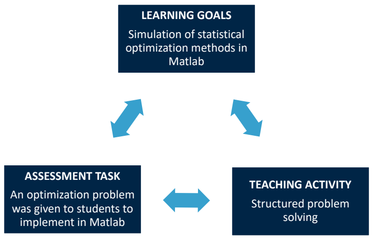


Figure 2: **Constructive alignment**

MAIN POINTS

1. **Main problem/challenge:** Stablish what they have been already taught in the main course and implement it in programming environment
2. **Teaching activity**: Flash review and Structured problem solving
3. **How did it go?** The activity was fruitful for most students but some students found it too complex, since they had different backgrounds and faced fundamental problems in Matlab.
4. **What to do next?** It seems healthier that group students with different background in different groups. Also, I think utilizing Jigsaw method for sharing information within and between groups would be helpful. It is more productive if students work on the previous week topics rather than topics has been just taught to them.

4. Looking forward

All students were happy about flash review, since they found it time-consuming to ask their questions during the main course. In the second part of activity, most students found it productive due to implementation of the optimization method in groups rather than in person. However, some students still needed more basic information about how Matlab works. Therefore, I think it is important how students are divided into groups. If students with different background are distributed in one group, they might learn better. Moreover, it is important that weaker students feel comfortable to ask their questions and know that implementation takes time.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Sadaf Farkhani
Signal Processing Group
Department of Electrical and Computer Engінerring

Principles of integration

- Bridging the gap between mathematical methods and solving physical problems

Learning Lab

Abstract:

Often students will struggle converting a written problem into the mathematical formulation needed to solve it. In electromagnetism this issue is especially significant. Therefore, this teaching activity will attempt to bridge the gap by doing a variation on "What's the principle", designed to help students practice this specific task, followed by having the students create a flowchart based on their method in what's the principle. This will force students to reflect on their learning and give them a valuable tool moving forward.

COURSE FACTS

- Course name: Electromagnetism, wave and optics
- Level: First year
- ECTS credits : 10
- Language: Danish
- Number of students: 18
- Your role: TA in problem solving

TEACHING IN PRACTICE

1. Identifying a problem

In physics one major struggle for the student is the conversion of a problem viewed as text and images to the mathematical formulation. This has been apparent in observation and during my own education – once the problem is formulated properly the execution is much less difficult.

The issue of formulating the problem mathematically is especially hard for the students in "electromagnetism, waves and optics". Here the setup of integrals is of special importance, since electromagnetism is one of the more integral heavy directions in physics.

The students struggle with setting the correct limits, direction of integration and choosing the right integrand.

When mathematics becomes an obstacle the learning of the actual physics is greatly impaired

2. Planning a teaching activity

This learning activity will attempt to bridge the gap between the physics and the mathematics by a vigorous exercise in integral setup.

As with most things practice makes perfect, and here the students will be able to practice on the specific activity of integral setup.

The activity will be done in two parts, first the students will be doing a variation on "what's the principle"[1], where they can practice the integral setup on old exam problems.

However, no further calculation will be done outside the setup. The correct integral will be the result.

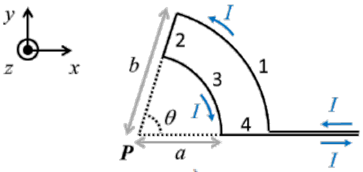
In the second part the students will work on creating a flow-chart for themselves, based on their experience from part 1. Doing this will force the students to reflect on what they did and learned in part 1, and will give them a valuable tool for later stages of the course.

3. Trying it out in practice

The teaching activity has not yet been implemented, but the current plan goes as follow:

15 minutes for writing up integrals for 5 different exam problems, modified to make the problem only about the integral. One example of a problem and its solution is given in figure 1. Following this there will be 8 minutes for students to write up a flowchart which they can use for future problems.

a) Find the magnetic field at P



$$\vec{B} = \frac{\mu_0}{4\pi}\int \frac{I\,d\vec{l} \times \hat{r}}{r^2} \quad (28.7)$$

$$\overrightarrow{B_1} = \hat{k}\cdot\frac{\mu_0 I}{4\pi}\cdot\frac{1}{b^2}\int_0^{\theta} bdl$$

Figure 1 | An example of problem-formula-answer for what's the principle, the question being "find the magnetic field in B". The students have to understand the problem, find the correct equation (28.7), and apply it setting up the limits and integrand.

MAIN POINTS

1. **Main problem/challenge:** Setup of integrals in electromagnetism.
2. **Teaching activity**: What's the principle + flowchart cook-up.
3. **How did it go?** To be implemented spring 2020
4. **What to do next?** Start teaching & implement it!

A full exam problem where integrals are a key feature will then be used for assessment.

The exercise will be followed by a break before resuming normal teaching, and in the break a mentimeter survey will be carried out for feedback. The questions will be rating on a scale from 0 to 100 and will be based on agreement with the following statements: "I have learned more from this exercise than I would have if we just spent time as usual", "I enjoyed the exercise", "We should do more of these exercises."

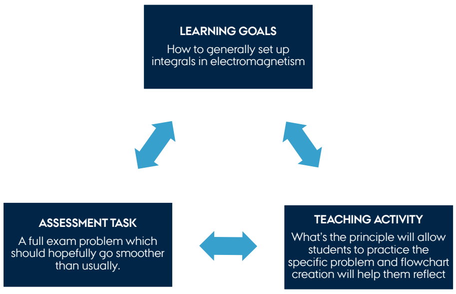


Figure 2 | Constructive alignment, learning goals, assessment task and teaching activity has to be aligned.

4. Looking forward

The teaching activity should be implemented and evaluated during the spring semester. For the timing in the semester, it should be after the students have seen some of the typical problem types, but aside from that, the earlier the better if it works out well, since it will save the students a great deal of time during the course to be adept at integration. Thus I expect it should be implemented 4-5 weeks into the course. After this the implementation and evaluation will determine the next steps.

References

1 | As outlined in: "*Classroom Assessment Techniques: A Handbook for College Teachers*", 2nd Ed. By Thomas A. Angelo and K. Patricia Cross.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Jens Jakob Gammelgaard
Nanocatalysis group
Interdisciplinary Nanoscience Center (iNANO)

Strip sequencing for combined experiments

- Understanding the science behind each experimental steps and their outcomes

Learning Lab

Abstract:

Working on experimental projects in the laboratory is easy when you just follow the protocols. However, sticking at the written protocols without deeply understanding of each step could not help with realizing the concept of experiments. Therefore, it is necessary for the student to go through each procedure and find out the aim of each specific step. To accomplish this goal, the strip sequence teaching activity is likely to be a good activity to encourage the students to think about the purpose of their actions by making them to order individual strips of two experiments and their outcomes they are performing on that day. To do this properly, they should find out what happens during each step of the protocol and what is the result of that part. Assessment of this activity has been done by TA via looking at strips of the groups and asking some specific questions from students. Generally, most of the students (90%) felt that they understood their protocol and their outcomes using the sequence strip activity. Therefore, this teaching activity could be performed for other protocols and be used in the next semester for all students taking this course.

COURSE FACTS

- Course name: Molecular Biology II
- Level: Bachelor's Degree
- ECTS credits : 10
- Language: Danish/English
- Number of students: 95
- Your role: Instructor/TA

TEACHING IN PRACTICE

1. Identifying a problem

Although there is a lot of information about protocols and some science behind it in the manual students do not follow it due to the limitation of time. To complete the report at the end of the course to pass this course, they have to understand the reasons for doing each protocol to be able to solve the questions of the report. However, it is not possible just by following the protocols without deeply thinking about it.

2. Planning a teaching activity

To address the mentioned issue, a teaching activity consisting of a strip sequence has been designed. This activity involves the students to arrange strips in the correct order for two different experiments and the outcomes that they are performing on that day. The activity aims to describe the experiments with their results which they are supposed to perform on the day.
The goal of this exercise is to teach the experiments in detail and tell them what happens during each individual step. These skills will help the students to analyze experimental methods and compare the outcomes with their actual results to check out if they did correctly?!

3. Trying it out in practice

The strip sequence activity is designed according to the protocols written in the manual. The developed strips consist of the specific protocols and their outcome where the students have to perform them at the day. The strip sequence is designed with different colors that show different main procedures (yellow) which the student should do them with other bluish strips for the outcome column which is corresponding to that main experiment of the day.
The student is asked to arrange the experiment and their related results in the correct order (figure 1). At the beginning of the laboratory lesson, the students are divided into small groups (2 or 3 members) and given the strip sequences to solve, along with a clarification of the activity.
The students are given 30 minutes to order the strip sequence. Then, TA will go around the lab and ask each group to be sure that the strip sequences have been solved correctly and the student found out the concept of each individual step.
The students are then instructed to complete their experiments as usual,
but keep the strip sequence to follow of their experiments and understand why they are doing.

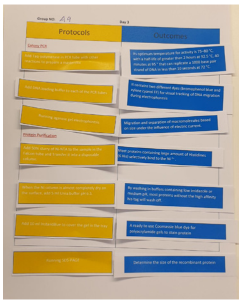


Figure 1. The strip sequence the students had to arrange it in the correct order.

MAIN POINTS

1. **Main problem/challenge:** The students just follow the protocols without well-understanding of protocols
2. **Teaching activity**: Strip sequence
1. **How did it go?** It was very good according to student's feedbacks
2. **What to do next?** Adding the details of more protocols and steps in order to cover all protocols of course

Evaluation of the activity has been done by comparing and asking some questions about the experiments from the students who did this activity (Lab 1) and who did not (Lab 2). Results showed that students from Lab 1 fully realized all steps with their outcomes but just 50 % of students from Lab 2 could answer questions about the concept of that laboratory exercises. Evaluation results from the students in Lab 1 revealed that 90 % of them were satisfied with this activity and took advantaged of doing experiments.

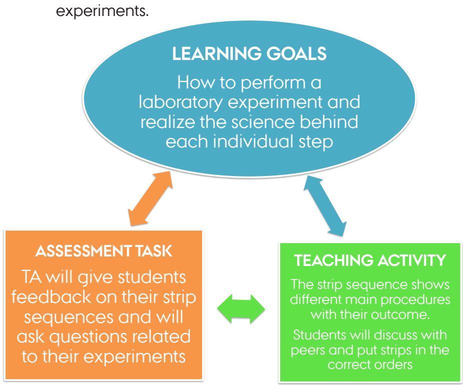


Figure 2 : Constructive alignment

4. Looking forward

Although this activity has been performed just for one laboratory (out of 3) and one day, the final results proved its helpfulness as most of the groups were able to solve it correctly without any help. Presenting the teaching activity at the first of the day helped the student to keep each step and the plan of the experiment of day in the memory, however, actions could be taken to help the students use the strip sequence actively combined with other teaching activity while carrying out the experiments. As the activity showed highly useful, it would be nice to add all protocols of the course and implement them for each day of course.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Sadegh Ghorbani
Nanobiointerface group
Interdisciplinary Nanoscience Center (iNANO)

Writing a Scientific Paper
- Piece by piece

Abstract:
A *strip-sequence* activity combined with matrix-group peer discussion is described and implemented on third-year Chemistry and iNano students. The activity aims to improve the students' understanding of the structure and language implemented in a "typical" scientific paper. The activity is designed to promote group discussion and critical thinking, by use of purposefully ambiguous answers. The activity was tested on 12 students in groups of three and repeated once with the same students in new groups. 33% of the students reach the intended solution in the first round and 58% in the second round. 50% of the students did not change their answers between the two rounds.

Course facts
Course name
Materials Chemistry II: Experimental Materials Chemistry
Level
Third year students (fifth semester) 10 ECTS
Language
English (Danish)
Number of students
15 students from Chemistry and iNano
My role
Laboratory instructor and general TA

Main problem/challenge: Getting Students accustomed to reading/writing scientific papers
Teaching activity: Strip-sequence activity combined with matrix-group peer discussion
How did it go? Students liked the activity and became more aware of language subtleties
What to do next? Implement the activity earlier

1. Identifying a problem
Students often struggle with identifying what information belongs in which sections of a "typical" scientific article. In *gymnasium* and first-year courses, they are taught to write reports, often using 1st person perspective, bullet-points, and with little to no attention to the figures. Even in their third year at university some of them still have some bad habits from prior educations. Apart from the bad habits, the students are not yet accustomed to reading and analyzing scientific papers, as the vast majority of their curriculum is based on textbooks, rather than examples from the literature.
All in all, it results in a poor understand of the structure and language of a "typical" scientific paper, e.g. what information belongs in an abstract, how should one write a detailed but compact experimental section, and what constitutes a good figure. Some of those issues are addressed in the following activity.

2. Planning a teaching activity
To keep the activity simple and less time consuming, the activity is focused on the overall structure of a scientific paper, namely the common sections: *Title, Authors, Abstract, Introduction, Experimental, Results and discussion, Conclusion, and Acknowledgements.* The activity is intended to give the students a better understanding of the subtle differences in language in the different sections.
This is accomplished by a *strip-sequence* activity combined with matrix-group peer discussion; The students are given a sheet of paper with the eight section titles, numbered from 1-8, and twelve strips, numbered from a-l, containing sentences from a fictional paper (Fig 1). The students will in groups of 3-4 people attempt to pair the sentences with the appropriate section title, followed by a shuffling of the groups and a second attempt. The activity ends with a class summary and an evaluation survey.
Several of the sentences are purposefully made ambiguous to promote group discussion and critical thinking; the students have to argue their case in order to solve the task. Likewise, some of the sentences are easy to give a sense of progress. A bit of humor is also added as a small ice-breaker.

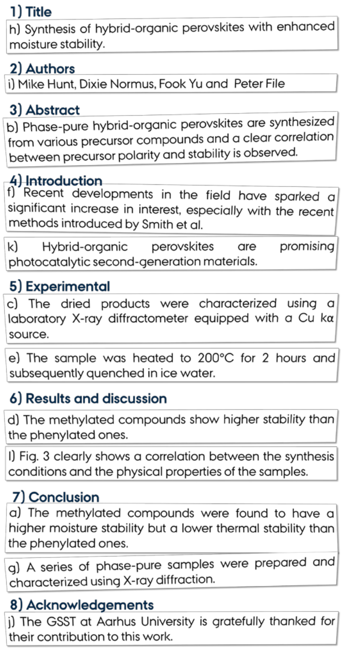


Fig.1 Illustration of the strip-sequence material.

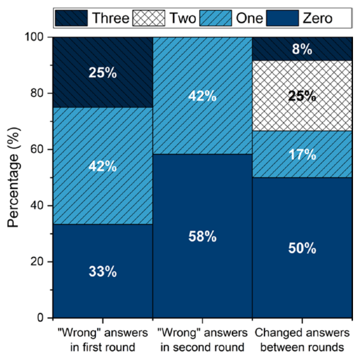


Fig.2 Results from the strip-sequence activity. With 12 different strips. 12 students participated.

3. Trying it out in practice
Twelve students, six male and six female, participated in groups of three. Each group had a sheet with the section titles and 12 strips with sentences (Fig.1). Furthermore, each student was handed a table for tracking of their answers, with an evaluation survey on the back. Once the groups had reached consensus, each student noted their answer and the groups were shuffled. This was repeated in the new groups, and the answers were collectively discussed in class. The full activity took approximately 25 min. During the activity, the students actively discussed the task at hand and, as intended, used both context and language variations to rationalize which sentences belonged to which section title. To quantify the students' solutions, their answers were compared to the "intended" solution, though it should be noted that such a solution is biased by the designer's opinion.
Fig. 2 shows how far the students were from the "intended" solution, and how they progressed during the two rounds. The students got very close to the "intended" result and 50% kept the same answers between the rounds. The close agreement with the "intended" solution is likely because the students were given time to reach consensus.
The evaluation survey results are shown in Fig. 3. All students found the activity relevant and that it made them more aware of subtleties in the language. The students agreed that they would have preferred the activity earlier in the course.

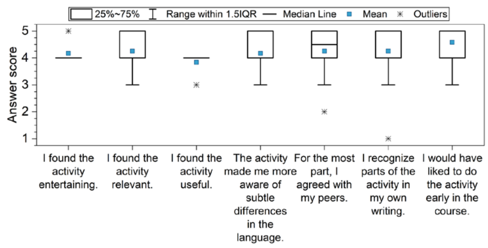


Fig.3 Evaluation results (12 students), where 1 = disagree, 3 = meh, and 5 = agree.

4. Looking forward
The activity was all in all a success. Well-prepared activity-material (strips, survey, etc.) definitely paid off, as the activity was easy to explain and the students quickly caught on. The students had plenty of time to discuss in the groups, which gave them ample opportunity to weigh their answers. One could imagine that a stricter limit on time would give a significantly different workflow, as this would force the students to rely more on intuition rather than rationalization. It might be interesting to implement a short first round followed by a longer second round; an intuition round and a rationalization round. This would make the students change more of their answers, promoting a deeper reflection and a thorough comparison of the language.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Frederik H. Gjørup
Magnetic Matter Aarhus
Department of Inorganic Chemistry

Learning Lab

Tools for technical terms

- Remembering essential background knowledge

Learning Lab

Abstract: At bachelor's level, many courses introduce several new technical terms essential for understanding more complex learning outcomes continuously introduced in the students' proceeding education. The learning goal was to inspire students to put an effort into learning and remembering these new terms via filling them in on handout-templates designed for this purpose. Afterwards the terms and their functions were discussed on class, where students actively engaged in the discussions. A mentimeter evaluation at the end of the class showed that only one out of fifteen students preferred this teaching activity when choosing between five, which indicates that the evaluation must be improved in order to obtain useful knowledge on how to improve the teaching activity further, aiming for constructive alignment.

COURSE FACTS

- Course: Student-internship on Bachelor in Agrobiology
- Level: Bachelor
- ECTS credits: (not defined)
- Language: Danish
- Number of students: 19
- Your role: Teaching assistant

MAIN POINTS

1. **Main problem/challenge:** Students need to learn and remember essential terms
2. **Teaching activity**: Fill in the missing terms on handouts of a given structure or system
3. **How did it go?** The students were very active, both during the exercise and the sum up
4. **What to do next?** Improve the evaluation of the activity

TEACHING IN PRACTICE

1. Identifying a problem

At bachelor's level, many courses introduce several new terms in each lecture that are not just needed for passing the exam, but essential for understanding more complex learning outcomes continuously introduced in the students' proceeding educational paths. This leaves the students with the responsibility to learn these terms by heart, but many seem to struggle with finding applicable learning strategies as well as remembering the terms after the respective final exams. The aim of the teaching activity is to meet and remedy this problem.

2. Planning a teaching activity

In order to assist and inspire the students to improve their abilities to learn and remember essential basic technical terms and structures, a teaching activity was developed. The intention was that students should fill in the missing words on a figure of a given structure, to familiarize themselves with the respective term and reflect upon the function of each element it correlates to. By doing this and correcting the work on class, the students obtain documents to bring home and save for further rehearsal and examination. Ideally every student could continuously collect documents from each technical structure encountered in the curriculum and use this collection as an encyclopaedia.

3. Trying it out in practice

The teaching activity focusing on the muscle structure related to meat science was introduced after 15 minutes of lecturing on this topic. The last slide before the activity introduced the muscle structure using a different figure than the one that was handed out. During the exercise the slide was hidden, and in pairs the students filled in as many terms on the handout (see Figure 1) as they could remember and guess by the function of the element or by simple elimination. They had 8 minutes to fill in the terms.

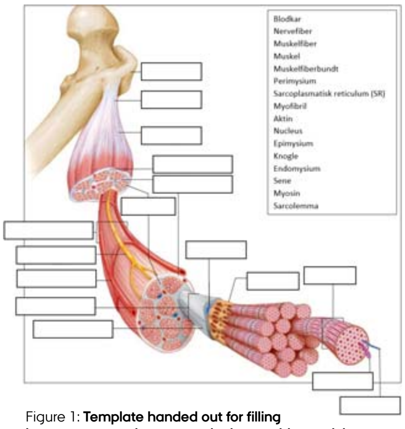


Figure 1: **Template handed out for filling in terms on muscle structure in the teaching activity**

After finishing the exercise the students were asked to volunteer to share their answers on class, and whenever it was relevant, additional questions about the functions of the respective elements were posed, creating new and interesting discussions. The performance level and interest among the students seemed high. They discussed well while preparing and during sum up on class more than half of the students provided at least one answer on class.

The day ended with a mentimeter asking which activity the students learned most from or preferred (see results in Figure 2). One out of fifteen students preferred this teaching activity, whereas nine students preferred the lectures, two preferred the homework, two preferred a video on muscle contraction and one preferred free-hand drawing a myofibril.

Figure 2: **Mentimeter questionnaire on teaching activity preferences answered by fifteen students.**

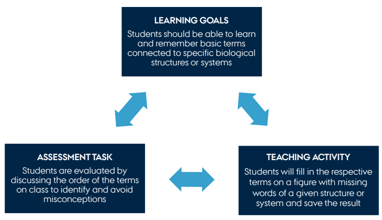


Figure 3: **Constructive alignment in this teaching activity**

4. Looking forward

The students showed high level of interest and engaged actively in the activity. However, as shown in Figure 2 the activity was not preferred by the students. Next time the activity is used, the evaluation should ask the students to rank the activities instead of just picking the one they prefer most. Improving the evaluation would help strengthening the constructive alignment (see Figure 3). To improve the activity in itself, one could consider turning the sum up on class into a game, where teams should fill in the technical terms and explain functions on a template on the blackboard.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Fie Følbæk Gravgaard
Differentiated & Biofunctional Foods
Department of Food Science

Introduction to plant breeding

- 1 hour lecture with ongoing Q&A

Learning Lab

Abstract: This 1 hour lecture was given with me as a guest lecturer at a summer course. The lecture was meant to give a short introduction to traditional plant breeding, whereas the rest of the course focused on the modern plant breeding techniques. The subject is heavy for a one hour lecture and to achieve deep learning it is necessary to follow the students understanding throughout the lecture. This was done with ongoing Q&A with reflective question asked after each subject and discussed in plenum. In the end the learning outcome and teaching was evaluated. The students evaluated that they understood the subjects and would be able to answer questions about them. They students also seemed to like the teaching activity.

COURSE FACTS

- Course name: Hands-on Advanced Methods and Techniques in Plant Science and Biotechnology
- Level: Master
- ECTS credits : 5
- Language: English
- Number of students: 9
- Your role: Guest lecturer (1x1h)

TEACHING IN PRACTICE

1. Identifying a problem

I know from previous years that the one lecture of one hour that I had to give, was a very compact lecture and students had problems with deep learning. The aim of my teaching activity is to achieve deep learning for the students in regards to the concept of plant breeding and the many different methods it contains

2. Planning a teaching activity

Throughout the lecture there will be quiz questions after each plant breeding method. The students will answer in plenum. These questions are meant as a reflecting break after each method. It will also help me understand whether the students understood the concept of the method and how it is different from the others.

Besides the questions, there will be some small calculation exercises that are answered through "menti". These will both test the students prior knowledge on genetics and breeding, but also help understanding the concepts behind the methods.

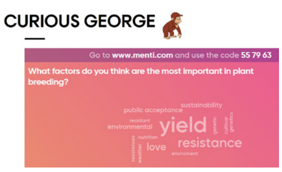


Figure 1: The word cloud created be the students in the beginning of the lecture.

3. Trying it out in practice

In the entire lecture there was 15 questions with around 1 min for each. First the students prior knowledge was tested and Curious George was introduced. He would appear every time there would be a question, see figure 1.

To understand the genetic segregation schemes and the crossing methods in the different breeding techniques, the students genetic understanding was tested, with answering through "menti". "Menti" was chosen in order to make everybody feel comfortable to answer, figure 2.

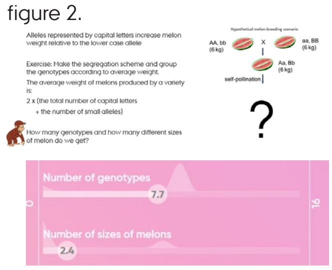


Figure 2. One of the calculation exercise and the students answers. The answers were afterwards calculated together.

Instead of explaining some of the genetic terms with the student, I let them reflect and match the terms with the definition. This was done in plenum and in order to create a break in the lecture

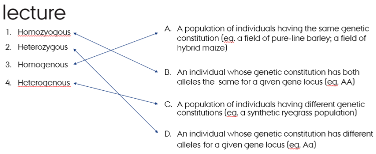


Figure 3. Exercise where the students had to match the term with the definition in plenum.

MAIN POINTS

1. **Main problem/challenge:** Concept understanding
2. **Teaching activity**: Calculating exercise, quiz, menti
3. **How did it go?** It went well, but it was a very compact and busy lecture
4. **What to do next?** Make the lecture more light and create room for discussion of the concepts among the students.

After covering the basics, the different plant breeding methods were explained. After each method and reflective question was given on the slide from George, see figure 4.

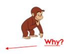


Figure 4: Curious George was used on the slides to mark the question.

In the end of the lecture the students learning and my lecture was evaluated with questions in "menti" and the very last slide was another word cloud of the students take-home keywords. Questions and results can be seen in figure 5.
The lecture is not described in the course learning outcome.

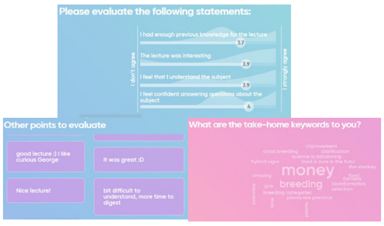


Figure 5. Evaluation of the students learning outcome and the lecture.

4. Looking forward

Even though I had cut down a lot on the lecture from last year, it was obvious that the lecture was still too compact and we had to rush through things. I would have liked if the students would have had time to discuss the pro and cons of each methods amongst each other. I think it would help if the students could be given some literature in advance, that gives a brief sum-up, so the lecture can focus and explaining the concepts and why the different methods are used where there are.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Pernille Bjarup Hansen
Crop Genetics and Biotechnology
Molecular Biology and Genetics

Learning Through Doing

- Teaching interaction design language through a association-based game

Learning Lab

Abstract:

This teaching activity attempts to support student learning in gaining an interaction design language to describe and discuss interaction design prototypes. Through a association-based game, the students are introduced to five themes of embodied interaction. Assessment shows that students improved their ability to include the learnings from the literature in their design work, but did not improve their ability to discuss and describe their prototypes in written language.

COURSE FACTS

- Course name: Foundations in IT-Product Design
- Level: Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 41
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

When new students start in the studies It Product Development at Computer Science, the majority to not have any experience with interaction design. In the course IT Product Design, the foundational learning goal is to teach the students an interaction design language. Acquiring such a language, enables the students to academically describe interaction designs. This goal has continuously been of focus in the last years. it is still a challenge to teach, and for the students to actively use the language in description of their prototypes.

The teaching activity described in this poster, look at a subset of the language, that the students are expected to be familiar with at the course conclusion. This is the paper by "How bodies matter: five themes for interaction design" (Klemmer at al., 2006) that introduces themes of embodied interaction design, that is relevant for the students to learn, in order for them to describe and discuss the interfaces they are building throughout the course.

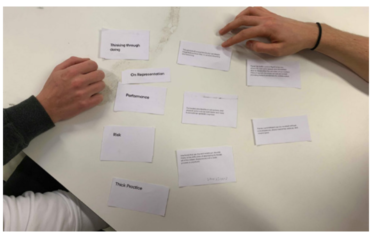


Figure 1: Students discuss themes and associated desc.

2. Planning the teaching activity & trying it out in practice

The students are expected to be familiar with the paper in preparation to the class. In class, the students will thoroughly go through the themes with support from a association-based game. The game is divided into three parts; an initial part that introduces the five themes and their description on individual slacks of papers. The students are to associate the descriptions to the correct theme (figure 1). These combined themes are headlines for the next part, where the 17 subthemes of the previous five themes are to be combined with descriptions. These parts are also all on individual slacks of paper. The final slacks of papers have visual descriptions of the subthemes, that they are to connect to the subthemes (see figure 3).

By having the students in groups discuss the specific themes and subthemes, they work thoroughly with the paper. In associating these themes to both descriptions, but also pictures that describe the interaction aspects of the themes, the students train their ability to use academic interaction language to describe product and interaction designs.

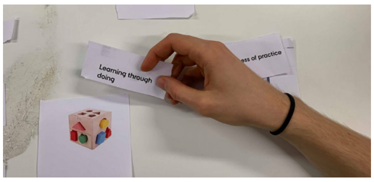


Figure 3: Students discuss themes and associated desc.

MAIN POINTS

1. **Main problem/challenge:** Teaching students an interaction design language
2. **Teaching activity**: associated based game to introduce various academic terms
3. **How did it go?** The students improved their ability to use the paper in their design work, but not in their ability to discuss their prototypes
4. **What to do next?** Reduce complexity of the second part of the activity and support it horizontally in the course.

The teaching activity was completed several days ahead of an assignment. Comparison of this assignment to previous years assignments, together with feedback from peer teaching assistants (TA) were used to assess the teaching activity. Peer Tas focused primarily on the activity itself. They believed that some of the more difficult parts of the paper made some students give up, but gave good discussion among other students. The assignments showed that the students were able to a higher degree to use the teachings of the paper (and the activity) in their design work, however, they were not able to describe and discuss this used academically in their assignment.

References

Klemmer, S. R., Hartmann, B., & Takayama, L. (2006, June). How bodies matter: five themes for interaction design.

4. Looking forward

Overall the activity worked well, and the students showed improved capabilities in their design work. There is still work to do, to support the students in gaining a language to discuss their prototypes. This might be through a more active focus and activities in discussing peer work in the following weeks. The groups would have benefitted from a written instruction they could have revisited after the oral instruction. All students actively participated in the group discussion. Three groups actively sought assistance from the TAs. When the activity is tried out again, more attention should be paid to the more silent groups, since the three active groups consisted of good students. Finally, the activity could have had the second part divided into two, to reduce complexity.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Kasper Heiselberg
Socio-Technical Research Group
Department of Engineering

Fundamental principle of LC-MS

- Employing the concept map diagram to improve the students learning

Learning Lab

Abstract: The aim of this course is to give the students hands-on experience about the principle of liquid chromatography-mass spectrometry (LC-MS) and its applications. Some theoretical lectures will be given and the level of the students understanding will be reflected by employing a concept map technique where the students will work in a group and they will discuss their reasoning for arranging the concept map in a specific order. Each group will present their result and TA will assess them. The students will also assess TA activity (filling out evaluation form) and TA will consider all the negative and positive feedbacks.

COURSE FACTS

- Course name: Hands-on Liquid Chromatography–Mass spectrometry (LC-MS) of the small molecules
- Level: PhD
- ECTS credits : 8
- Language: English
- Number of students: 9
- Your role: TA in the lab and some of the theoretical lectures

TEACHING IN PRACTICE

1. Identifying a problem

Based on previous years of experience, we know that many of the students might have a poor chemistry background which will normally reflect in their laboratory exercises as well as final report. Some pre-course materials will be provided prior to the lectures. However, to ensure that all the students were able to follow the course materials in a same degree as others concept map will be implemented to make complicated processes simple.

2. Planning a teaching activity

The concept of the liquid chromatography as well as mass spectrometry, is not easy to understand if the students do not have prior knowledge. Therefore, The TA will utilize the pictorial concept map to let the student go inside of the principle which will be easily conceivable in the long-term memory of the student. The TA will prepare the materials for making the concept map (fig.2) in advance such as pen, paper, and marker. The student should make step by step picture of the process in the group and ask themselves what is going to be happen in this process and make a decision before the next step in a group before completing the concept map

3. Trying it out in practice

The teaching activity was made of six steps:

1- The TA will give a theoretical lecture about the concept of LC-MS and then he will support the student learning by providing them the concept map materials.
2- The idea behind the concept map will be introduced to the students and the TA will demonstrate one example as a test (figure 1) in front of the students to guide them how the concept map works.
3- The student will be divided into a group of 3 and they will start making a concept map to display the concept of triple quadrupole mass spectrometer (figure 2) to each other and make a common agreement on the final result.
4- From each group one person will stay and another 2 will be moved out to other groups. Then, the students will discuss about their concept map again and will try to make their final assessment.

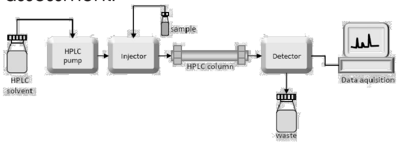


Figure 1: Process concept map for an HPLC procedure

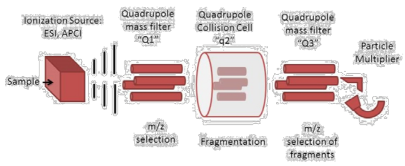


Figure 2: Schematic of a triple quadrupole (QQQ) mass spectrometer concept

MAIN POINTS

1. **Main problem/challenge:** For some students with no chemistry background was difficult to understand the principle behind LC-MS.
2. **Teaching activity**: The concept map with subtle hints helped the student to support their understanding of the concept of LC-MS.
3. **How did it go?** The concept map concept will be evaluated based on the students evaluation.
4. **What to do next?** I will try to modify the concept map for next year course.

5- The students will present their final concept map design in front of TA and TA will evaluate whether or not they demonstrated it correctly.
6- The student will fill in the evaluation form and assess the activity.

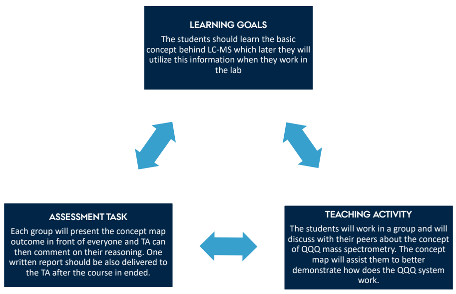


Figure 3: **Constructive alignment**

4. Looking forward

The aim of this activity is to help the students better understand the principle of LC-MS concepts. This is imperative when the students work in the laboratory in the second week of the course and the concept map could help them to remember the process step by step. TA will evaluate at the end of the course based on the students assessment, how helpful was the combination of the concept map and the theoretical lecture which based on that similar work can be implemented for the other concepts which will be discussed during this course.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Kourosh Hooshmand
Natural Product Chemistry and Environmental Chemistry
Department of Agroecology - Crop Health

Visualizing Variance
- Mathematics is more than numbers.

Learning Lab

Abstract:
University mathematics are often taught with a principal focus on definitions, theorems, and proofs. Although a sensible structure, there is a risk that the *meaning* is lost, when the focus is so heavily on theory. Many abstract concepts can be concretized by means of interactive visualization methods. We advocate for a visualization activity with assessment. The method was not tried due to time constraints.

COURSE FACTS

- Course name: Multivariate Statistical Analysis
- Level: Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 16
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

"Theory without practice is empty; practice without theory is blind." The famous statement, attributed to Kant, is important to keep in mind when teaching mathematics, where excessive focus on abstract concepts can blur the essence of what is being taught.

Many students benefit from *seeing* the underlying reality that mathematics attempts to describe.

2. Planning a teaching activity

Although applicable in many contexts, we focus here on the particular course "Multivariate Statistical Analysis", which deals with multivariate Gaussian distributions.

The understanding of covariance, conditional distributions, and dependence between the coordinates of a 2D Gaussian vector can be aided elegantly by visualization of the density function. Here, theory is concretized into matters of symmetry, intersections, and rotations. This allows for thinking about theory in visual terms.

3. Trying it out in practice

Unfortunately, the activity could not be tried out in practice, due to the very limited time for extracurricular activities. Instead, we present here how the activity and assessment would be carried out, time permitting.

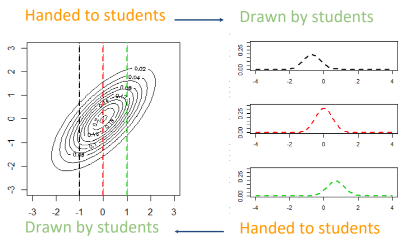


Figure 1: **Diagram of part 1 of the activity.**
Students (in groups) are either given images likes those on the left or right, and are instructed to draw the corresponding image on the other side. They are asked to discuss with each other if there is dependence or not.

Students will pair up in groups, 3-5 people in each. The groups will be handed some pictures of a bivariate Gaussian density with x coordinates for conditioning, and some stacks of slices from a bivariate density. After a brief introduction to the exercise and the relation between the pictures, they will be asked to draw the opposite image(s) to each of the images they have been given, see Figure 1.

In part 2 of the activity, the groups will discuss if the picture(s) correspond to dependent variables or otherwise. If they argue for dependence, they should visually find the rotations that provide independence.

MAIN POINTS

1. **Main problem/challenge:**
Losing the essence of theory when neglecting practice.
1. **Teaching activity**:
Visualization.
1. **How did it go?**
The program is, unfortunately, too crowded to allow for additional teaching activities.
1. **What to do next?**
Find a means of incorporating the activity more seamlessly into TØ.

For assessment, students will be asked to provide feedback on the exercise with an online questionnaire.

The questionnaire will ask if the students felt that they gained any new insight. It will also ask the students if the instructions were sufficiently clear, or if there was still doubt when beginning the activity.

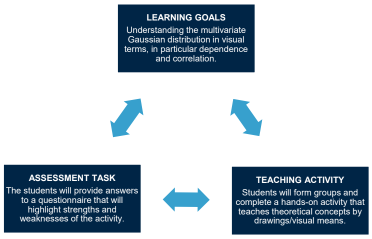


Figure 2: **Constructive alignment**
Learning goals, teaching activity, and assessment must all have an appropriate interplay for a successful teaching activity to be possible. This figure illustrates how each component is realized and related.

4. Looking forward

The activity is involved, and thus does not fit into a tightly scheduled TØ program. This, in a way, is a fault in the activity, as a teaching activity must be *both* helpful *and* realistic.

In retrospect, a course where the program is not quite as packed, perhaps a first-year course, would have been a better candidate for a visualization activity.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Louis Gammelgaard Jensen
Department of Mathematics

Process Analysis for Advanced Mechanics

- Analyzing the problem-solving process of advanced mechanics by a method-driven strip sequence technique.

Learning Lab

Abstract:

Finding the appropriate method within math or physics, when approaching a general problem in analytical mechanics, have been reported by the students to be difficult. To clarify this, an analysis of the problem-solving process of analytical mechanics have been performed. This is done by a method-driven strip-sequence technique. Thereby the students gain insight on when to apply approximations based on physical arguments, and when to apply mathematical formalisms as they approach the assigned problem. During teaching activity, the students produced various strategies, which resulted in fruitful discussions among them. Small refinements to the teaching activity will be made for future use.

COURSE FACTS

- **Course name**: Videregående Mekanik (Advanced Mechanics)
- **Level**: Bachelor (2. Year)
- **ECTS credits:** 5
- **Language:** Danish
- **Number of students:** 20
- **Your role:** Teaching Assistant for TØ

TEACHING IN PRACTICE

1. Identifying a problem

The course on advanced mechanics is very math reliant and many of the important physical points will be hidden in difficult derivations or differential equations. This is contradictory to the introductory courses where the physics are easier to comprehend, as the conclusion often come as a number with a unit.

From discussions with other TA's and by listening to the most common questions in class it has become clear, that what the students find difficult is very often in the intersections between math and physics. This happens e.g. when they need to use physical arguments to do mathematical approximations, and when they need to conclude on the physical behavior of a system based on solutions to difficult differential equations.

2. Planning a teaching activity

The activity revolves around letting the students work out a clear strategy to approach most problems in analytical mechanics and letting the students reflect on when they are using math or physics in this process. With this, the students will be able to find a go-to procedure when dealing with advanced mechanics. This will assist them in the future in the procedure of using analytical methods to solve abstract physical systems, which is exactly the learning goals of the course.

3. Trying it out in practice

The teaching activity consist of a method driven process analysis, using a strip-sequence method. This allows for the students to reflect on which methods to use when, and to locate the steps where important physical points may be hidden. The students will be handed multiple strips describing different parts of the problem-solving process in advanced mechanics. With this, the students will need to address in what order they will apply the different methods in order to solve a general problem. Furthermore, once they have completed their sequence of methods and have a full process analysis, they will need to address their methods. Here they are supposed to address at which points in the analysis, they are applying math, physics or both. This is done individually, compared in small groups and at last the process will be discussed in class. For the class-discussion, each strip has been provided with a number, and the sequence is then to be written as an outline on the blackboard. Figure 1 shows the sequences from the different groups. The different problem-solving structures of all four groups provided a fruitful debate.

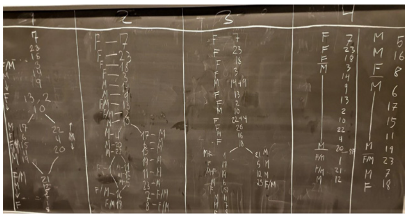


Figure 1: **Group Answers**
The sequences made by each of the four groups with corresponding process analysis.

Assessment of the activity is done at first by listening to the student's discussions. When doing the concluding remarks on the discussion, I will also give the students feedback on their analysis, which they also have received as they discuss with their peers. If the process analysis of the student seems to lack an understanding, this can be discussed with the other TA's or the course coordinator to address any problems the students might have.

MAIN POINTS

1. **Main problem/challenge:** Understanding the underlying physics within the math dependent analytical mechanical formalism.
2. **Teaching activity**: Modified strip-sequence approach to analyzing the processes of solving problems with the framework of analytical mechanics.
3. **How did it go?** Reasonably Well
4. **What to do next?** Refine and implement the activity again next year.

The student evaluation is carried out by a simple "ticket out the door" vote. The students are simply asked the question if they would rather have the teaching activity or have been using the 30 minutes for problem-solving as they usually do. The results of this vote can be seen in Figure 2. Generally the students had a positive response, however some of them, which might already have realized the general structure of analytical mechanics would rather solve problems as we usually do. Some of the students, furthermore, commented that it was a good activity as a summary at the end of the course, but would prefer regular problem solving for the rest of the TØ sessions.

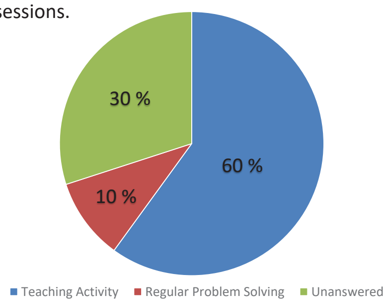


Figure 2: **Student Evaluation**
The anonymous evaluation of the teaching activity, made as an "ticket out the door" vote at the end of class. The students were asked what they would prefer to have spent the time on.

4. Looking forward

The teaching activity was an overall success. The groups had some good discussions regarding their different approaches and strategies when solving problems in analytical mechanics. The teaching activity might be structured otherwise in the future, by adding additional blank strips to let them fill in missing parts or in a minimalistic version with fewer strips, depending on how much time is allocated next year. Furthermore, it seemed as if the reflection on the structure of the methods made the students more confident in their knowledge of advanced mechanics.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Simon Vendelbo Bylling Jensen
Bojer-Group
IFA – Institute of Physics and Astronomy

Confidence booster or confidence killer – the fate of laboratory exercises

- STRIP sequence - enhance the learning outcome through reflection and dialogue.

Abstract

Laboratory exercises are unique opportunities for the students to get practical experience and in-depth knowledge about topics that are difficult to learn from a textbook. Laboratory exercises are also very demanding underlining the importance of a successful outcome for the students. Lot of students struggle with the laboratory exercises. The STRIP sequence is a tool that can facility learning prior, during and after the laboratory exercise and is a low resource high potential learning activity to improve the students' outcome.

COURSE FACTS

- Course name: Visiting service
- Level: high school /BA
- ECTS credits : none
- Language: Danish
- Number of students: 4 - 30
- Your role: Instructor

TEACHING IN PRACTICE

1. Identifying a problem

The students are modifying a DNA oligonucleotide followed by gel electrophorese analysis. Only half of the students are able to conduct the exercise in a proper way. The students that are unsuccessful often express disappointment. The aim of the exercise is to introduce the university and stimulate the curiosity for science.
Most of the high school students find the exercise difficult and the outcome strongly relate to the instructor's ability to communicate the content in an understandable manner. It is difficult for them to take down all the information and turn it into actions.
By improving the teaching materials and the introduction, the students will be able to perform the exercise correct and thereby get a successful experience. Hence, confidence boost.

2. Planning a teaching activity

My idea was to turn the lab protocol into a STRIP sequences exercise. The students are going to match properties to reagents. Thereby facilitating a better understanding of the molecular biology and support the work in the lab. STRIP exercise is a tool that in a simple manner break complex information into simplified pieces of information supporting the students learning.
In groups, the students will match a reagent with a function/ property. Then they will have to "assembled" the pieces into a complete protocol. The students will be guide by hints and explanations on each paper slip. The students do this prior to their visit. As part of the introduction, will the instructor go through the STRIP exercise and ask additional questions to the students.
The intension is that the in-group work facilitate a discussion between peers that help them understand the protocol and the technics. The aim of reviewing the exercise again is to repeat the main point and allow the students to ask questions.

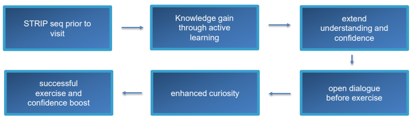
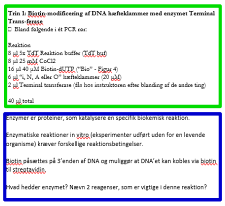


Figure 1
STRIP sequence exercise intended flow

3. Trying it out in practice

The students did in groups of 2-5 participants go through the STRIP sequence exercise prior to their visit.



Trin 1: Biotin-modificering af DNA hæfteklammer med enzymet Terminal Trans-ferase
□ Bland følgende i ét PCR rør:

Reaktion
8 µl 5x TdT Reaktion buffer (TdT buf)
8 µl 25 mM CoCl2
16 µl 40 µM Biotin-dUTP ("Bio" - Figur 4)
6 µl "i, N, A eller O" hæfteklammer (20 µM)
2 µl Terminal transferase (fås hos instruktoren efter blanding af de andre ting)

40 µl total

Enzymer er proteiner, som katalysere en specifik biokemisk reaktion.

Enzymatiske reaktioner in vitro (eksperimenter udført uden for en levende organisme) kræver forskellige reaktionsbetingelser.

Biotin påsættes på 3'enden af DNA og muliggør at DNA'et kan kobles via biotin til streptavidin.

Hvad hedder enzymet? Nævn 2 reagenser, som er vigtige i denne reaktion?

Figure 2
Example of STRIP pair. Green from protocol and blue slip students correctly matched.

The intention is that the students spend 20 minutes on matching the paper slips, followed by a 20 minutes group discussion and point to the statements they are uncertain about. During the exercise the instructor will go through the STRIP exercise in a dialogue form. The students get the opportunity to ask questions and address essential parts of the protocol once more but also given the instructor important information about the students' knowledge and laboratory experience. Allowing the instructor to adapt the content of the introduction to the students' knowledge level.
The students are assed on their results. The DNA origami will only assembly if the experiment is perform properly. Furthermore, the gel electrophoresis is an intermediate step that allows assessment and give the instructor an opportunity to discuss the results with the students.

MAIN POINTS

1. **Main problem/challenge:** : Most of the high school students find the exercise difficult.
2. **Teaching activity**: STRIP sequence
3. **How did it go?** The students did a great job in the lab. Working with confidence and curiosity – main goals achieved.
4. **What to do next?** Improve statements and develop dialogue.

To evaluate the quality of the STRIP exercise and the opinions of the students a questionnaire was fill in shortly after the laboratory exercise.

Figure 3
Results of questionnaire handed out to the students.

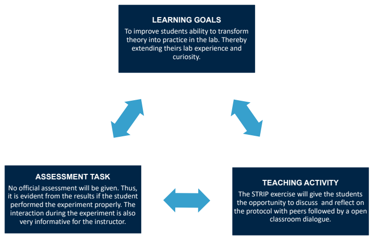


Figure 4: **Constructive alignment**
Representing a brief presentation of goals, tool and assessment criteria.

4. Looking forward

Overall, the STRIP exercise worked very well. The students were very pleased by the informal setup and positive about the classroom dialogue. The student quickly got in to the exercise. It is obviously that the students recognize the format from other learning activities, which is a very essential since the focus should be on the scientific content and not the exercise itself. The previous classes' need much more support through the laboratory exercise than this class, clearly indicating that the STRIP exercise help the student to be more self-driven. The evaluation also showed that the students find the exercise interesting and helpful. To improve the learning outcome some of the STRIP statements be more specific. Furthermore, better guidelines should be send to the high school teacher and the in classroom dialogue further developed.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Asger Givskov
Kjems laboratory
Department of Inano

Concept Map

- Visualizing the relationship between concepts and models within machine learning

Learning Lab

Abstract: Machine learning is a field with a large number of different models. This can make it hard to get a good overview. Many of these models are built upon the same concepts. Understanding the models in-depth and learning new models is easier if the students have an overview of how they relate. This teaching activity (a concept map) is designed to aid the students in getting an overview of relations between concepts and models. The activity was successfully implemented and feedback was provided by the students. The through the feedback and observing the activity in action is was clean that activity improved the students understanding but that the timeframe was to short.

COURSE FACTS

- Course name: Machine Learning
- Level: Bachelor, 5th semester
- ECTS credits : 10
- Language: Danish
- Number of students: 8
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

The field of machine learning contains a large number of models and concepts which can be hard to graphs for students that are new to this field. However, many of these models are built upon the same ideas and use the same concepts. Understanding how models and concepts relate to each other can aid the students in getting an overview of the learned models and make it easier to learn new once that utilize the same concepts.

2. Planning a teaching activity

The teaching activity is a concept map that is designed to help the students relate concepts and models. To do this I have prepared 5 different types of concepts (hypothesis, data, objective, method and, model). For each of the different types, I have formulated all the different concepts using the same mathematical notation. This is done to more clearly highlight the similarities between models.
The formulation of some concepts are depending on the usage. I have grouped these formulations together under one concept and written all of the different formulations to make it clear that they are the same thing.
I constructed a small digital example of a concept map to support the explanation of the activity.
I also created a summary of the activity as a pdf that contains all the different models and the related concepts. This is for the students to use after the activity e.g. when studying for the exam.

3. Trying it out in practice

At the beginning of the activity, I explained what a concept map is. The explanation was supported by a small example containing some of the relationships. Then I gave the students time to read and get an overview of the different concepts. After reading, they were tasked with connecting the concepts with different relations, see Figure 1. This was done in small groups. It quickly became apparent that the provided timeframe was to short to construct a concept map using all the concepts. After the construction of the concept maps the groups compared there results with the neighboring group. In the end, we went through the concept maps in class and corrected a few miss conceptions.

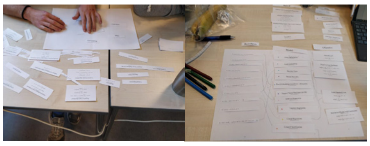


Figure 1: Students construction concepts maps and organizing in very different ways.

4. Evaluation

After the activity, the students evaluated it anonymously through a survey with 9 questions, see 3 out of the 9 questions in Figure 2. The general impression is that the activity improved there understanding of concepts and their relations and that the task and goal were well defined, but that the timeframe was short.
The students also expressed that the activity should be repeated next year. Some students believe that the activity would be better at the end of the course and some think that it should be repeated after learning about each model.

MAIN POINTS

1. **Main problem/challenge:** Getting an overview of the relationship between models and concepts.
2. **Teaching activity**: Concept map
3. **How did it go?** I implemented it and performed it together with one of my two TA-classes and it went well. But more time should have been allocated for this activity.
4. **What to do next?** Students from my other TA-class have requested that I should do the activity with them as well – so I will do that as exam preparation, but with more time.

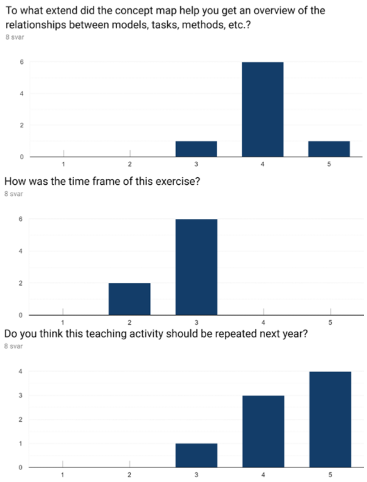


Figure 2: 3 of the 9 questions in the evaluation. Rated from very bad(1) to very good(5).

5. Looking forward

This activity worked well based on the questionnaire answered by the students. I, therefore, expect to reuse this activity later with little to no changes. The biggest problem of these exercises was the short timeframe in relation to the number of concepts. This could either be solved by removing concepts of providing more time for the activity. But not covering all concepts would be a shame and I will, therefore, provide more time next time I implement this activity.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Jakob Rødsgaard Jørgensen
Data-intensive System Group
Department of Computer Science

From milk to cheese

- Learning the concepts of cheese production by a strip sequence puzzle

Learning Lab

Abstract: This course is a collaboration between Aarhus Municipality and Aarhus University, where teaching material is developed for public school. Here, the pupils will learn about the concepts of cheese production. One challenge is that the pupils have difficulties understanding more complicated concepts related to the cheese production. Therefore, the aim of this teaching activity was to help the pupils understand the steps in the cheese production through a strip sequence puzzle. The teaching material is still being developed. After the material is tested on a public school, it will be evaluated and there will be a possibility to make changes.

COURSE FACTS

- Course name: From Milk to Cheese
- Level: Public school
- ECTS credits : 0
- Language: Danish
- Number of students: 15-30 in each class
- Your role: Development of the material and practical exercises at AU FOOD.

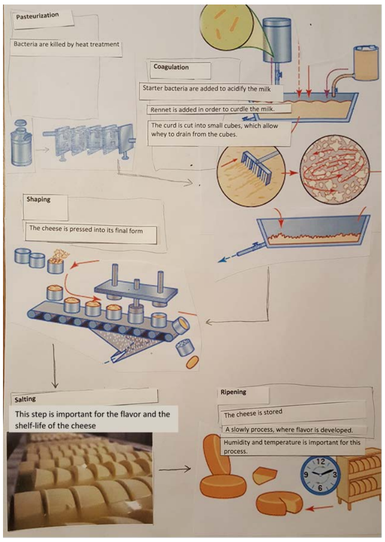
TEACHING IN PRACTICE

1. Identifying a problem

In this course pupils from public schools in Aarhus will learn about the production of cheese support their understanding of how chemistry and biology is used in academia and the industry. The material is developed as a combination of reading, problem solving and practical exercises. It is intended to include an excursion to AU FOOD to test some cheese production experiments.
For the reading part, it has been observed that some pupils have trouble understanding more complicated concepts related to the cheese production – both the individual steps and the connection between steps. The concepts are illustrated and explained by a figure including the different processes in the cheese production.

2. Planning a teaching activity

The teaching material is developed to introduce and explain the concepts and terms related to the cheese production, e.g. pasteurization, coagulation and cheese ripening. This forms the basis of the teaching activity, that has been developed to meet the challenges in understanding the concepts explained by a figure.
The teaching activity itself, is based on the idea, that the pupils work with the content of a cheese production figure from the material. They will do an exercise in remembering and understanding the given concepts.
Additionally, the pupils will be working with some of the concepts from the figure in a practical exercise prior to this exercise.



The concepts of cheese production
The pupils get the figure with illustrations of each step in the cheese production process. They also get the strips containing explanations of each step in the figure. Then they have to match strips and illustrations.

3. Trying it out in practice

After reading about processes involved in cheese production, the pupils will groupwise get a figure (without explanations) and sequences matching the pictured steps. They have to combine the strips of explanations to the right steps in the process.

MAIN POINTS

1. **Main problem/challenge:** Understanding cheese production by a figure.
2. **Teaching activity**: Cheese production puzzle.
3. **How did it go?** It has not been tested yet.
4. **What to do next?** Finish the material and test it in practice.

The solutions are discussed in class to encourage the pupils to explain their reasoning and to ensure they understand the process. Finally, each group removes the printed explanations and fill out the blank explanation boxes with their own explanations/key words and combine them with the pictures. This last step is to encourage the pupils to formulate their own explanations for a better understanding of the concepts and to support their learning.

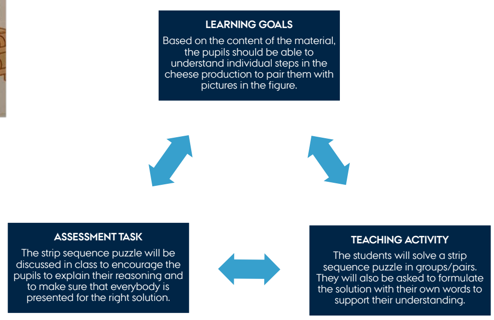


Figure 2: Constructive alignment
The learning goals of the material in general is supported by the teaching activity, as the pupils are encouraged to use their understanding of the cheese production concepts to solve the strip sequence puzzle. In the end they also provide themselves with a figure with own formulations and explanations.

4. Looking forward

When the teaching material is done, it can be offered to public schools in Aarhus Municipality. Then the pupils will try out the teaching activity as they work their way through the material. Hopefully the elements of the material, including the activity, will help them understand the concepts of cheese production. After being tested the material will be evaluated (orally or written) by teacher and pupils in order to make changes.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Lotte Juul Knudsen and Natacha Roed Róin
Food Chemistry and Technology
Department of Food Science

Concept map - Pig Behaviour

Reflections on Motivation, Social Groups, Behaviour and Welfare Problems in Pigs

Learning Lab

Abstract: Understanding and recall of concepts can be improved if students get to reflect and discuss instead of having answers "handed" by the lecturer. Making a concept map offers opportunity for peer-to-peer discussion on interconnected concepts. It is also possible for the TA to add og correct misconceptions in a semi-structured way in plenum. However, as concepts maps can easily become "messy" and confusing, focus should be given on the in-plenum follow-up. The current teaching activity did not succeed in eliminating confusion and improvements to facilitate discussion in plenum should be made.

COURSE FACTS

- Course name: Animal Behaviour and Welfare
- Level: BA
- ECTS credits : 5
- Language: Danish
- Number of students: 11
- Your role: TA in one session (3x45min.)

TEACHING IN PRACTICE

1. Identifying a problem

The overall aim of the course is to give the students an introduction to basic elements of animal behaviour and its application in relation to livestock farming and animal welfare. From previous teaching, it has been found that students have prior conceptions on pig welfare in livestock production depending on their background, and these will in different degree be based on knowledge. The challenge and aim for this teaching session was to make students reflect on the interactions and conflicts between pigs' natural behaviour and their welfare in pig production based on current knowledge from research.

2. Planning a teaching activity

In previous teachings at this course examples of pig behaviour and the conflicts with animal welfare were "handed" to the students during a lecture. Students were only given little opportunity to discuss amongst each other. Discussion with peers and putting concepts into a context can improve understanding and recall. A teaching activity providing room for reflection was therefore introduced.

The chosen concepts of piglet behavoiur and motivations relate and interact on different life stages in a complex matter. Therefore the concept map was chosen for the activity as it can both both show complexity and connections. The specific learning outcomes were to relate important motivational states, social interactions and behaviour to different life stages of the pig. Thereafter to compare the pigs motivation and behaviour under different life stages with the conditions in intensive production systems in order to discuss and reflect on the the consequences for pig welfare in intensive production systems.

3. Trying it out in practice

The students were divided into groups of 2-3 students. Each group was handed a sheet of A4 paper and pens in three colours. TA presented five different life stages of pigs, concepts related to motivation, social interactions and behaviour in different colours and asked students to connect them. The students were told that there was not one right answer. They were however also given three concepts that did **not** relate to pigs to check if they are critical. They were not told this.

Figure 1: The concepts provided to the students. The concepts were divided into colours; pig life stages (green), social groups (red), behavior (blue) and motivation (yellow).

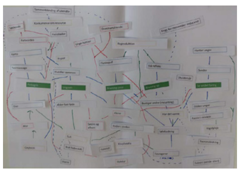


Figure 2: Example of one groups final concept map.

The students were given 15 min. to work on the concept map. They were then given statements of welfare consequences in pig production and be asked to relate these to their concept map the next 5-8 min. Afterwards on class, TA asked students for their connections between the concepts and thereafter TA showed her own version. As evaluation students were given a "ticket out the door" where they could rate each of the exercises made during the session from 1-10 (10 being the best) according to how helpful they felt they were for their learning combined with a written comment from the students.

MAIN POINTS

1. **Main problem/challenge:** Improve reflections and recall of pig behavior in relation to animal welfare
2. **Teaching activity**: Concept map of four pig life stages, motivation, behavior, social groups and welfare problems
3. **How did it go?** Students found it messy and confusing
4. **What to do next?** Improve follow-up in plenum by making students draw a connection one by one and explain

The mean rating of the concept map was 5.6 out of 10. The concept map was given the lowest rating of the four activities included in the lesson. Several students rated it below average. A general student response to the teaching activity was that it was confusing and messy. Some also found it helpful and nice to have the opportunity to discuss with peers.

An unwanted differentiating between students was created by the three extra "trick" concepts that did not relate to pigs, truly tricking the one student who was biologist among the agrobiologist. It should have been stated that there were trick concepts included.

Furthermore, TA realized during the follow-up in plenum that this should have been done differently. TA showed her version in a Powerpoint, but this became "stiff" an did not open for enough discussion. To improve the activity, the students should be asked to each come to the board to draw a connecting line and argue why they made it.

4. Looking forward

Creating a concept map was found to be "messy" and confusing by the majority of students. It did however gave opportunity to discuss with peers. If the activity should be repeated, the in plenum review should be changed. It should be based on the students concept map instead of the TA's version to better facilitate discussion.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Behaviour and Stress Biology

Compressive Sensing in Internet of Things - A practical approach

Learning Lab

Abstract: Compressive sensing is used for compressed sampling, which requires nonlinear decoding at the receiver. Mathematical understanding of CS encoding and decoding is required for developing the Internet of things (IoT) applications. In this lesson, an intuitive understanding of CS algorithms is demonstrated in the MATLAB environment. The learning outcome is evaluated based on paper test and group performance.

COURSE FACTS

- Course name: Internet of Things Technology
- Level: Master
- ECTS credits : 10
- Language: English
- Number of students: 25
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

Developing the Internet of things (IoT) applications requires knowledge from different engineering streams. It is not possible for students to cover every concept in detail. Therefore, it becomes necessary for the instructor to make every student learn the importance of mathematical concepts without going into details. Compressive sensing (CS) theory is mathematical, and it has an important application such as compressed sampling, data compression, encryption, error correction, data collection, etc. These applications are paramount in resource-constrained IoT devices. In this task, the use of CS is demonstrated on the MATLAB platform by applying CS algorithms on real data such as image, speech, ECG, etc.

2. Planning a teaching activity

TA's teaching activity is planned to demonstrate applications of CS optimization algorithms in IoT through MATLAB tools. For Teaching material, "an Introduction of CS optimization algorithms for solving problems using MATLAB" will be given to students before class. The MATLAB cheat sheet will also be given to students, which contains basic instructions. It will be demonstrated how CS optimization algorithms are applied to various IoT applications using Demos.

3. Trying it out in practice

The teaching activity was planned in the following way.

1. A short theory of CS was covered using powerpoint presentations. The importance of CS is presented by examples, and various optimization algorithms described, and their importance in IoT technology was shown.
2. TA asked students to use the existing demo code and observe the compression provided by the CS optimization algorithm.
3. TA divides the whole class into groups, asks them to change the code, and implement the encryption module in the existing code. TA interacted with students who were having doubts related to this activity.
4. Finally, the five-minute paper test was conducted, and TA discussed what we have learned in this lesson.

Learning Goals:
1. Intuitive understanding of CS algorithms.
2. MATLAB commands for instantiating optimization algorithms and parameter values for CS.
3. Application of these CS algorithms in IoT technology.

MAIN POINTS

1. **Main problem/challenge:** Use MATLAB as an environment to demonstrate students how CS optimization algorithms are applied to IoT applications.
2. **Teaching activity**: the Jig-saw with problem solving
3. **How did it go?** All the students participated actively and learned from the exercise well.
4. **What to do next?** Prepare extra exercise for challenge the students with higher levels.

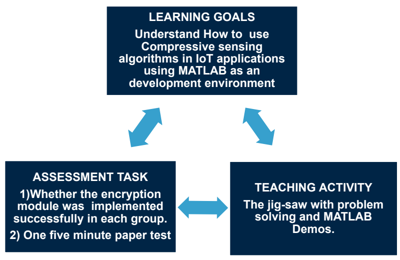

Figure 2: **Constructive alignment**

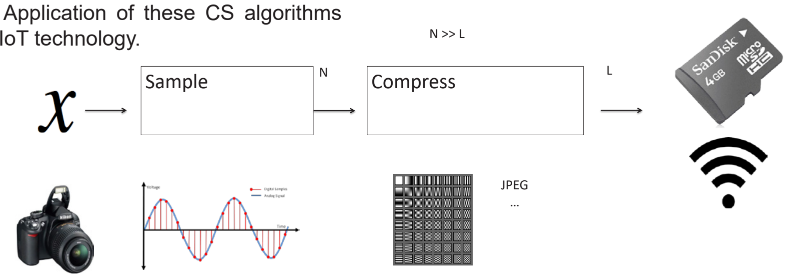

Figure 1: Compression by sensing

4. Looking forward

TA was able to work as planned. Students got hands-on the implementation of CS algorithms in MATLAB environment. The prepared paper test provided feedback that most of the students were able to understand the lesson. However, the planned activity was for two hours only, and the TA felt that the duration should be more to raise the difficulty level and also to provide more demos.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Department of Engineering

Dipping your toes into *deep time*

- Realizing the relationship between process and outcome through discussion and satellite imagery

Learning Lab

Abstract: An Issue many students face in geology is the concept of deep time- that is how do we grasp the millions of years it can take for mountains to erode, coastlines to change and similar. This activity will allow students to see some of the landscape processes that determine how the natural world appears, by having the students observe landscape changes in the past 30 years through time lapsed satellite pictures, and having them determine the specific processes at work through discussion with each other and full classroom followup. A version of this teaching activity was held in class and students generally appreciated this different way of looking at deep time, and found it helpful to discuss and put it into their own words what is going on in the landscape.

TEACHING IN PRACTICE

1. Identifying a problem

An issue arising for understanding landscape processes is the common issue of *deep time*, that is that geological processes can often take years to millennia to complete. Often this makes it difficult to grasp the connection between the processes learned in class and the resulting landscapes in the real worlds. This is exacerbated by students not formulating why the two are connected in their own words. The goal of this teaching activity is therefore to address this disconnect in understanding.

2. Formulating a Solution: The Teaching Activity

Often as a TA the freedom of designing and implementing how teaching is done is limited, so this one was designed to integrate easily into the exercise part of the class, where similar work was already being done, and it is indeed complementary to the goal of the already present exercises.

The goal of this teaching activity is to address the difficulty in connecting geological process that happen over long stretches of time, with the landscapes we observe in the real word. This is done through small group discussion and full class presentation of the discussion results, the teaching activity should engage all of the students in confronting the subject matter, with fewer student going "under the radar" as compared to the normal exercises.

This will support students in accomplishing the main learning outcomes of the lesson as well as one of the learning outcomes of the course, namely being able to explain and describe landscape processes and the resulting landscape forms

3. Trying it out in practice

The students were introduced that todays exercise would be a little out of the ordinary and that we will be doing them in the context of this teaching activity.
The students were first subdivided into groups of 3-4 and then were presented the plan of the 3 step approach.

STEP 1 Ca. 7 minutes
Using google earthengine observe timelapse changes of types of landscape at a locality

STEP 2 Ca. 7 minutes
Discuss in the small groups why the changes are occurring and what processes from the lectures are at work

STEP 3 Ca. 7 minutes
One group chosen by the TA will have to present their answer as to what is happening at the locality. The other groups will ask them questions

The activity block takes around 20 min and is performed several times for the different covered landscape processes. Rivers, Dunes, Coasts, Hill-slopes, Glaciers.
Finally a follow up was made, where the students where asked if they found this type of teaching helpful.
Feedback was generally positive with students feeling that they had understood the subject better.
Though some students found it slow compared to the normal exercises and not necessary for understanding the subject. It was difficult for most students to ask questions of the presenting group.

COURSE FACTS

- Course name: Hydrology and Landscape Processes
- Level: Bachelor, 2nd year
- ECTS credits : 10
- Language: English and Danish
- Number of students: ca. 22
- Your role: Teaching assistant

MAIN POINTS

1. **Main problem/challenge:** Connecting geological features with the slow processes that produce them.
2. **Teaching activity:** Timelapse satellite imaging and small group discussion with plenum follow up.
3. **How did it go?** Overall well, with engagement and discussion in all of the groups. Plenum parts were more of a challenge
4. **What to do next?** If reimplemented, the small group discussions should also prepare the questions they want to ask for the general discussion

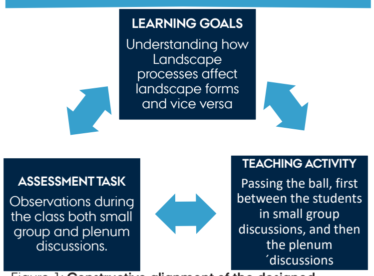

Figure 1: **Constructive alignment of the designed Teaching activity**

4. Looking forward

The students participated readily in the activity, and were active throughout. Its irregularity as compared to the normal class exercises was appreciated. During the plenum part it was difficult to get the other groups to ask questions of the presenting group, in future they should prepare questions as part of the small group discussion for the plenum discussion. Overall I think the activity was a success, and most students thought this was a fun way to address the subjectmatter.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Department of Geoscience

MIND-MAP LETS IT EASY
TO UNDERSTAND AND REMEMBER OF COMPLICATTED EXPERIMENTAL PROECEDURES

Learning Lab

Abstract:
Mind-map is a good method to clear students mind. In this course "Applied Lipid Biotechnology", there are too many steps in each experiment. It is hard for students to learn and remember each step by just description of the principle. Therefore, it is a good idea to apple Mind-map to this course to strengthen students' understanding and memory. What's more, after the experimental course, to get the evaluation from students using Mentimeter with four statements is included.

COURSE FACTS

- Course name: Applied Lipid Biotechnology
- Level: Master
- ECTS credits : 5ECT
- Language: English
- Number of students: 12/14
- Your role: Instructor in the two experiments of all

TEACHING IN PRACTICE

1. Identifying a problem

To get students learn the principle of the experiments clearly.
Some experiments' processing theory is hard to understand so that students can not really know it and effectively remember it. Therefore, it is really needed to find a good teaching activity to strengthen their memory about the principle.

2. Planning a teaching activity

Mind map is a good method to deal with the problem mentioned above.

This teaching activity consists of four parts:
1.Write key words of every step in the experiments on the label notepapers.
2 Let students to organize these label notepapers by their mind .
3 Let students say why the order is like that.
4 According their description of their order, point out the wrong parts and tell them why it is wrong.

These four steps have their own functions
Step 1 is to let students easily remember the key words of each step
Step2 is to strengthen their memory about the key words and built initial memory about the order by individual thinking.
Step3 is to reflex their idea and also strengthen the memory of key words and the experiment processing order.
Step 4 is to finally strength their memory

3. Trying it out in practice

The teaching was performed as the table shown below.

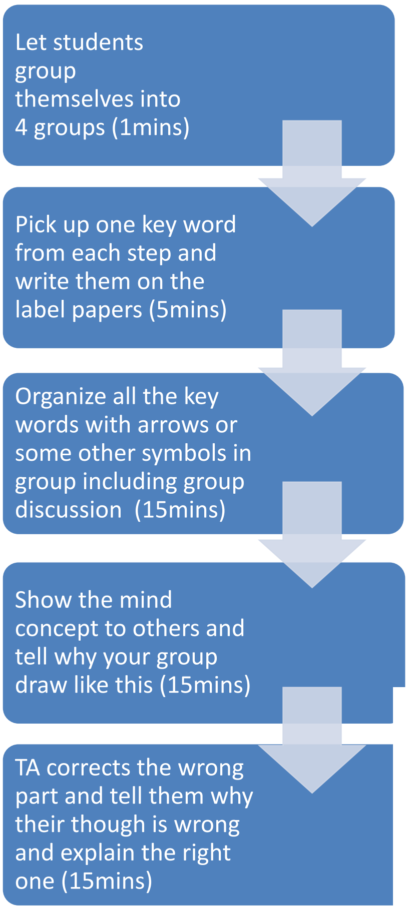

Figure 1: The process of teaching activity using mind-map

MAIN POINTS

1. **Main problem/challenge:** Understand and remember complicated principle of the experiments
2. **Teaching activity:** Mind-map
3. **How did it go?** Implement it and performed it together with other TA in this course. It worked well but students thought that the time of discussion should be longer
4. **What to do next?** Longer the discussion time and see the reaction of students.

4. Evaluation and Feedback:

After class, ask students to evaluate this teaching activity by giving scores to four statements. From the result, we can see most of students think it is useful for them to improve the understanding and strengthen the memory of each step of the experiments. However, the arrangement of the time is needed to consider again. Students want to longer the time of group discuss.

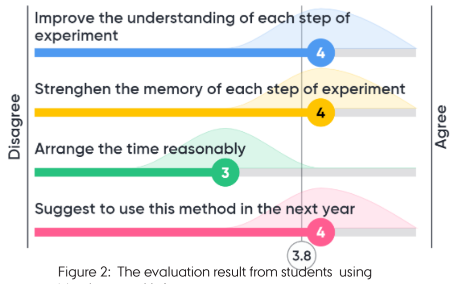

Figure 2: The evaluation result from students using Mentimeter with four statements

4. Looking forward
Just describe the principle is really boring and can not achieve all the students remember and understand it. Therefor, it is better for TA to create a good teaching activity. Mind-map can clear the mind structure of students, which is a good method to solve problems of this course. But from the feedback from students, the discussion time should be longer. So in the next year, we will longer the time of discussion, and then check student's reactions.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Biochemical Group
Department of Engineering

Facilitating Active Learning in the Lab
- Using Strip Sequences to Construct Protocols

Learning Lab

Abstract:
A major difficulty for teaching assistants in laboratory courses is gauging the level of understanding of students during exercises. From the students point of view, it can be difficult to connect the content of lectures and assessments to lab exercises. This project describes teaching modifications for a lab exercise to be run in 2020, in which students construct the experimental protocol themselves within the lab session. Students will use a 2-column strip sequence using information provided in lecture notes and the lab manual. This will hopefully improve student engagement and learning compared to the implementation of the exercise in 2019, where students were simply provided a detailed protocol to follow.

COURSE FACTS
- Course name: Chemical Production Engineering
- Level: Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 24
- Your role: Developing new lab protocols

TEACHING IN PRACTICE

1. Identifying a problem
Often the experiments in lab courses are simple to do if adequate instructions are provided, however providing full instructions means that the students can just follow the protocol without engaging with what they are doing. As a result, students have problems with data analysis, reports and assessments, because they have not been able to connect their lab exercise to the learning outcomes of the course, or the content of their lectures. It requires effective communication and consideration on behalf of the teachers to prepare and teach lab exercises that facilitate active learning for the students.

2. Planning a teaching activity
This project focuses on a chemistry themed lab exercise, where students perform iodometric titrations to determine if materials they have synthesized are suitable for removing heavy metals from wastewater. This involves a range of new chemical reactions and techniques, teaching the students to conduct chemical experiments with multiple steps, and analyze experimental data.
Importantly, the experimental procedure will only work if the steps are done in the right order, and in the past the students have simply been provided a protocol to follow. Assessments and evaluations from 2019 indicated that students did not fully grasp the concepts of the exercise.

It is intended that the students learn basic lab, data analysis, and report writing skills in the course, and their final exam relates heavily to the experiments and reports they complete during the semester. To assist students in meeting the learning outcomes, students will complete a strip sequence exercise to order the steps of the protocol in 2020. Hopefully this will encourage the students to engage with scientific concepts and link them to the theory they have learnt in lectures (Figure 2).

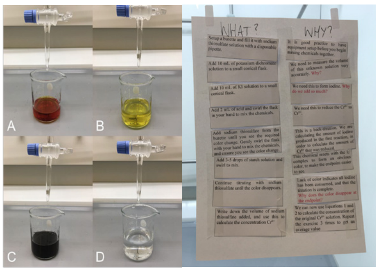


Figure 1: Example of theoretical information provided to the student to assist them with the strip sequence, and the completed strip sequence mounted on a fumehood sash.

3. Trying it out in practice
Prior to performing the lab exercise, students attend a lecture and complete an online quiz related to the exercise. During the actual lab session, there is an hour gap at the start of the experiment that can be used strategically to perform the exercise. In small groups, the students complete the 2-column strip sequence, to determine both the ordering of the steps, and the reason for doing them. After deciding on a solution, students can try their protocol to ensure that they see the correct color changes, and reach the right endpoint.

MAIN POINTS
1. **Main problem/challenge:** Engaging students with lab protocols, without providing them a 'recipe' to follow
2. **Teaching activity**: 2-column strip sequence
3. **How did it go?** Has not yet been implemented
4. **What to do next?** The suggested teaching modifications will be applied and assessed in 2020

When satisfied with their protocol, students can tape their solution together and attach it to the fumehood sash, using it for the duration of the experiment. (Figure 1). If teaching assistants notice any issues with the order of steps or reasoning, they can discuss this with the students throughout the lesson. Through interactions and observations of students, and evaluations of the submitted reports, teaching assistants can gauge the level of understanding and enjoyment of the students. To gauge student's impressions of the strip-sequence exercise, a quick survey can be used in a 'ticket-out-the-door' type of activity at the end of the lab session.

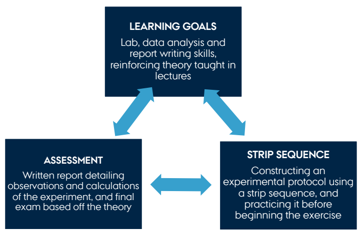


Figure 2: Intended alignment of the activity, assessment and learning goals as a result of implementing the strip sequence exercise.

4. Looking forward
This lab exercise was conducted in 2019 with assessments and evaluations indicating that students did not fully understand the exercise. The application of a 2-column strip sequence technique in 2020 will hopefully improve this by better engaging the students, without requiring alteration of the current lecture content or lab manual. If this approach is successful, it could also be applied to other lab exercises. The use of a computerized version of the strip sequence could also be considered, to reduce time and hassle of handling many small pieces of paper.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Melissa Marks
Hybrid Materials Lab
iNANO

Programming as a tool for class exercises

How to teach simple R exercises in small classroom teaching

Abstract: The students usually struggle using the R programming software to solve exercises in class. In order to help their learning outcomes, I developed a double strip sequence teaching activity where the students can match the task that they need to perform with the corresponding R script. This proved to be useful for the students and they had overall positive responses to the activity. When asked if they would be comfortable using the R script again, they did not have a significantly positive response. To solve this problem, a detailed explanation would be added at the end of the activity.

COURSE FACTS

- Course name: Advanced population biology
- Level: Bachelors
- ECTS credits : 10
- Language: English
- Number of students: 28
- Your role: Teaching assistant in theoretical exercises

TEACHING IN PRACTICE

1. Identifying a problem

During my teaching of a previous course I had to help the students solve exercises using R the programming software R. I faced a lot of resistance from the students and they had difficulties solving the problems and understanding the output from the program.
I previously tried providing the script (commands written in the R programming language) to the students, but that resulted in them copy-pasting the commands in R without understanding what they were doing, nor advancing their knowledge on how to use the software. Overall the learning was not as good as could be.

Task	R script
♦ Install packages to read the dataset excel file and to analyze it	• install.packages("readxl") • install.packages("bipartite")
♦ Upload the packages to your R session	• library(readxl) • library(bipartite)
♦ Read into the session the Galapagos dataset	• galapagos <- read_excel("path to the file in your computer")
♦ Show the dimensions of the dataset	• galapagos
♦ Calculate the total number of links in the dataset	• sum(galapagos)
♦ Create a network matrix of the Galapagos dataset	• visweb(galapagos)
♦ Create a network graph of the Galapagos dataset	• plotweb(galapagos)
♦ Calculate the network metrics (including NODF) of the Galapagos dataset	• networklevel(galapagos)

Figure 1: Double strip sequences activity

2. Planning a teaching activity

To solve this problem, I developed a double strip sequence with the tasks on one side and the corresponding R script on the other (Figure 1). This way it is possible to provide the students the correct script while making them analyze what each step is achieving.
The learning goal is for the students to learn how to use basic programming to solve population biology exercises (Figure 4).

3. Trying it out in practice

The students where provided a series of questions in relation to a dataset. In order to find the answers, they were given strip sequences that had the actions and scripts that would lead to the solution of the questions.

- First step: The students working in pairs put the 2 sets of strips into order. The strips have different vignettes according to what column they go in.
- Second step: I go through the groups to check that the order was right and that they can move on to the next part (Figure 2).
- Third step: The students run the script they just compiled on the programming software R to answer the questions provided to them for this exercise.

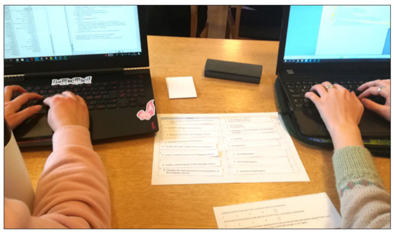


Figure 2: Students working through the exercise with the Double strip sequences

I went through the groups in the classroom to answer any questions and made sure that they were answering the questions correctly. The students had 40 minutes for this activity, including organizing the sequences and answering the questions.
I evaluated the performance of the activity through a ticket-out-the-door/classroom poll. Each student was given a piece of paper with 3 questions that they had to answer with a number from 1 to 5.
In the performance evaluation, the majority of the students responded that they finished the exercise and that they thought having the strip sequence helped them do it (Figure 3, A & B). I assessed the learning goal through asking how comfortable they would be to use the script they compiled in the exercise again (Figure 4). This assessment did not show a significantly positive result as the performance evaluation did. Therefore, this is the section of the activity where improvements should be made (Figure 3, C).

MAIN POINTS

1. **Main problem/challenge:** Using the R programming software consciously to solve exercises.
2. **Teaching activity**: Double strip sequences and running R script.
3. **How did it go?** Overall positive response.
4. **What to do next?** Give them more time, add a detailed explanation of what they did.

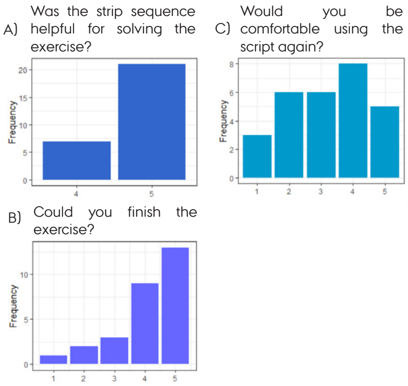


Figure 3: Evaluation of the teaching activity. Results of the classroom poll to each of the 3 questions.

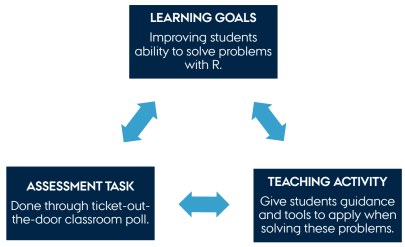


Figure 4: **Constructive alignment.**
The correlation between learning goals, the teaching activity and the assessment task are shown in this figure.

4. Looking forward

The activity was successful overall. It helped the students solve the exercises and they understood what each R command meant, so they are more likely to be able to use these tools again. Some students did not have enough time to finish the whole exercise. Next time, I would make sure to give the students more time for this teaching activity, so that they can work more calmly. Also, at the end I would give a detailed explanation of what they did, which would hopefully help them feel more comfortable using the script again.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Julia C. Mata
Section of Ecoinformatics and Biodiversity
Department of Bioscience

Theory vs practice

-Approach of both strategies to improve learning

Learning Lab

Abstract: A common challenge students face in their every day life is how to retain all the information learnt during a period of time and moreover, how to apply this concepts. In order to interiorize new knowledge and be able to apply it is necessary to not only study a subject from different perspectives (practice and theory) but to use other strategies like explaining to peers and give examples to test if the concept is clear. In the course "Food and Ingredients" different approaches and strategies to learn will be used in order to make it easier for students to acquire new knowledge on food science, more specifically plant proteins, their current applications, challenges and future regarding their uses in industry.

COURSE FACTS

- Course name: Food and Ingredients
- Level: Master
- ECTS credits : 5
- Language: English
- Number of students: 32
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

Due to the broad topic that is going to be explained in the course, it is likely that students won´t be able to retain all the information. Therefore, it is highly important to find a way to help students interiorize the most important concepts and relate them to the different areas of food science so they can expand easily their knowledge.

Even though the course is theoretical, practical strategies adapted to the classroom will be used.

2. Planning a teaching activity

The teaching activity will focus on the most important aspects about plant proteins, and how these are related to areas of food science.

Activities where students participate may be useful for them to interiorize the concepts and further relate it in the other lectures of the course.

First, students should read guides before coming to the course. Once there, the theory will be explained using slides as support. Furthermore, a practical exercise in groups will be organized were students apply the recently acquired knowledge to explain the phenomenon of the short experiment.

3. Trying it out in practice

Once the theory is clear, students will be organized in small groups in which they must collaborate in order to perform the experiment. For this materials such as NaOH, HCl, small beakers, water and a pH paper will be used.

Different groups will use different proteins (pea or rice) at different concentrations/ratio. And will hypothesis on the results obtained according to their observations and theory.

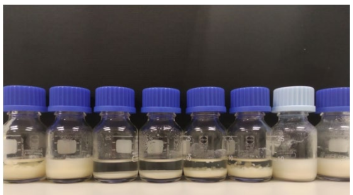


Figure 1.: Protein precipitation, using pea and rice protein isolates. Effect of pH and temperature.

The students are expected to take responsibilities in teams and lead discussions based on specific articles that can be used as a guide to connect the theory with the practice. After this activity, each group will present their results, the explanation and the others will listen, ask questions and socialize their results to reach a consensus on the results.

This activity tackles the challenge to learn a new topic by using different methodologies applied to the same area of knowledge.

MAIN POINTS

1. **Main problem/challenge:** The course topic is broad and may be difficult for students to retain information
2. **Teaching activity**: Plant proteins, functionality digestibility and future trends.
3. **How did it go?** Students were able to understand the concepts through practical exercises and interactions.
4. **What to do next?** Work on the recommendations and think about strategies that could be incorporated for further courses

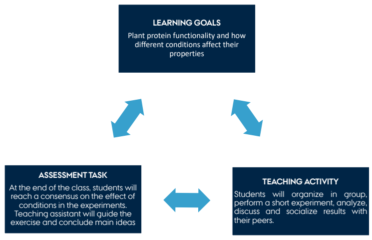


Figure 2: Constructive alignment
Constructive alignment

4. Looking forward

The teaching material was useful and provided students with guides to understand the overall purpose of the lecture, and practical exercises proved useful to interiorize the main points of the lecture. It will be reasonable to think about more strategies that encourage students to participate and interact in the class. This way it could strengthen the concepts learnt.

References

Day, L. (2013). Proteins from land plants- potential resources for human nutrition and food security. Trends in Food Science and Technology. 32, 25-42.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Luis Miguel Jimenez Muñoz
Food Proteins
Food Science and Technology

Turning the 'We' into an 'I'

Strip Sequence & Meta-Problem Solving in 1st year Physics

Learning Lab

Abstract: We all know the challenges of adjusting to the expectations and alien environment of the university during our first semester. New students often cope with this by clustering together in groups. However, with individual exams waiting for them after Christmas, it is important they learn to solve difficult problems alone. This activity helps them think about and create a guide to challenging problems and forces them to become aware of their own level of problem solving. Overall, the activity was well-received, especially the strip sequence task reflecting on the most efficient way to tackle a problem, although many students did not find the time to try out their plan at home. Giving an easier problem and time in class may fix this issue.

COURSE FACTS

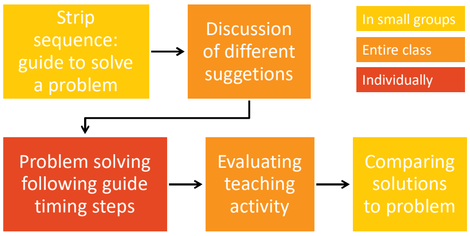
- Course name: Mechanics & Thermodynamics (for Nanoscience)
- Level: 1st semester
- ECTS credits : 10
- Language: Danish
- Number of students: 19
- Your role: Teaching Assistant

MAIN POINTS

1. **Main challenge:** Students work mostly in groups, but the exam is individual. Also, setting up and solving a problem can be intimidating and tricky.
2. **Teaching activity**: 'Strip-Sequence' constructing a Battle Plan for problem solving and individual walkthrough of a difficult exercise following the Plan and timing the steps
3. **How did it go?** The students were well-involved in the group work, but only 9 went through the activity at home. The wrap-up tried to convey their experiences to everyone else.
4. **What to do next?** Try with an easier exercise and give them time during the lesson to ensure the weak students get through.

1. Identifying a problem

We have all been there: The first semester of Uni-life. Hand-ins, reports, loads of exercises, confusing hallways, moving out, etc., etc. If you do not stick together in groups, odds are you are not going to make it. So that is what people do. That is what we did. Talk with our classmates about the exercises, solve the hand-ins together. And that is fine, as long as one remembers that the exam is NOT a group exam. But people tend to forget. And suddenly you find yourself alone, you vs. the exam with not a clue as to how to tackle this formidable task, because all you ever did during the semester was nod, when your classmates said something smart and be like: "We really understand this..."



2. Planning a teaching activity

My goal is to turn the 'we' into an 'I'. By forcing the students to solve an exercise by themselves while timing their steps, I hope to give the 'nodders-not-doers' a scare and make them realize how important it is to know thyself before entering the exam room. To help them along with their problem solving, they will make a group/class activity, where they reflect on the best way to set up and solve exercises, so they have a red line to follow if they ever get lost: A so-called Battle Plan for attacking the problem.

Ultimately, I hope to bridge the gap of misalignment between the way Theoretical Exercises are run (with group work and discussion questions) and the individual exam, where it's all about finding the right solution. Alone.

3. Trying it out in practice

TE Class 1: Battle Plan Strip Sequence

The students were asked to order 8 steps in setting up and solving a generic physics problem in **groups of 3-4** (10 min.). The different versions were discussed **on the class** (20 min.).

At Home: **Individual** Problem Solving

Following their newly constructed Battle Plan (or my own suggestion), the students had to solve one of the more challenging problems at home, while timing their steps.

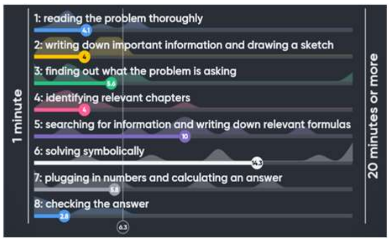


Figure 2: Time spent on each step of the Battle Plan (in minutes). The vertical bar denotes average of all steps.

TE Class 2: Evaluation / Wrap-Up

The students were asked to fill out a questionnaire about their experiences (5 min.). Only 9 students had solved the exercise and answered the questions (Figs. 2-3). Nevertheless, we shortly discussed the results **on the class**, so hopefully everyone learned from the experiences of the 9 who managed to go through it.

Everyone participated actively in the first 'Strip Sequence' part of the activity and the results from the poll also indicate that many found this interesting and useful. The students who actually solved the exercise at home also liked the more organized way of 'attacking' the problem, although they disliked timing their steps. Even though this might be overkill, I still think it makes them aware of time pressure in a real exam situation. Luckily, most feel better prepared for the exam! The aim of the activity was not entirely fulfilled, though, since the 'nodders-not-doers' continued doing what they do best. I will try to redo the activity with an easier exercise.

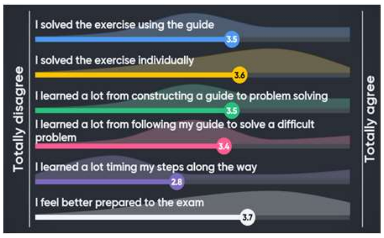


Figure 3: Students' opinions about each part of the activity.

4. Looking forward

Even though all students liked the group 'Strip Sequence' session, only about half of them went through the individual exercise at home. These students, however, liked the exercise – especially constructing and following a guide to make problem-solving less insurmountable. Happily, the majority feel better prepared for the exam, which is also the exact purpose. The 'nodders-not-doers', however, were not persuaded to solve the individual exercise, but I will try to give them an easier problem and time during one of the classes.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Semiconductor Group
Institute of Physics and Astronomy

How to get active students?

- Proposals for activities which ensures well prepared and active students during class

Learning Lab

Abstract:

Often problems with unprepared and inactive students during class are encountered. To counteract this, students were asked to prepare and present parts of the curriculum themselves. The students prepared nice, relevant presentations and performed well. However, they only prepared thoroughly for the part of the curriculum which they were responsible for. Therefore, the activity will be supplemented with a multiple choice test next time focusing on all parts of the curriculum.

COURSE FACTS

- Course name: Husdyranatomi og Fysiologi
- Level: 3rd semester
- ECTS credits : 10
- Language: Danish
- Number of students: 8
- Your role: TA teaching about the integumentary system

TEACHING IN PRACTICE

1. Identifying a problem

Two major challenges were identified: 1) Students attending class unprepared and 2) inactive students during lecturing. It makes it difficult to ensure that the expected learning from the class is meet. Therefore, the intention with this teaching activity was to 1) get the students to prepare before the class and 2) to participate actively during the class.

2. Planning a teaching activity

In the activity, students will present different parts of the curriculum during the class which they have to prepare before the class. This will motivate them to meet prepared and make them active during the class. To implement this activity, the original teaching plan was restructured. The class was a mix of lecturing, student presentations and small exercises.

Hopefully, the changing and involving activities will contribute to, that the students stay motivated during the whole lecture, participate actively and obtain the qualifications specified in the learning outcomes:

1) describe the anatomy, physiology, growth and functions of the integumentary system and
2) train oral presentations on core course concepts.

3. Trying it out in practice

Four major topics were identified:

1) epidermis
2) dermis
3) glands
4) hair

In groups of two, the students were asked to prepare a 5-10 min. presentation about these topics. A textbook chapter were provided as teaching material. They were asked to use PowerPoint for their presentations.

The learning of the activity was accessed by TA observation. During/after the presentations, the TA clarified misunderstandings and added missing parts.

They students prepared nice presentations, performed very well and included the relevant material in their presentations. Additionally, the students were participating actively during the class.

MAIN POINTS

1. **Main problem/challenge:** Unprepared inactive students.
2. **Teaching activity**: Student presentations of different parts of the curriculum.
3. **How did it go?** The students were better prepared, active and pleased with the activity.
4. **What to do next?** Multiple choice motivating to prepare all parts of curriculum; rubric for presentation evaluation.

The students liked the new teaching format compared to the old lecturing format. They felt they have prepared better for their own subject than otherwise and that it was motivating with the changing teaching style during the class. However, they did not prepare the other parts of the curriculum very well which has to be dealt with next time.

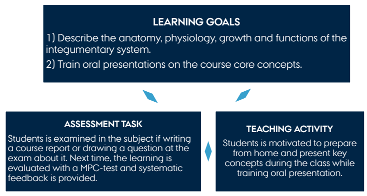

Figure 1: **Constructive alignment**
Alignment between learning goals, teaching and assessment.

4. Looking forward

The students prepared well for their presentations, they participated actively during the class and they expressed that they felt motivated during the class due to the changing activities. However, they stated that they did not prepare the other parts of the curriculum very well. Additionally, it was hard to assess whether the students had obtained the competences stated in the learning objectives. Therefore, the teaching material will be expanded with a multiple choice test with 4-5 questions per topic to get an impression of how the students are learning. The test will be at the very end of the class. It will be announced before the class to motivate the students to get familiar with all parts of the curriculum before the class and listen carefully to the other presentations. Finally, a rubric to use during the presentations to evaluate the presentations and provide systematic feedback to the students will be developed.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Department of Animal Science

Think-pair-share

- Enabling students learning to represent phylogenies as trees

Learning Lab

Abstract:

The think-pair-share activity was carried out for the course of Algorithms in bioinformatics in a class of 15 students. It introduced students to trees and how they can be used to represent phylogenies. This activity is important because students are biological students and were unaware of tree data structures. The activity equipped students to get a theoretical understanding of the topic but also implementing a tree (efficiently) that would help them with oral exam and in a future course. Overall, the activity went well in which most of the students liked the teaching activity and would like the activity to be continued in the remaining weeks.

COURSE FACTS

- **Course name:** Algorithms in Bioinformatics
- **Level:** Masters
- **ECTS credits :** 10
- **Language:** English
- **Number of students:** 15
- **Your role:** Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

The students enrolled in the course usually come from diverse backgrounds and not necessarily Computer Science. Therefore, for most of them, it is the first time they are asked to approach a biological problem from the computational aspect. Most of the students have only worked with strings. They have not worked with trees before and don't have an in-depth understanding of how biological information can be stored in trees. Therefore, it is important make sure that students have sufficient understanding of trees which will constitute the main part of the oral exam and for the next course as well.

2. Planning a teaching activity

Based on the above-mentioned problem teaching activity was planned such that students get an in-depth understanding of trees. By the end of the activity, students must:

1. know how to construct and traverse a tree.
2. be able to compute the distance between the two trees.

The students were asked to solve six theoretical exercises and one coding exercise on trees in their favorite programming language.

By the end of this activity, student will have a better understanding of trees algorithmically which will help them not only in their oral exam but also in the course in the next semester. This activity will help students develop communication skills by discussing the solutions. This wil help them in their oral exams.

3. Trying it out in practice

The teaching activity (think-pair-share) was carried out in the eighth week of the semester. The structure of teaching activity is given in Figure 1. First students had to go through the exercises and answer them individually in the first hour of the class. In the second hour, students paired up to discuss their solutions followed by a general discussion in the class in the last hour. In general discussion each pair was given a certain question to present.

For evaluation of the teaching activity,

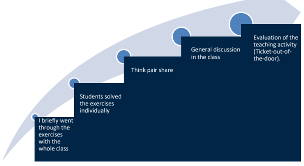


Figure 1: Structure of the teaching activity conducted in week 8.

Students were given ticket-out-of-the-door questionnaire which they had to fill out in the last 15 minutes of the class.

4. Evaluation

Based on the questionnaire responses, students found the activity to be useful. All students but one found the teaching activity extremely helpful (see Figure 2a). And, 13 students were helped by their partners in understanding at least one concept which they wouldn't have been able to understand otherwise. (see Figure 2b). The concepts students needed help with included depth first traversal, number of splits in a binary tree (see Figure 3).

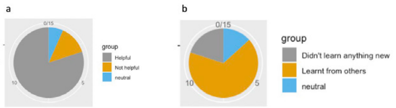


Figure 2: Evaluation of the teaching activity

MAIN POINTS

1. **Main problem/challenge:** Approaching a biological problem from a computational aspect.
2. **Teaching activity**: Think-pair-share
3. **How did it go?** It went well. Students would like to continue with this approach.
4. **What to do next?** Continue doing group discussions and make solutions available after the class

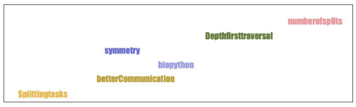


Figure 3: Most common words found in questionnaire.

During class discussion, I felt students were more confident in answering questions. And even those students answered questions that mostly remained quite in previous weeks. The general feedback to continue with this activity and make the solutions available on blackboard at the end of the of each class.

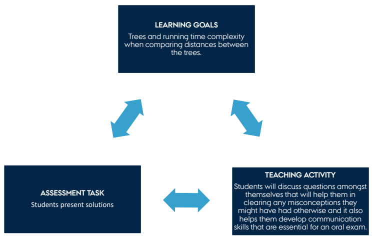


Figure 4: **Constructive alignment**

4. Looking forward

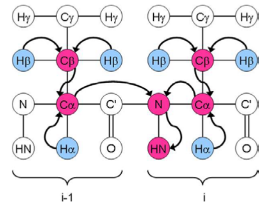
The students generally seem to learn a lot from group discussion which means that this activity should be carried out in all classes. Also, it'll help them if solutions to exercises are made available after the class. This will allow students to look at the solutions later which will reinforce the concepts more.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Bakhtawar Noor
Bioinformatics Research Center

Pencils, rulers and 3D-NMR spectra

- Dropping the computer screen and using traditional school desk tools to learn the basics of solving 3D-NMR spectra of proteins.



Abstract: As analysis of the 3D-NMR spectra requires precise determination of peak placement and identification of relationships between individual signals, a traditional yet forgotten pencil-and-ruler method support the learning outcome of the students. In this teaching activity, the students can represent coupling between signals by drawing lines between the peaks and their neighbors directly on top of the spectra. Through that, the students manifest their thoughts graphically one peak at a time, which allows them to approach the problem way more systematically than they would by simply looking at a computer screen. The students reacted positively towards this learning activity, suggesting further application and development of this approach.

COURSE FACTS

- Course name: Biomolecular Structure and Function
- Level: 2. year BA
- ECTS credits : 10
- Language: Danish
- Number of students: 25
- Your role: TA in TØ and LØ

TEACHING IN PRACTICE

1. Identifying a problem

Second year students attending this course are met with solving 3D NMR spectra of proteins for the first time in the time of their education and struggle making sense of how to approach such an assignment. The students are handed the assignments out on their computers, however, the untrained eyes of the students have a hard time deciding whether signals are correlated or they just merely resemble each other. It is simply hard to connect the dots on a screen. Solving such problem is a craft and the learning curve is steep and the students need all the help they can get.

2. Planning a teaching activity

Analysis of 3D-NMR spectra requires precise determination of peak placement and identification of many relationships between individual signals. Here, I show a back-to-basics approach that is both more graphically approachable and more manageable for a person still to learning the basics of solving protein 3D-NMR. Understanding the process is made easier by connecting signal one by one, which can be achieved by drawing on top of the spectra. Therefore, I provide the students with printed assignments, pencils and rulers. I show them initial steps on a whiteboard, while they follow on paper and gradually take over individually.

3. Trying it out in practice

Traditionally in theoretical exercises, the students are divided into groups, solve the problem and present their results in front of the class. Here, we solved the assignment in plenum in stead, where I introduced the initial steps of the method and each student followed these steps on their own piece of paper and gradually started solving the rest in their own.

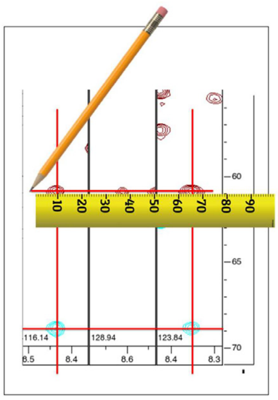


Figure 1: Schematic of the pencil and ruler method, where the student can systematically connect the nitrogen signal from C_α and C_β, shown here by red lines. The students are handed out the assignment on a A4 page together with pencils and rulers.

Once the students began solving the rest of the problem on their own, I approached each student and checked if they could proceed on their own to asses whether they got the basics. If not, I used extra time on these students. Most students seemed to understand the basics by the end of the class. I evaluated this activity by a three question survey, showing largely positive results (fig. 2).

MAIN POINTS

1. **Main problem/challenge:** Learning to solve 3D-NMR specra
2. **Teaching activity**: Paper, pencil and ruler in stead of computer screens.
3. **How did it go?** Remarkably positive results!
4. **What to do next?** Consider using this as standard method of learning to solve 3D-NMR.

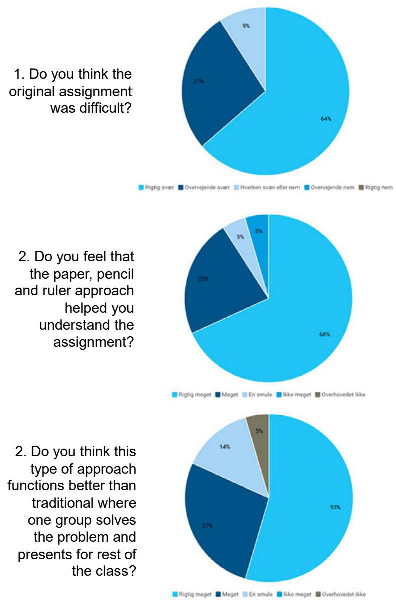


Figure 2: Feedback from students from a three question survey (22 responses) in Danish. The results show that students thought the assignment was difficult and that they feel this kind of learning activity help them understand basic concepts of solving 3D-NMR.

4. Looking forward

In these digital times we might consider taking a step back from time to time and make use of analog tools at our disposal to help the students learn difficult concepts such as solving 3D-NMR spectra. The students feedback was overwhelmingly positive, suggesting that this approach should be a permanent part of the course. This learning activity could be improved by providing the students with a how-to handbook, so they do not depend on the instructor.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Jan S. Nowak
Protein Biophysics Group
iNANO

Connecting the Dots

- Relating exercises to overarching physics concepts

Learning Lab

Abstract: The considered course introduces students to a wide range of basic physics topics over a limited time span. This can result in students having difficulty maintaining an overview of the overarching physics concepts and how these are related to each weeks exercise problems. To combat this, this activity makes students reflect in groups on the current week's most important concepts and put this on a paper. This is done at the beginning and end of each week and has minimal time and material requirements. In practice, the students perceived outcome was positive but did not exceed the ordinary teaching's.

COURSE FACTS

- Course name: Mechanics and thermodynamics
- Level: 1st semester
- ECTS credits : 10
- Language: Danish
- Number of students: 20
- Your role: TA in problem solving

TEACHING IN PRACTICE

1. Identifying a problem

The course introduces students to a wide spectrum of fundamental physics topics. Due to the limited time available, it is normal for students to feel overwhelmed by the rate at which they are expected to become proficient within each topic. For this reason, students have difficulty maintaining an overview of how the week's problems are related to each other and earlier problems in terms of the overarching physics concepts. This reduces their ability to both solve the given exercises but also extract the desired learning outcomes from doing so. The purpose of the exercise presented here is to help maintain this overview and thereby strengthen the students learning outcomes.

2. Planning a teaching activity

The activity is inspired by the "give-one-get-one" activity [1] and only takes a very limited amount of time away from the ordinary teaching (~20 minutes from 5 hours). As well, it requires minimal materials: each student should have pen and paper.

The idea is to have the students reflect for 10 minutes to come up with the most important concepts and points related to the week's topic. Each student individually writes these on a piece of paper but sharing through group discussion is encouraged.

References

1. Active learning and adapting teaching techniques (the University of Toronto)

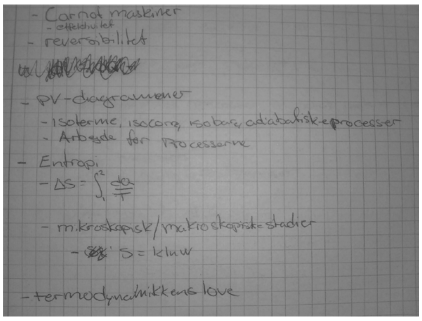


Figure 1: **Paper example**
Example of one student's 10 minute reflections on the most important points from thermodynamics.

Each week contains two exercise sessions. The activity is carried out at the beginning of the first session and repeated at the end of the second one. This is with the purpose first of repetition of related concepts to bring these fresh to mind prior to problem solving. Then to aid cementing the important concepts by having the students immediately reflect on which they used.

3. Trying it out in practice

In the activity the students were divided into groups of 4-5 in which each student individually filled out a paper with the most important concepts while discussing with group members. A short example of such a paper is shown in fig. 1.

Due to its low time and material requirements, the activity was smoothly integrated into the ordinary teaching. The perceived student reception was positive and so the activity went well overall.

MAIN POINTS

1. **Main problem/challenge:** Maintaining overview of exercises relation to overarching concepts
2. **Teaching activity**: Give-one-get-one inspired reflections
3. **How did it go?** The activity was smoothly integrated into the ordinary teaching and the students were positive about their perceived outcome
4. **What to do next?** Despite the positive student reception, their perceived outcome was not greater than that of the ordinary teaching leaving little motivation for further use.

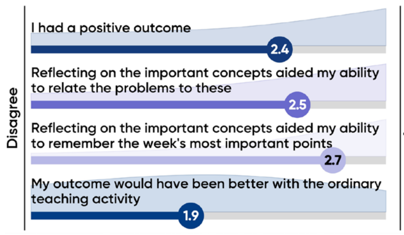


Figure 2: **Evaluation**
The activity was evaluated using Mentimeter with four statements as shown in the figure but in Danish. Each statement was commented on on a scale from 1 to 3 corresponding to disagreement, neutral, and agreement. The number of participants was 16.

In a following exercise session, the activity was evaluated. This is summarized in fig. 2. The student's perceived outcome was positive and aligned with the intention. However, they did not judge this outcome to exceed that of the ordinary teaching.

4. Looking forward

The activity has low time and material requirements which makes it easy to integrate into eventual future sessions. Furthermore, the perceived outcome from the students perspective was positive – especially when it comes to aiding the student's ability to relate exercises to the overarching concepts.

Despite this, they did not perceive the outcome to exceed that of the ordinary teaching's. Therefore, there is little motivation for repeating the activity.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Jonas Olesen
Neurophysics
Department of Physics and Astronomy

Academic Report Construction

- Understanding The Build-up And Content Of The Exemplary Scientific Report

Learning Lab

Abstract:

The course "Inorganic Chemistry I: General Chemistry" introduces new students to basic concepts of both theoretical and practical (laboratory) inorganic chemistry. As a key learning goal, the students have to write several reports; however, it has been observed that students just accepted at the University have complications writing proper scientific reports. Through the presented Think-Pair-Share (TPS) exercise, students will achieve a clear understanding of how a scientific report should be structured and what content the different sections should contain. Unfortunately, the teaching activity was not conducted due to the time-frame of teaching.

COURSE FACTS

- Course name: Inorganic Chemistry I: General Chemistry
- Level: Bachelor, 1^{st} year
- ECTS credits : 10
- Language: Danish
- Number of students: 17
- Your role: TA in Laboratory Exercises

TEACHING IN PRACTICE

1. Identifying a problem

It became rapid very clear teaching this course that newly accepted students at the university have difficulties writing a well-structured academic scientific report. However, this is completely understandable as no introduction is given to the students. The students have following difficulties:

1. Applying academic parlance.
2. Structuring the report.
3. Understanding the content of the different sections.

Mastering the writing of scientific reports is a crucial part of producing results and being an excellent scientist. A teaching activity, which enhance the students understanding on scientific writing is therefore to be implemented.

2. Planning a teaching activity

The planned teaching activity is based on the active learning technique "Think-Pair-Share" (TPS).
Before starting the activity the students will be asked to write several scientific papers. When starting the activity, the students will by themselves reflect on the characteristics of the exemplary scientific report. After thinking for themselves, the students will have to discuss in pairs and present their key points. At last, the students and TA should have a class-discussion evaluating the presented views. As an additional element to the TPS-activity, students will immediately after the activity have time to look at their own to-hand-in-report to identify any mistakes. The learning outcome of the activity is to improve the main understanding of scientific writing.

Figure 1: General concept of teaching activity.

3. Trying it out in practice

The learning activity relies – as stated – on the TPS teaching activity. In the first part, the students briefly have to think about the characteristics of the exemplary scientific report. After five minutes of thinking, the students will pair up and discuss for an additional five minutes. Afterwards, the TA will manage a sharing-session for the entire class, where the different students groups will share key points. During the share-session the different points will also be discussed to ensure the students obtain a great understanding. This part is intended to take 10-15 minutes.

MAIN POINTS

Main problem/challenge:
Student-understanding of academic report construction.

1. **Teaching activity**:
   Think-Pair-Share.
2. **How did it go?**
   Teaching activity not performed to this point.
3. **What to do next?**
   Perform activity next year.

After the share-session, the students will be given about 10-15 minutes to look at future reports to identify any compliances with the presented points from the share-session.
The assessment of student learning will primary occur by correcting the next report and look for significant improvement.
The evaluation strategy is intended to be Ticket-out-the-Door, where the students have to state two good things about the teaching activity and two things to be improved before leaving class.

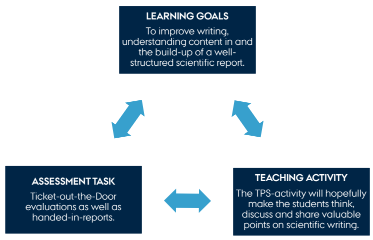


Figure 2: **Constructive alignment**
The teaching activity was chosen to make the students think what elements are crucial for a scientific report – and how to implement these.

4. Looking forward

As the teaching activity has not been performed yet nothing can really be concluded on the TPS-activity. However, I look forward to implement the activity next semester to observe if the activity promotes any improvement.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Rasmus Nørbøge Ottosen
Chemical Biology group
Department of Chemistry

Learning the concepts of NMR

- Repetition by Mentimeter and hands-on experience

Learning Lab

Abstract:

The lesson had two major problems: it was difficult for the students to grasp that happen in the different steps of NMR analysis and the order of the steps. Moreover, they had practical challenges pipetting the solution into the NMR tube. Implementing a Mentimeter quiz with questions on what happen in the different steps will hopefully help the students to recap the method and help the students remember. A short session of showing tips and tricks on how to transfer a solution into the narrow NMR tube followed by hand on work with the technique, will hopefully minimize the error rate handling the samples.

COURSE FACTS

- Course name: Food Chemistry
- Level: Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 39
- Your role: TA in laboratory exercises with three other TAs.

TEACHING IN PRACTICE

1. Identifying a problem

Teaching this year's course two different problems appeared. Correcting the assignments, I found that the student had difficulties understand the nuclear magnetic resonance (NMR) method used in the exercises. The lesson included a lecture of about 20 min on the NMR method and concept, but this was not sufficient for the student the completely understand the method. This year 7 of 8 groups had problems explaining the method and the steps involved in it even through this lecture about the method was included. Therefore, the students need some learning activity to help them understand the concepts of the method. Moreover, they need help to structure the different steps in the analysis to remember the order of the steps. During the NMR exercise, the students had to pipet the supernatant into the narrow NMR tube. This caused the students problems and some groups ended up losing some of the supernatant, resulting in odd results in the following quantification.

2. Planning a teaching activity

The lecture on the NMR will still be included and the students will be encouraged to ask questions both during the after the lecture. After the lecture, a Mentimeter quiz will be implemented to ensure a better learning outcome for the students. The quiz should be with questions on the NMR method and the different steps and concepts in it.

The quiz consists of ten questions: nine questions on the different steps and the purpose of each – the steps is in chronological order. In the last question, the students are asked to arrange the steps chronologically. I hope that it will help them remember the function of each step and remember the order of the steps. During the NMR exercise, right before the pipetting of the supernatant to the NMR tubes, I will implement a small section where all students will have time to practice pipetting a solution into a NMR tube. In the beginning of the section, I will show and explain them how to transfer the supernatant into the NMR tube. In that way, the students will hopefully be more confident and perform better pipetting the actual supernatant for the NMR.

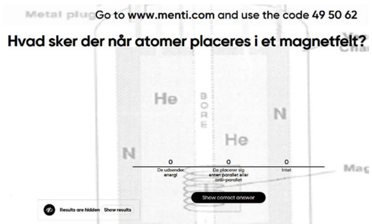


Figure 1: Example of a Mentimeter question on the NMR method.

3. Trying it out in practice

Unfortunately, I was not able to implement my teaching activity and therefore I could not access whether the activity improved the learning and helped the students achieve the learning goals. Instead, I will in the following go through the teaching activity in more detail.

As described before, after the 20 minutes lecture on NMR, the lesson will continue with the Mentimeter quiz on the topic.

MAIN POINTS

1. **Main problem/challenge:** Understanding the theory behind the NMR method and practical problems pipetting.
2. **Teaching activity**: Mentimeter quiz on NMR and a shot session where the students have time to practice pipetting solution into the small NMR tubes.
3. **How did it go?** Unfortunately, I was not able to implement my teaching activity.
4. **What to do next?** The next step will be to test the teaching activity the next time the course is run and to evaluate the effect on student learning in the written assignment and during the experiment.

A question could e.g. be "What happens when atoms are placed in a magnetic field?" With the options: "They emit energy", "They arrange either parallel or anti-parallel to the field" or "Nothing". I will then go through the questions and discuss the answer with the students. Hopefully, this repetition will help the students structure the knowledge and this should be reflected in the assignment. Before the students should transfer the supernatant to the NMR tube, we will have a small session where all students have time to practice this. First, I explain how to do it with some tips and tricks and thereafter the students get some time to practice it. This will hopefully minimize the errors with the real sample and make the students more confident.

4. Looking forward

The first step will be implement the teaching activity in next year's course. The teaching will be evaluated by the students explanation of the NMR method in their assignment and by the way they handle the final pipetting into the NMR tube. Hopefully they will be more confident in both assignments and have less corrections in their paper.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Sofie Kaas Ovesen
Differentiated and Biofunctional Foods
Department of Food Science

Paleo think-pair-share

- Reconstructing past environments in pairs

Abstract: It is not always easy for the students to pick up the important information from a lecture series in order to understand the big picture. With a think-pair-share exercise and a following class discussion the students can reflect on their already acquired knowledge, and the lecturer is able to assess their level of understanding. After trying the activity out in practice, we can see that it works very well, however, it would be beneficial to include at the end a more solid student evaluation.

Learning Lab

COURSE FACTS

- Course name: Geological Reconstruction of Climate and Environment
- Level: Bachelor
- ECTS credits : 10
- Language: English
- Number of students: 12
- Your role: TA and lecturer

TEACHING IN PRACTICE

1. Identifying a problem

Often students get a lot of different information during their courses, which they have to organize and connect in order to be able to solve the final assignment. The information are like puzzle pieces, that they have to be able to assemble alone to get the big picture. However, this is not always an easy task, especially if the students have never done it before. Moreover, it is often not clear to the lecturer before the final assignment, if the students understood the main concepts in order to be able to solve the problem.

2. Planning a teaching activity

It seems to be a good idea to make an exercise during the lecture, where first the students can try to interpret data in pairs, share their ideas, and when they feel more confident about it, discuss it with the others in plenum.

During the selected course, I will give a lecture, where I will include the above-mentioned think-pair-share exercise. In the first part of the lecture I will tell about how to interpret different environmental-proxy curves. Then, I will give them an already published figure (Fig. 2) and ask them to pair up and discuss, what kind of environment the curves could indicate in the different time intervals (colored columns). After the pair-discussion I will encourage the students to discuss their ideas/interpretations in plenum.

References
Telesinski, M.M., Spielhagen R.F., Lind E.M. (2014). A high-resolution Lateglacial and Holocene palaeoceanographic record from the Greenland Sea. *Boreas* 43(2), 273-285.

The teaching goal is to activate the students during the lecture to reflect on their acquired knowledge through discussion.

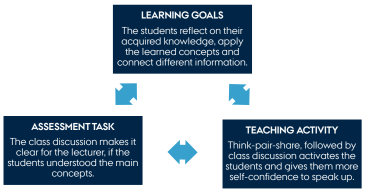


Figure 1: Constructive alignment

3. Trying it out in practice

I performed the teaching activity after a 20 minutes lecture. The figure (Fig.2) was available on the big screen and on Blackboard too. The students paired up, and they actively discussed in 5 minutes with each other the possible meanings of the curves. After 5 minutes, I asked different pairs to tell us how they interpret the changes in different time intervals, and I encouraged the other students to discuss it if they are not agreeing with the interpretation. Finally, I confirmed and added some information that was not mentioned before.

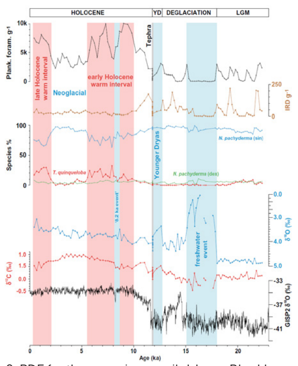


Figure 2: PDF for the exercise, available on Blackboard. Figure taken from Telesinski et al., 2014.

MAIN POINTS

1. **Main problem/challenge:** To activate the students to connect acquired information and to assess their understanding.
2. **Teaching activity**: Think-pair-share, followed by class discussion.
3. **How did it go?** Very well. The students engaged actively in the discussion, which prepared them for the final assignment, and enabled me to assess their understanding of the topic.
4. **What to do next?** It would be a good idea to perform again a similar exercise, but with a more complicated figure, before the course ends. Moreover, it would be nice to implement the student evaluation with Mentimeter.

The teaching activity worked really well, the students got engaged, and I was able to assess, if they understood the main concepts, and if there is something that I should explain again or more in detail.

At the end of the lesson I asked the students, if they found the teaching activity useful or if they would change it somehow. The response was positive, the students liked the exercise and they found it beneficial for the final report.

4. Looking forward

The students liked the teaching activity, they felt that it prepared them better for the final assignment. I was also satisfied, because the students got activated during the lecture, and I could assess their knowledge better. I will suggest to the course organizer to keep the exercise in the next year too, and maybe add another similar but more complicated one just before the course ends. I will also suggest to use Mentimeter for the student evaluation next year.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Teodora Pados-Dibattista
Paleoceanography and Paleoclimate
Geoscience

What is stressing my plants?

- Building bridges between theory and practice

Learning Lab

Abstract:

During class, students sometimes have difficulties remembering and fully understanding intensive information and applying it in practice. Promoting a learning environment through brainstorming and discussions will help establish a better connection between different topics and linking the concepts of practice and theory together. For this purpose, we developed a teaching activity in which the students will apply the knowledge learned in class to explain the reactions of stressed plants observed in practice by answering a spectrum of questions available on Menti.com. These questions will help the student understand the topic better and will work as a guideline for discussion throughout the teaching activity. Unfortunately, we were not able to implement our teaching in practice, thus no conclusions or improvements will be mentioned on this poster.

COURSE FACTS

- Course name: Applied methods in crop physiology
- Level: PhD
- ECTS credits : 5
- Language: English
- Number of students: 12
- Your role: TA in practical lecture

TEACHING IN PRACTICE

1. Identifying a problem

This PhD course is an extremely intensive course in which students receive an incredible amount of information that can sometimes be hard to remember, understand and later on, apply it in practice. When subjected to questions in which is required for the students to connect different topics to reach a correct conclusion, they are often unable to remember key aspects that are fundamental for problem solving.
In order to facilitate the connection between different topics and to build a bridge between practice and theory it is a good idea to promote a learning environment in which brainstorming and discussions about the topics occur naturally.
By exposing the students to group discussions and other interactive activities, they start connecting key components, gaining a deeper insight and understanding of the theoretical background and explaining plant reactions observed during practical lectures based on the knowledge gained during theory lectures, all learning outcomes of this course.

2. Planning a teaching activity

For our practical lecture, the learning outcome is that the students are able to understand the effect of drought stress on plant physiology. To fully understand this, students need to be able to relate different aspects of stress biology.
In our teaching activity, the students will apply the knowledge learned in class to answer several questions in Menti, which will help the students explain the reactions of stressed plants observed in practice.
We believe that brainstorming associated with real life examples allow for a better understanding of the theory and key concepts. As such, the students will be divided in small groups and will discuss the answers to the quiz together.
At the end of the teaching activity, the students should be able to analyze and assess the implications of abiotic stress events on crop growth, more specifically on photosynthesis and gas exchange. Thereby, menti quiz will allow the TA to assess the students knowledge.

3. Trying it out in practice

The practical lecture is limited to a three-hour schedule in which the students will be measuring gas exchange (original plan for the lecture created by the main lecturer).
Our teaching activity will be occurring at the same time as the measurements, as a complementary exercise with the objective of promoting understanding of theory through the active participation.
We will be introducing the teaching activity at the beginning of the practical lecture.
A spectrum of questions will be provided related with gas exchange, abiotic stress and photosynthesis that need to be answered in groups (4-5 students/group) during the practical class. These questions will be available on Menti.com and will work as a guideline for discussion throughout the lecture. While the groups are waiting for the plants to stabilize, we will promote discussion about the different questions on Menti.
Once all the groups are finished with discussing the results and answering the questions, we will look at the results of Menti in order to see which topics need more attention and discuss the answers with the whole class. This will promote brainstorming and "tie loose ends".
Finally, we will sum-up the main points of the teaching activity.

Questions from Menti Quiz:

Q.1. At which light level should a A/Ci curve be performed?
a) Ambient b) Low c) Saturating

Q.2. Which hormone induces stomatal closure under drought stress?
a) Jasmonic acid b) Ethylene c) Abscisic acid

Q.3. Under heat stress conditions, what happens to the photosynthetic system of plants?

Q.4. Under drought stress, plants open their stomata – TRUE or FALSE? Why?

❖ The assessment of the students learning will be divided in two parts:
1) By listening and promoting the discussions about the menti quiz during the measurements
2) Mainly through the answers to the menti quiz. We will look at the results of Menti in order to see which topics need more attention and which topics were rather easy to understand.

MAIN POINTS

- Main problem/challenge: Difficulties remembering and understanding topics due to the immense amount of information
- Teaching activity: Menti quiz combined with brainstorming in groups
- How did it go? Not tried out in practice yet. Will be applied in April 2020
- What to do next? Apply the teaching activity and improve it based on experience

❖ The evaluation of the teaching activity will take place at the end of the practical lecture, after all the answers from the quiz were corrected and explained. The evaluation will be in the form of a rating questionnaire and will focus on how much did the student learn, how much the student liked the activity, would the student like more activities like this, positive points and things to improve.

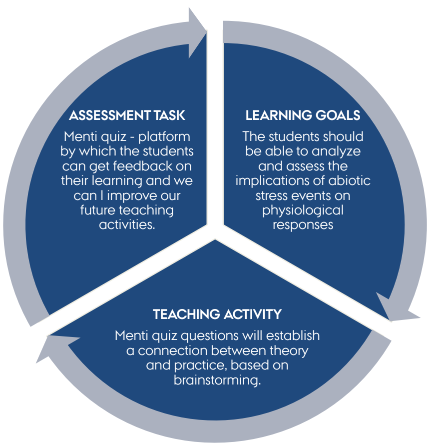


Figure : Constructive alignment of the teaching activity

4. Looking forward

We have not yet implemented the teaching activity, but we are looking forward to apply it in April 2020. Our main concern is that all the students will remain interested and engaged during the activity. We think that our teaching activity will not only help the students to learn and remain active, but will give insight in to what needs to be improved.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Carolina F. Palma and Lamis Abdelhakim
Plant, food and climate
Food science

Cosmic carbon hunting

- Games to help understand the role of hydrocarbons on terrestrial and interstellar environments

Learning Lab

Abstract: We created a science communication pop-up shop inside one of the most busy malls in Bristol city center. We wanted to raise awareness about the role of Polycyclic Aromatic Hydrocarbons (PAHs) in interstellar, but also terrestrial environments. PhD students from different disciplinaries (physics, chemistry, biology, etc) are having the role of the scientist in this shop, where they discuss with the audience their different approaches into studying PAHs. The purpose is to explain some of these techniques in a playful and understandable way, but also make the audience realize that everyone can be a scientist. We reached over 600 people

FACTS

- Shop name: Cosmic Carbon Hunters
- Language: English
- Number of people: ~100/day
- Your role: Scientist

TEACHING IN PRACTICE

1. Identifying a problem

Scientists are finding hard time at engaging with the public. Audiences are not always interested in discussing scientific subjects and they blank their minds to whatever involves science understanding.

PAHs are abundant in the interstellar medium and they play an important role in interstellar chemistry. They also exist in terrestrial environments and they are known to be carcinogenic. So understanding these molecules' properties is of great importance.

2. Planning a teaching activity

It is an exhibition which takes place inside a shop of an actual shopping mall. The aesthetics and the environment is arcade-like, which purpose is to be inviting for people to come in and play. The audience perceives science as a fun activity and learns through games. Half of the games-stations are inspired and based on techniques that each PhD student uses to study PAH molecules, but others are auxiliary, in order to familiarize the users with the molecules under investigation.

Stations:

- Sandbag game (aux.) (see Fig.1)
- Surface science (see Fig.2)
- Molecule building (aux.) (see Fig.3)
- Quantum chemistry (see Fig.4)
- Game boy (aux.) (not shown)
- Fishing game (not shown)

3. Trying it out in practice

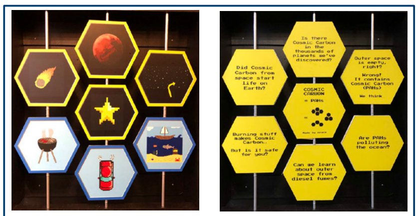


Figure 1: Sandbag game.

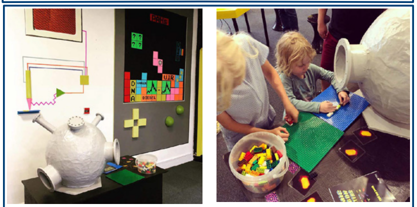


Figure 2: Surface science station.

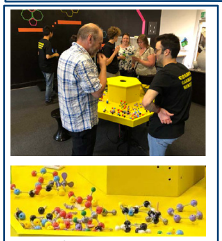


Figure 3: Molecule building station (top) and zoomed aspect of it (bottom)

Figure 4: Quantum chemistry station (top) and arcade-like quantum chemistry game.

Fig.1 shows the sandbag game. These hexagonal shaped plates show an environment where PAH molecules exist. The visitor has to turn them by throwing a sandbag and read the facts on the other side of the plate. A scientist is normally around to discuss with the user. Fig. 2 shows the surface science station. Inside the "chamber" there is a shape made by LEGO bricks. The user has to put their hands inside the chamber and "scan" the surface in order to understand the shape, mimicking surface science techniques. In the center of the shop there is a hexagonal shaped molecule building table as shown in Fig. 3.

MAIN POINTS

1. **Main problem/challenge:** Science communication with the public
2. **Teaching activity**: Games
3. **How did it go?** Really well
4. **What to do next?** The same, but with more targeted audience

This is a nice chance, especially when the audience has lack of knowledge of basic physics and chemistry to illustrate atoms and molecules Molecular structures exist by arguments of lowest energy and structural changes need extra energy to happen. In the quantum chemistry game shown in Fig. 4 the user has to collect energy tokens in order to be able to surpass the potential barriers to complete the level.

Assessment of whether or not the audience was able to get the message was really tough and, it was mainly based on verbal communication. Some of the activities were better at attracting younger people and others at attracting older. Also, the level of education was playing a role on the depth of the discussion.

4. How the activities support learning?

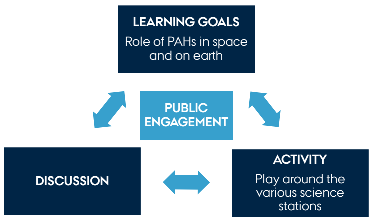


Figure 5: **Public engagement in science**. The scientist is not the lecturer, but is engaging in discussion.

In Fig.5 is presented how learning through public engagement of the scientist work. The aim is to stimulate science discussion in a non constitutional setup.

5. Looking forward

The shop was able to attract a large number of people. It changed not only the way the visitors think, but also how the scientists explain their science to the people. One thing that could be improved in the future is the highly diverse education level of the audience. Scientists had to readjust the level of the scientific discussion constantly. Homogeneity of the audience will ensure a more structured approach to the public engagement.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Georgios Pantazidis
Surface Dynamics Group (SDL)
Department of Physics and Astronomy

Group work-based experiment design

Bridging prior obtained knowledge in order to design and innovate a hypothetical experiment

Abstract:

Students do not always see the the different lectures in the bigger picture. Thus, in order to encourage students to interconnect different neuroimaging methods and psychiatric disorders, in an holistic way, the current teaching activity manifests in designing a hypothetical experiment that can answer a self-generated research question. Students are first lectured in different types of eating and addictive disorders and then divided into groups of 4-5, each assigned a specific disorder. One hour is allocated for the group work, which is followed by a 10 min. presentation. This type of activity is crucial for real-life application (The activity have not yet been implemented)

COURSE FACTS

- Course name: Neuroscience in a clinical perspective
- Level: 1st year Master
- ECTS credits : 5
- Language: English
- Number of students: 20
- Your role: TA/lecturer

TEACHING IN PRACTICE

1. Identifying a problem

The course introduces multiple mental and psychiatric disorders and the methods to study each of them. However, often students solely focus on one method for one condition in isolation without thinking of the actual overlapping neurological and/or methodological patterns that interconnects them. This prevent students from realizing and applying gained knowledge in a real-life contexts.

2. Planning a teaching activity

After the lecture of the different types of eating and addictive disorders, students will gather in groups of 4-5 group where they discuss the different disorders. To give the student a clearly defined purpose of the discussion, they are told to choose one disorder and a related research question they want answered. Their task is then to design and present a hypothetical experiment that can solve their question by recalling and interconnecting prior knowledge from the lecture. Thus, the students will not only learn to collaborate and communicate, but also actively employ what they have learned for a "real-life" application.

3. Trying it out in practice

As I have not yet implemented this teaching activity (I will not teach until the end of 2020 or beginning of 2021), following is based on expected outcomes. Since I have tried similar activity in a course where I participated as a student myself, I believe that this form of groupwork is highly efficient. It is both easy to implement for the TA and execute for the students. The the disorders have already been decided and students, simply have to assign into one of five groups corresponding to five different eating or addictive disorders. This part will require some logistics, as the students should be able to work with their first or second priority, but is not impossible. After approximately 1 hour of group work, each group has to present their study for the rest of the class in a small (10 minutes PowerPoint presentation. I will be available for help during the whole session.

MAIN POINTS

1. **Main problem/challenge:** Connect different neurological concepts and employ them in "real-life"
2. **Teaching activity**: Group work
3. **How did it go?** Not implemented
4. **What to do next?** Implement it, and use students follow-up answers as feed-forward

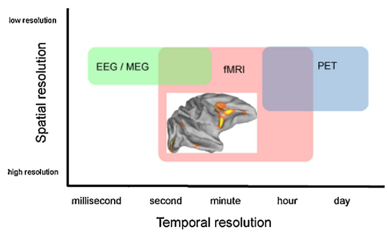


Figure 1: Illustration of the most popular neuroimaging techniques and their temporal and spatial resolution

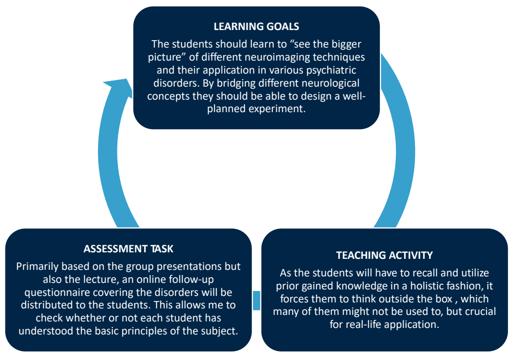


Figure 2: Diagram of the constructive alignment.
Learning goals, teaching activity, and task assessment are all interconnected, and each step can profit one another

4. Looking forward

As I have participated in similar activity as a student myself, I believe that this teaching activity would yield positive feedback for the students after implementation. Likewise, this type of teaching activity is fundamental for students in any scientific field. It allows them to actively think about what they have just learned and also apply it in an innovative and holistic manner. However, as the lecture(s) associated with the group work is on and introducing level, future activities on e.g. PhD-course level, or more extensive Master courses could work more in-depth with the given topic by assigning several hours or days for the challenge. This would essentially simulate real-life problem solving even more.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Danni Peng-Li
Food Quality Perception & Society
Department of Food Science

HOW TO

- Make data in molecular biology digestible

Learning Lab

Abstract: Imagine that you haven't worked with original data before, and you are to solve problems regarding original data, on which you are asked to analyse and draw conclusions. This is the learning goal for students in Molecular Biology II. Some students might find it difficult to interpret complex data and extract the necessary information *in order to* analyse the research results. Here, students were provided with a list on "how to – make data in molecular biology digestible", which was applied by the students in groups prior to students' presentations. The students found the list useful and indicate that they will use it again.

COURSE FACTS

- **Course name:** Molecular Biology II
- **Level:** Bachelor
- **ECTS credits :** 10
- **Language:** Danish
- **Number of students:** 20
- **Your role:** teaching assistant at TØ

TEACHING IN PRACTICE

1. Identifying a problem

This course is the first time that bachelor students in Molecular biology work with original data, and are asked to analyse, discuss and draw conclusions based on the original data (course learning goals). However, the TØ questions do not necessarily address the methods, materials and thoughts behind the data; instead they "invite" the students to start directly with the analysis and conclusions.

2. Planning a teaching activity

Some students may lack a helping hand on how to dissect original data *before* analysis. Hence, this teaching activity provides the students with a guide on how to dissect original data in molecular biology. A list on "how to – make original data in molecular biology digestible" (figure 1) will guide the students through original research results. The guide is expected to encourage them and make it easier for them to move on to the analysis and to draw conclusions based on the original data, which is the main course learning outcome (see figure 2).

3. Trying it out in practice

In this course the TA first enters the class room *after* problem solving in groups and *before* student presentations. However as a TA it is important to make sure that everybody follows. At the beginning of TØ, I asked the students if they found some of the exercises difficult, and as one of the exercises was especially troubling, I distributed the original data among the groups. Then I presented the "how to" list (figure 1) for the students, who spend 15 minutes to go through the list and hereby understand, interpret and eventually analyse the data step-by-step.

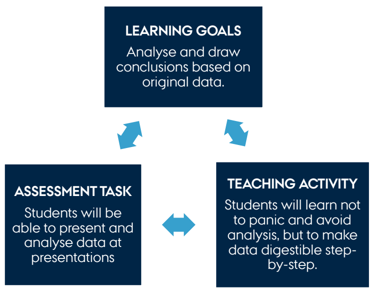


Figure 2: Constructive alignment

Afterwards at the student presentations, the respective groups contributed to the analysis of each piece of original data during the presentation of the specific exercise. The students were assessed during the presentations on whether they included their thoughts behind their analyses and if they gave a proper introduction of the original data that they were to analyse.

MAIN POINTS

1. **Main problem/challenge:** Learn how to analyse original data and draw conlusions.
2. **Teaching activity**: a list on "HOW TO – dissect data in molecular biology"
3. **How did it go?** Students were found the list helpful and most will definitely use it again as a helping hand.
4. **What to do next?** Implement it at future TØs where the students find some exercises especially difficult.

In general the "how to" list made the students more confident in their observations, analyses, thoughts and conclusions, and there was a higher degree of class discussions.

At the following TØ the students evaluated the learning activity by use of mentimeter (figure 3). The students found the teaching activity very usefull and most of them expressed that they will definitely use it again.

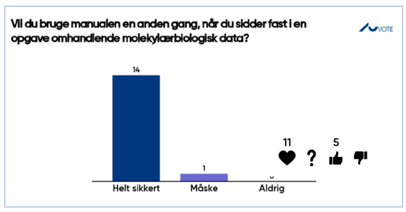


Figure 3: Evaluation of the learning activity: Will you use it again? (left) Did you like or dislike it? (right)

HOW TO – GØR MOLEKYLÆBIOLOGISK DATA LETTERE AT "FORDØJE"

1. Hvilket eksperiment er blevet udført? Hvordan udføres det? Hvad er formålet?
2. Hvad er start-materialet? (f.eks. Hvad er blevet loaded på gelen?)
3. Hvilke øvrige reagenser er blevet anvendt? Hvorfor?
4. Hvad bliver visualiseret? (f.eks. specifikt fragment DNA (radioaktiv probe) eller alt DNA (EtBr))
5. Hvilke kontroller er anvendt? Negativ eller positiv, samt loading kontrol.
6. <u>Analysér data:</u> Fokuser på de prøver, som skal sammenlignes (dvs. undlad kontrol-prøverne i første omgang, og diskuter efterfølgende, hvorfor kontrollerne er nødvendige).

Figure 1: The "HOW TO – dissect data in molecular biology

4. Looking forward

In order to help students before they encounter their first analysis problems the "how to" list may be presented to students in the beginning of the semester. An example of usage could be provided as an introduction. Then the students can apply it to all difficult data that they may encounter during the course.
For future evaluations, an anonymous poll might give more nuanced spectrum of opinions.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Julie Lund Petersen
Genome Stability and Technology
Molecular Biology and Genetics

Understanding Principle of an Experiment

- Connecting theory with practice

Learning Lab

Abstract: Students doing an experimental work in a lab often follow a protocol without thinking about the outcome of individual steps and thus not understanding the principle of an experiment completely. This can lead to misinterpration of their results and drawing of incorrect conclusions. My teaching activity aims to encourage the students to connect their theoretical knowledge with the protocol they need to follow. Using a strip sequence the students must put the protocol steps in the right order and pair them with the correct outcomes. The activity was successful, the students were able to explain the experimental principle in their reports and they thought the activity was helpful themselves.

COURSE FACTS

- Course name: Molecular Processes in the Cell
- Level: BA
- ECTS credits : 10
- Language: English/Danish
- Number of students: 60
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

Based on the lab reports from the previous year, many students didn't fully understand the principle of an experiment they performed in the course. Due to that some of them also misinterpreted their results. The reason behind this is likely that the students follow the protocol without realizing what the individual steps in it are good for. Thus they need to learn the importance of connecting their theoretical knowledge with practical aspects of the laboratory work.

2. Planning a teaching activity

My teaching activity uses the strip sequence method to help the students understand the principle of one of the experiments in the course by focusing on the importance of individual steps in the protocol. This will further help them avoid mistakes and interpret their results correctly. By learning to break down an experiment into steps and connecting them with their theoretical knowledge, they can get a better understanding of any method they will learn in the future.

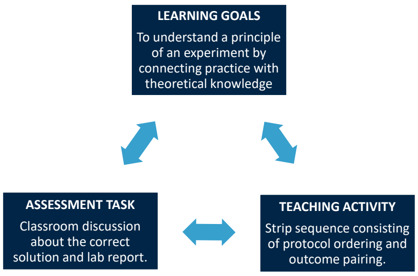


Figure 1: Constructive alignment.

3. Trying it out in practice

After a theoretical introduction, the teaching activity was explained to the students including emphasizing the purpose of the activity. The students were given an empty table and paper strips containing the protocol steps (blue) and the outcomes (green). They were then asked to first put the protocol steps in the correct order and then pair them with the right outcomes (Fig. 2). They worked on the activity in groups of 3 for 6-7 min. After that a short classroom discussion about the correct solution followed.

Protocol step	Outcome
• Wash the cells in the flask with PBS	❖ Traces of the cell medium contents are removed from the cell culture
• Add EDTA solution to the cells and incubate at 37 ° C for 10-15 min	❖ The cells detach from the surface
• Count the cells and dilute them to the final concentration of 0.6×10^6 cells/ml	❖ Optimal coverage of the plate well surface by the cells is ensured
• Add serum-free medium or EDTA to the coated 96-well plate	❖ Divalent cations are effectively removed in EDTA while staying available in serum-free medium
• Add the cells to the 96-well plate and incubate in cell incubator for 1-1.5 h	❖ The cells attach to the coated surface if they can
• Wash the 96-well plate with PBS	❖ Unattached cells are removed
• Add CellTiter-GLO reagent to the 96-well plate and incubate for 10 min	❖ Reaction with ATP from the cells occurs producing light

Figure 2: Strip sequence used in the teaching activity. The students had to put protocol steps in the correct order and pair them with the right outcomes as shown here.

The teaching activity was evaluated based on the lab reports and by students' feedback. The lab reports showed an improvement compared to the previous year. Most of the students clearly demonstrated that they had understood the principle of the experiment and they didn't make any major mistakes in the interpretation of their results.

MAIN POINTS

1. **Main problem/challenge:** Students not thinking about the outcome of individual steps of the experimental protocol.
2. **Teaching activity**: Protocol ordering and outcome pairing through strip sequence
3. **How did it go?** The students found it helpful to understand the principle of the experiment.
4. **What to do next?** A similar activity can be implemented for the other experiments of the course.

The students were also asked to provide a feedback the next day (Fig. 3). Overall, they felt the activity helped them understand the principle of the experiment better and many of them applied the same way of thinking in another experiment as well.

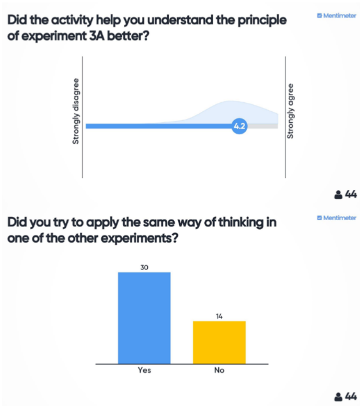


Figure 3: Students' feedback through Mentimeter. Overall they agreed that they had got a better understanding of the experiment and most of them also used the same approach in at least one of the other experiments in the course.

4. Looking forward

The teaching activity went overall well. The students' lab reports and feedback showed that it was useful for their learning. One problem was that only some students were active during the classroom discussion. To solve this, a discussion between the groups where each group explains their solution could be implemented instead. Similar activity could also be prepared for the other experiments of the course.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Patrik Polák
Torben Heick Jensen Lab
Department of Molecular Biology and Genetics

Visualizing policy typologies for agri-environmental management scenarios

- Peer-to-peer scenario building to understand underlying behavioral assumptions of policy tools

Learning Lab

Abstract: 60 years of the European Union's agricultural policy and its myriad instruments introduced to achieve environmental objectives represents a complex and abstract topic, making the subject difficult to understand for students. The learning activity aims to address this challenge by promoting student understanding of policy instrument typologies studies through visualization and scenario-building. The activity was performed by 10 students. The assessment demonstrated that the activity was successful as students were better able to grasp concepts and apply them to current policy debates.

COURSE FACTS

- Course name: Agriculture Policy & Environmental Regulation
- Level: MSc
- ECTS credits : 5
- Language: English
- Number of students: 10
- Your role: Teacher Assistant

TEACHING IN PRACTICE

1. Identifying a problem

Agri-environmental policy in the European Union represents a shifting landscape that interacts with various policy agendas and sectors. Keeping pace with the numerous changes and understanding the intricacies of policy processes from design to implementation can be challenging to follow for novices. Furthermore, the political and legal language can be difficult to understand. Students often feel that the material is ambiguous and difficult to grasp. Therefore, presenting the material that both stimulates engagement and understanding is the main challenge.

2. Planning a teaching activity

The teaching activity of peer-to-peer scenario-building contributes to increasing student engagement and understanding of the material by putting it into practice through application. The activity is designed step-by-step to first address the basic concepts and then build in the more complex material along the process. The activity culminates in applying the concept learning to a current 'hot topic' in agriculture policy debate.
The learning goal of the teaching activity is two-fold:

1) For students to be able to identify and describe the typologies of behavioral assumptions underlying policy tools.
2) To be able to critically examine policy behavioral assumptions and develop policy instruments for future scenarios.

References

https://sc.teachers.ab.ca/SiteCollectionDocuments/Vol.%2041,%20No.%201%20January%202011.pdf#page=24

https://uwaterloo.ca/centre-for-teaching-excellence/teaching-resources/teaching-tips/educational-technologies/all/concept-mapping-tools

3. Trying it out in practice

After the lecture which reviewed the key concepts from the assigned reading, the students were asked to pair up and design a policy instrument as part of a scenario-building exercise that offered a solution to a current agricultural issue. A template outlining the core concepts and a visual example were provided, anticipating that the students had not performed such an activity before. The students were in pairs and their task was to develop a policy instrument that reduces agricultural GHG emissions.

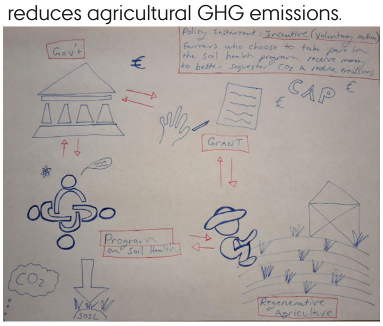


Figure 1. Activity example: scenario-building of potential policy instruments to reduce agricultural GHG emissions.

The students were also asked to identify the behavioral assumptions that informed their choice of policy instrument and to describe to their partner (and later to the class), their justification for why they thought it would be successful in achieving the intended policy objective. Following the peer-to-peer scenario-building, each pair presented their proposed solution to the class. After the presentations, a discussion ensued, where comparisons were made between the approaches.

MAIN POINTS

1. **Main problem/challenge:** Creating a receptive learning environment where students understand the material
   Teaching activity: peer-to-peer scenario-building
2. **How did it go?** The activity went well, yet pressed for time to complete it.
3. **What to do next?** Amend the activity to correspond more realistically to the amount of time each part takes.

INSTRUMENT TYPOLOGIES IN LITERATURE

Carter	Schneider & Ingram
Regulation	Authority
Voluntary action	Incentives
Govt. expenditure	Capacity-building
Market-based instruments	Symbolic/hortatory
(Information)	Learning

Figure 2. Example of lecture slide with key concepts

Evaluation: Taking a step-by-step approach from peer-to-peer to classroom presentation and then discussion, allowed for active learning to take place on different levels. Students were able to further develop skills, from being able to critically examine an issue, to articulating their arguments and presenting in front of their peers. It also allowed for assessment and feedback throughout the process. Students articulated that the activity was enjoyable and helpful to their learning experience

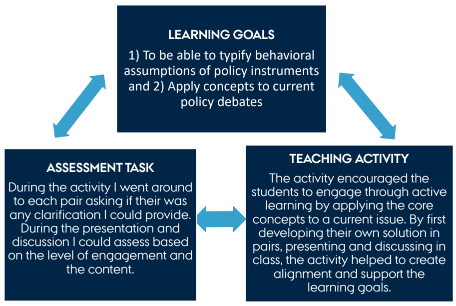


Figure 3. Constructive alignment

4. Looking forward

I was pleased that the students were engaged and brought a lot of energy to the activity. Situating the course material within a current policy issue that the students were familiar with helped make the learning experience more relatable. The activity of building a scenario of what a policy instrument to reduce agricultural GHG emissions would look like and behave like gave the students agency. It was visible on their faces and in the high level of engagement that the activity spoke to them. Building on the activity, I would have liked to incorporate a concept mapping activity, to build a visual of how the policy process system works in practice. In doing so, I would like to enhance student learning and create more constructive alignment between the learning goals, teaching activity and assessment task.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Emilia Noel Ptak
Agricultural Systems and Sustainability Section
Department of Agroecology

The Higgs Mechanism

Taught using a problem solving approach

Abstract

Learning the details of the Higgs mechanism is usually one of the more difficult part of particle physics. We have therefore created a set of problems for the students to do, rather than just giving them a note with all the results of the mechanism. The problem set is then discussed over approximately three times three-hour classes, with room to adjust depending on how fast the students progress. During the activity it was clear that more students joined in on the discussion, particularily on the not-so-mathematical questions. The evaluation showed no statistical evidence that the students prefereed the theaching activity to the rest of the course. However, it should be mentioned that the rest of the course is taught in a similar way. One thing that the evaluation did show, was that the students seemed to like the small non-mathematical questions throughout the problem set, such as: *Why is that?*

Course facts

- **Course name:** Particle Physics II
- **Level:** MSc
- **ECTS credits:** 10
- **Language:** English
- **Number of students:** $\sim$ 20
- **Your role:** Teaching assistant

1. Identifying a problem

The Higgs mechanism is usually challenging concept to grasp for most of the students. This is both the case in the ablean case, where it can be drawn and the more difficult non-ablean case. This subject is usually taught following a note which is discuss during class. However, as the mathematics of the note is rather intricate, and the Higgs mechanism is it self rather abstract, the students are often reluctant to participate in the discussion. When the students do not participate in the discussion their learning outcome is diminished and it becomes difficult for the teacher to identify and remedy of the students learning.

2. Planning

In order to make the students more involved in the discussion of the Higgs mechanism, we wish to implement a number of problems in the note, thus forcing the students to do the calculations themselves. With this approach the students become actively involved in the learning process, instead of just reading and forgetting. When a student is presented with a note giving all the answers, the students will often tend to sit back and do nothing, since they have been given all the answers. If the students on the other hand are presented with a series of problems, they will have to engage in the class in order to obtain all the answers. The existing note have therefore be rewritten in a way such that a lot of the results in the note have been replaced by questions leading the said results. The note is based on textbooks in quantum field theory such as Peskin and Schroeder, and Griffiths.

The fact that the teaching activity is discussion of questions agrees very well with the learning outcomes (see Figure).

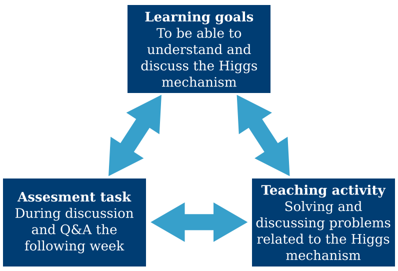


Illustration of the connection between what we intend the students to learn, how we teach it, and how the students are assessed.

3. Trying it out in practice

The problem set was made available to the students, on Blackboard, approximately a week before the first class on the Higgs mechanism was to take place. The students were told to look at the problem set before hand, and prepare questions for the parts they found difficult, as well as to solve the problems they found manageable. The students were encourage to work the problem set in groups.

In class the problem set was then discussed as an all-class-discussion. The TA was in charge of the discussion, however, it was the students who answered the questions in the problem set. Regardless, the students had accumulated quite a few questions themselves, which we also discussed, letting the students answer each others questions, with the TA stepping up when needed.

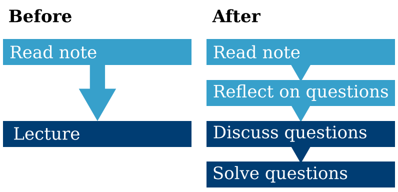


Illustration of the planning of the teaching activity compared to before the activity was implemented. Light blue corresponds to out-of-class activity, and dark blue corresponds to in-class activities.

Main points

1. **Main problem/challenge**
   The Higgs mechanism is an abstract and challenging concept for most students.
2. **Teaching activity**
   Problem solving as a way to induce class discussion.
3. **How did it go?**
   More students joined the discussion in the small questions. Everything else went as the rest of the course.
4. **What to do next?**
   Implement small reflection questions in the rest of curriculum.

When a problem of more mathematical character emerged, a student usually volunteered to go to the blackboard and show the necessary steps.

4. Looking forward

During the teaching activity more students joined in on the discussion than usually. This was particularily the case regard the small reflection questions asked throughout the course, such as: *Why is that?*

The evaluation was done as a questionnaire with a few qeustions about the theacing activity and the course in general. The evaluation showed the same tendency: The students liked the small reflection questions throughout the problem set: "I like the small questions in the text as we are 'forced' to reflect upon certain values and concepts." There was no statistical evidence that the students like this teaching activity more than the rest of the course. However, the rest of the course is taugth in a similar way, which the student do like compared to other courses. Therefore a further developement could be to implement similar small questions in the rest of the curriculum.

References:

Peskin, M. E. and Schroeder, D. V., *An Introduction to Quantum Field Theory* (1995) Westview.

Griffiths, D. J., *Introduction to Elementary Particles* (1987) Wiley.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Stig Elkjær Rasmussen
Department of Physics and Astronomy

Guiding students on achieving deep learning

Biomass pretreatment technologies

Learning Lab

Abstract: The high load of information about several biomass pretreatment technologies on a short period of time can compromise students learning. A teaching activity will be performed in order to help students to memorize, describe, analyze and compare these technologies. They will fill out a table describing several items about pretreatment technologies and will share their answers with the whole class, under the supervision of the teaching assistant. The teaching activity will be performed for the first time on Spring semester/2020.

COURSE FACTS

- Course name: Integrated biorefining technologies
- Level: Master
- ECTS credits : 5
- Language: English
- Number of students: 20
- Your role: teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

In a lecture performed by one of the teachers of the course, the students will be introduced to several kinds of pretreatments applied to lignocellulosic biomass aiming to enhance biogas production. Questions about the topics covered on the lecture will be part of the final oral exam, therefore, it is important that the students are capable not only of describing the pretreatment technologies, but also of making comparisons among them, understanding their pros and cons and suggesting solutions for the problems encountered currently. As there will be a high load of information to process on a short period of time, the students learning might be compromised. The teacher`s lecture will include solely the description of the pretreatment technologies, leaving for the students the critical analysis of advantages and disadvantages of each pretreatment type employment. Therefore, the teaching activity implementation will be helpful to guide the students towards the achievement of other learning goals (deep learning).

2. Planning a teaching activity

In order to facilitate the learning process, the teaching assistant will perform an activity that aims to guide students on summarizing what was covered on the lecture and obtaining a deeper learning on the subject by making comparisons and inducing critical thinking.

Students will work in pairs. They will receive a table containing several items which should be ranked/filled for each pretreatment technology covered on the previous teacher`s lecture. The items will be, for instance.: effect on biomass, degree of impact, installation costs, running costs, energy consumption, production of inhibitors, duration, employment of chemicals, need of chemicals recovery, full-scale applicability, important variables, advantages, obstacles and possible solutions. The same table will be drawn on the white board and each group will be required to fill in the information of one pretreatment technology while sharing with the whole class the information they found/discussed in pairs. This way, the teaching assistant can assess the students learning while complementing and correcting them when necessary.
In order to complete the activity, the students will use information from the slides presented by the teacher on the previous lecture and will be encouraged to read additional references as well. Some recommended references selected by the teacher and teacher assistant will be available for download prior to class. Making their own search on scientific websites will also be suggested.
By the end of the teaching activity, the teaching assistant will ask students about how they perceived the activity, i.e., if they considered it useful for improving their learning, and about suggestions they might have.

3. Trying it out in practice

The activity will be performed for the first time on Spring semester/2020 and it s hoped that it will be well received by the students.

MAIN POINTS

1. **Main problem/challenge:** High load of information in a short time, which can difficult deep learning.
2. **Teaching activity**: Students will fill out a table containing several items about several topics covered on a previous class, allowing the students to make comparison among them and the analysis of their pros and cons.
3. **How did it go?** The teaching activity have not been implemented yet.
4. **What to do next?** The teaching activity will be adjusted accordingly to students evaluation and learning.

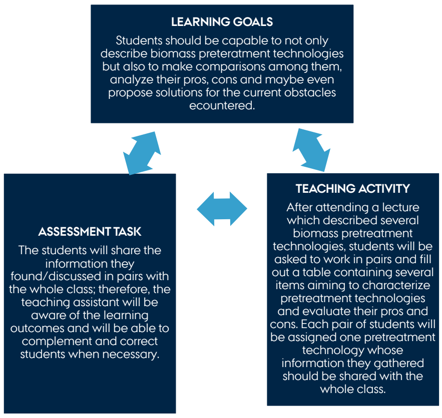


Figure 01: **Constructive alignment**

4. Looking forward

Observing the students learning during the activity and receiving their feedback about the activity will guide the teacher assistant on making adjustments on the activity for the following semester.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Cristiane Romio
Department of Engineering

Cut out figures as visual aid for laboratory exercises

Improving understanding of the experimental design

Learning Lab

Abstract: Molecular Processes in the Cell is a third year BA course that has extensive laboratory practices. Students perform four simultaneous experiments in the span of one week, which might prove problematic for students to fully understand the experimental design and methodology used in each one of them. For the learning activity, I have implemented cut out figures as visual aid for experiment 2, which allowed students to more easily visualize the experimental design. Student response to the activity was mostly positive, and in general they could reflect on the experiment they were performing, and used the figures to present their hypothesis on expected results.

COURSE FACTS

- Course name: Molecular Processes in the Cell
- Level: Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 35 x 2
- Your role: Laboratory instructor

TEACHING IN PRACTICE

1. Identifying a problem

Molecular Processes in the Cell is a course aimed at third year Molecular Biology Bachelor students. It includes a one-week laboratory practice where students will work on four different experiments simultaneously. This presents a problem for students, since they tend to lose track of the methodology and design of the experiments they are performing. This results in students blindly following their lab protocol, not fully understanding the reasoning behind the experimental setup or the methodology used, and being confused and overwhelmed with the simultaneous activities.

2. Planning a teaching activity

The activity I will implement to help solve this problem is the use of cut out figures of the plasmids used in the lab as visual aid representing the experimental design. This will allow students to reflect on their work, and better understand the purpose of the experiment they are performing. Students will reinforce their knowledge on the signaling pathways involved in the experiment, the role and structure of promoters in gene transcription, and the use of reporter genes. Most importantly, students will get some minutes to analyze, understand, and discuss the experimental design being used, and present their hypotheses on what results they are expecting to see before the final steps of the protocol.

3. Trying it out in practice

In their lab groups one by one, immediately before looking at their final results, I gave the students cardboard cut-out figures representing the four plasmids (pGAS, pTA, pNF-kB, and pCMV) and the two cytokines (IFN-gamma and TNF-alpha) they used in the experiment, provided by the course coordinator. The cytokines and the promoter they are associated with were color-coded.

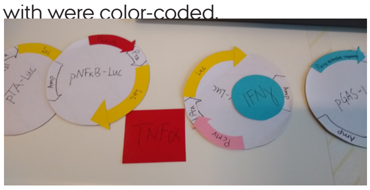


Figure 1: **Plasmid cardboard figures used in the activity.** Figures representing the four plasmids they used to transfect HeLa cells on experiment 2 of the course. From left to right: pTA , pNF-kB, pCMV, and pGAS. TNF-alpha is represented by the red square, and IFN-gamma by the blue circle. All materials were provided by the course coordinator.

I first asked the groups about reporter gene (luciferase) expression when the blue cytokine (IFN-gamma) was added, to which students correctly responded that it will be higher in cells with the pGAS plasmid, correctly matching it to its color. When I asked them about luciferase expression when the red cytokine was added (TNF-alpha) was added, students noticed the color pattern and responded that it will be higher in cells transfected with the pNF-kB plasmid. I immediately asked them why is TNF-alpha regulating expression in a promoter associated with NF-kB, forcing them to think about its signaling pathway. Some groups were caught by surprise by the question.

MAIN POINTS

1. **Main problem/challenge:** Students having trouble keeping track of the experiments they were performing.
2. **Teaching activity**: Use figures to discuss expected results.
3. **How did it go?** Results were heterogeneous between groups, but worked well in general.
4. **What to do next?** Correct lab reports to evaluate the

Other groups did not know the answer, which I explained to them, taking advantage of the visual material. For a third group of students, they already knew answer in detail, and I could discuss in more detail the techniques and experimental design used with them. Revising the lab reports students handed in one week later, it was evident that they had a solid knowledge on the concepts studied in the experiment.

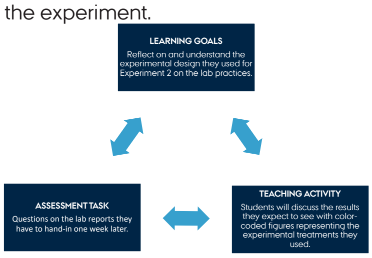


Figure 2: **Constructive alignment**
Alignment between learning goals, teaching activity, and assessment task of the learning activity.

4. Looking forward

Using a color-coded matching exercise worked well in most groups. Students easily found the answer, but were forced to think and reflect on it since the matched was not obvious at first. Performing this activity with each group individually worked great since there was a lot of discussion. The next step would be to try to implement similar exercises on the other experiments performed during the course.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Oscar Gabriel Sevillano-Quispe
Hanne Poulsen Lab, DANDRITE
Department of Molecular Biology and Genetics

Quiz sheets and Group discussion

Better understanding of a root quantification method

Learning Lab

Abstract:

Successful performance of any lab exercise needs a good understanding. Quantification of plant roots in Mini rhizotron method can be complex and confusing as it has many guidelines and rules. Performing a quiz sheet test after brief introduction of the method will enable students to clear any misconceptions of the counting technique and help them later to do the exercises. Every method or technique is subjected to critical analysis and improvement. A group discussion at the end of teaching session will encourage students to critically analyze the potential of the root counting method and ways for future improvement. The students will assess their understanding of the root counting method through quiz sheets and the TA will assess students understanding through group discussion. A mentimeter survey is planned to evaluate the teaching activity.

COURSE FACTS

- Course name: Nutrient Cycling and Environmental Management
- Level: Masters
- ECTS credits : 10
- Language: English
- Number of students: 14
- Your role: Teaching assistant (Exercises)

TEACHING IN PRACTICE

1. Identifying a problem

The teaching challenge is identified in one of the plant root counting methods – Mini rhizotron. Root films are taken inside 3 m long tubes that are inserted below ground with grids drawn on them. These grid lines have specific reference lines, which are taken into account when counting the roots. Not all roots seen in the tubes are counted but only when they cross the reference lines in a specific way (it has many rules and patterns). During the method description, complete understanding on how to count the roots was found to be a big challenge (I have observed students this year and found this part was most challenging). Often students get confused here and if not cleared properly, it will affect their following root counting exercise. After a brief introduction to the counting technique, a teaching activity is planned to make sure that students understood the method correctly, before they start the exercise. Even though, Students learn the method they could still be unaware of the practical application, advantages and disadvantages of the method. A group discussion is planned after the exercise to encourage students reflect on these topics.

2. Planning a teaching activity

Activity 1 : Quiz sheets

Quiz sheets will help students assess their understanding of the root counting method. Even though, root counting technique is explained at the start, due to many instructions, it is easy to get lost. By handing out a quiz sheet, containing different root growth patterns and asking the students to count them in pairs will help them find the confusing parts. The final answers are displayed and explained to the students, which will clear any misconceptions and helps in better understanding.

Activity 2 : Group discussion

A Group discussion at the end of the exercise will help students assess the root counting method. More than learning the method, it is important to have a knowledge on how best the method could be used and any improvements that are needed. The group discussion will help students to think on these topics and gain from other students views

3. Trying it out in practice

The quiz sheet will contain grids with roots having different growth pattern (Left side). It will be handed out to the students and they are asked to discuss with their neighbours in pairs and write the answers. The students have to count only the roots that cross the reference line in a specific way (Top to bottom and left to right not the other way) as per the previous instruction and write the answer in the circles to the right. The students should have good understanding of the reference lines and the rules to do this exercise. Later the answers are displayed and explained, where there is a misunderstanding. This will clear the misconceptions and let the students do the main exercise with confidence.

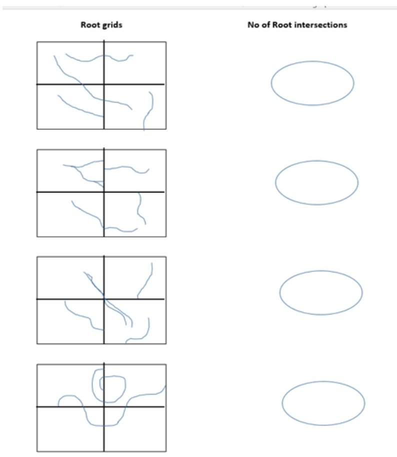


Figure 1: Quiz sheet that will be handed out to students to discuss in pairs and fill the correct answers in the empty boxes (right side)

MAIN POINTS

1. **Main problem/challenge:** Good understanding of the mini rhizotron method and root counting techniques
2. **Teaching activity**: Quiz sheets and group discussions
3. **How did it go?** The teaching activity will be implemented next year
4. **What to do next?** Based on the feedback from students and teaching colleagues, the teaching activity will be improved and modified if necessary

Student Groups

The students are separated into three groups and are asked to discuss the points displayed in the screen

Minirhizotron Method

- **Advantages**
- **Disadvantages**
- **Potential research uses of this method -(e.g. To find out the root depth of a crop)**
- **Suggestions for improving the method**

They will be given a specific time and told beforehand that they have to present their views after. They could take some notes during the discussion, as they have to present their views to other groups. TA will facilitate the discussion to clear any misunderstandings or to add more points at the end.

Assessment of learning

The quiz sheet will help students assess their understanding of the method themselves. Group discussions will help TA to assess students understanding of the method.

Assessment of teaching activity

The teaching activity will be evaluated using a quick mentimeter survey graded from 0-"not effective" to 5 – "very effective" by the students and the suggestions are used to improve the teaching activity.

4. Looking forward

The teaching activity will be implemented next year and TA will make sure a better participation of students in the teaching activities especially in group discussions. Students feedback and peer feedback will be used to improve or modify the teaching activity.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Sindhuja Shanmugam
Plant, Food and Sustainability
Department of Food Science

More interesting to learn
- Menti, Fish bow and Drawing a picture

Learning Lab

Abstract: Master Students with different backgrounds can attend the course. It may be difficult for them to identify and compare the concepts of different milk proteins and human proteases. Another problem is the complicated protein digestion process for the students to remember. In order to support students' learning, different teaching activities will be prepared before the course, like Menti, Fish bow and Drawing a picture. By implementing these activities, lecturer can solve the challenges identified during the course.

COURSE FACTS
- Course name: Milk digestion and human health
- Level: Master
- ECTS credits : 5.0
- Language: English
- Number of students: ~20
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem
Students with different backgrounds may attend the course. Some of them may be not familiar with milk or proteases. However, milk or other dairy products could contain different milk proteins with different genetic variants, thus the matrix is complicated. Besides, there are different proteases within human digestion system, and they have varying optimum environments and hydrolyzing sites. After digestion, peptides with different bioactivities will be released from proteins. All these concepts and process are difficult to remember and compare.

In summary, the challenges can be identified during the course are:
1) It is difficult for students to identify and compare concepts of milk proteins and human proteases.
2) It is difficult for students to describe the process of protein digestion.
3) It is hard for lecturer to identify how much the students have learned.

Therefore, the teaching activities are utilized to solve these problems.

2. Planning a teaching activity
During the course, different types of challenges appear. Therefore, the idea is applying varying teaching activities to solve related problems. For this course, we are planning to utilize three teaching activities, Menti, Fish bow and Drawing a picture, in order to support students' learning and help lecturer to identify students' performance.

Menti will help the students to identify and compare some concepts and functions of human proteases and milk proteins.

Fish bow will encourage the students ask questions, they can get feedback from each other and me. The students will learn a lot and clarify what they do not know during the activity.

Drawing a picture will help the students know the process of digestion of milk proteins in human body and which protease is involved at each step.

3. Trying it out in practice
For **Menti**, some easy questions are prepared for students to answer. After each question, detailed explanation will be given again to enhance their memory.

Menti questions
- "which one is protease",
- "which one is pepsin/trypsin/chymotrypsin",
- "where is pepsin/trypsin/chymotrypsin",
- "how does pepsin/trypsin/chymotrypsin work",
- "what is the best pH for pepsin/trypsin/chymotrypsin"

For **Fish bow**, the students are encouraged to write down one question that they want to know about the course, and give the question cards to lecturer. Then, the students will be asked to discuss their question another students. During this period, some interesting question are picked, then students will be asked to answer the question and lecturer will give them feedback.

MAIN POINTS
1. **Main problem/challenge:** Concepts of milk proteins and proteases; Digestion process.
2. **Teaching activity**: Menti, Fish bow, Drawing a picture
3. **How did it go?** Have not been implemented.
4. **What to do next?** Perform the teaching activities and evaluate them.

For **drawing a picture** (Figure 1), the students are separated into groups, four to five people one group. a figure about human digestion system will be offered. The students are asked to write down the name of each protease at right positions and their working environment (ions, pH) how the protein is hydrolyzed and what they become in the stomach or intestine, and how and where they are absorbed by human.

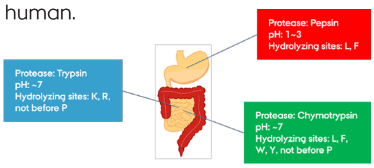


Figure 1: **Drawing a picture.**

These teaching activities are helpful for students to compare different concepts of milk proteins and human prteases, describe the protein digestion.

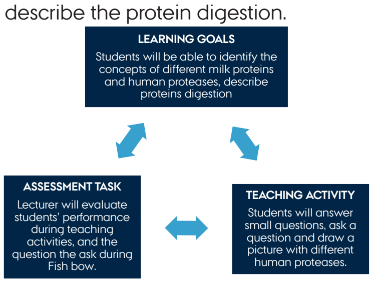


Figure 2: **Constructive alignment**

4. Looking forward
Although the teaching activities are not implemented yet, it should be useful to solve the problems that are identified during the course.

After applying the teaching activities, it would be easier to figure out the advantages and drawbacks.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Bulei Sheng
Food Chemistry and Technology
Department of Food Science

Graphical Explanation of Operations in IoT

- An intuitive way to understand optimal strategy for a networked system.

Learning Lab

Abstract: Analysis of a complex networked system often relies on abstract/mathematic modeling. At the early stage of the learning, many students feel it difficult to have an intuitive understanding of the mathematic model and how it is derived from the practical problem. This teaching activity is mean to inspire students to learn how to model practical internet of things problems through the Linear Programming (LP) or Mixed-Integer Linear Programming (MILP). The activity is expected to enhance the understanding of theory and bridge between theory and application. Feedbacks from students show that it helps to draw attention in the lecture, but it is still difficult to measure how much it can help.

COURSE FACTS

- Course name: Internet of Things Technology
- Level: Master
- ECTS credits : 10
- Language: English
- Number of students: 10
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

Many mathematic model have been well developed for optimal decision making. However the mathematic model often aims to solve generalized problem with reliable logic, which leads to a very abstract interface for application. The lack of intuitive understanding will result in a too steep learning curve for students. On one hand, students spend a lot of time to learn a theory, algorithms and proofs, on the other hand, students feel frustrated while having difficult to know how to use it.

2. Planning a teaching activity

To address the problem in 1), I try to involve more graphical explanation during the introduction of model and algorithms. Visual sceneries and stories are proposed through powerpoint slides together with classic definitions by math formulas. A hands-on in-class group activity is planed to practice a simplified practical problem using newly learned knowledge.

The learning goal is to enhance the understanding and learn to model and solve practical problems through the LP and MILP. Teaching activity fits the course learning outcomes.

3. Trying it out in practice

Teaching activity is operated following the constructive alignment.

Learning goals:
Students will learn the concept of Linear Programming (LP), Mixed-Integer Linear Programming (MILP), the solver to calculate LP, MILP and its related use cases (Robotics and Smart grid). Students will learn to model practical problems through the LP or MILP.

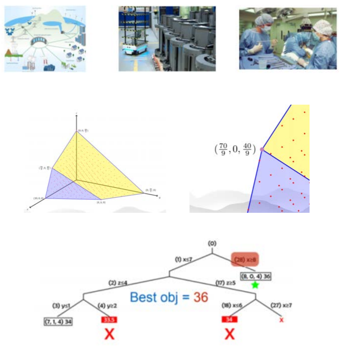


Figure 1: Graphical explanation of MILP and Its applications

Teaching Activity:
Use cases were firstly presented to students for giving an overview of applications. Theory of LP and MILP were introduced through graphical explanation, as shown in Figure 1. Then an in-class group activity was scheduled to analyze and model a simplified practical problem in smart grid topic. The problem was introduced through an introduction slide with pictures.

MAIN POINTS

1. **Main problem/challenge:** Teaching mathematic modeling in an easy to understand fashion
2. **Teaching activity**: Lecture on the theory of LP/MILP & Group use case analysis and modeling
3. **How did it go?** Yet to be improved.
4. **What to do next?** adjust the teaching plan for the following lectures

Students were organized in groups with oral discussion. Groups discussed the use case considering the features of LP and MILP.

Assessment Task
Groups shared their conclusions at the end of the teaching activity. It was observed that students shown an good understanding of key features of MILP modeling. Comments and feedbacks from TA were shared in meantime. Evaluation of the teaching activity may use mentimeter.

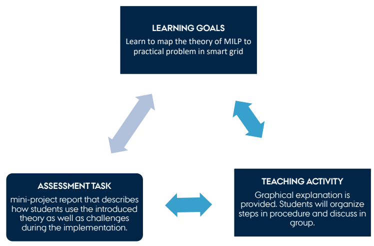


Figure 2: **Constructive alignment**

4. Looking forward

Graphical explanation of the model helped to catch students' attention during the introduction section.

The next step is to let students use high level modeling language to implement the designed mathematic model and solver for a simplified practical problem. Then evaluate and discuss the implemented solution/code.

TA will use feedbacks to communicate with the course coordinator and may adjust the teaching plan for the following lectures and improve the course plan for the next year.

References

Introduction to Linear Optimization, Dimitris Bertsimas, John N. Tsitsiklis

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Liping Shi
Networks and Analytics
Engineering Department

The Predicament of Preparation

Motivating student preparation by a clear connection between out-of-class and in-class activities

Learning Lab

COURSE FACTS

- Course name: Husdyrproduktion
- Level: Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 7
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

Students learn the most by working actively with the content they want to learn. Often in-class activities are preceded by out-of-class activities where the students are expected to work independently with the material. During the preparation, they obtain prior knowledge to build on and may identify difficulties. Hereby, they are expected to gain more from participating in the in-class activities and to better be able to exploit the expertise of the teacher. However, it is common that students do not prioritize out-of-class preparation.

2. Planning a teaching activity

Making a very clear connection between out-of-class preparation and in-class activities may increase the students' motivation to prepare. A teaching activity was planned where the students were asked to prepare part of the content so that they could present it during class. By working actively with the content before class the students obtain prior knowledge to build on in class.
In addition to motivating the students for preparing, the activity should further support the relevant lecture and course learning outcome: Describe the use of key figures in milk production management. By presenting in class the students will practice this.

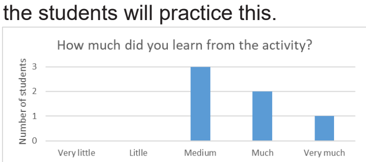


Figure 1. Distribution of student answers to the question 'How much did you learn from the activity?' in a questionnaire evaluating the teaching activity

3. Trying it out in practice

The teaching assistant instructed the students in the activity via the intranet. The students were divided into groups according to three topics: production, reproduction and health. The students were provided with a slideshow containing tables with key figures and manuals on how to read the tables. The students were asked to identify the slides that were relevant for their topic and prepare to present them during class. To align the students preparation with the learning outcome they were asked to prepare by considering three points: 1) Describe in general what the slides contain. 2) Select 1-2 key figures that you think are particularly relevant and justify your choice. 3) Suggest how the key-figures can be used in relation to the specific topic.
Only two out of seven students were prepared for the activity. To enable execution of the activity during class time was allocated for the students to work in groups preparing the presentations. During the activity the students obtained insight into a series of relevant key figures and practiced how to evaluate the key-figures in relation to production management in line with the learning outcome. The presentations enabled assessment of the students understanding and discovery of misconceptions. Furthermore, the activity facilitated discussions and motivated student questions.

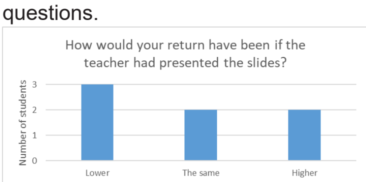


Figure 2. Distribution of student answers to the question 'How would your return have been if the teacher had presented the slides?' in a questionnaire evaluating the teaching activity

MAIN POINTS

1. **Main problem/challenge:** Motivating the students to prepare
2. **Teaching activity**: Asking the students to present part of the content during class
3. **How did it go?** Most students were not prepared, but worked actively with the content during class
4. **What to do next?** Improve instructions, provide more structured feedback for the students

The activity was evaluated at the end of class by a questionnaire.
The students agreed that the activity contributed to an average to high learning output (Figure 1). However, most students thought that their return had been the same or higher if the teacher had presented the slides (Figure 2).
Although only a few students were prepared for the activity, six of the seven students felt that the activity was motivating for their preparation, while one disclosed that she had not had the time.
When asked what worked well during the activity most students answered that the opportunity to work with the content themselves was good. Additionally, group work, discussions and the opportunity to ask questions was mentioned.
When asked what could be improved most students mentioned more clear instructions. Additionally more guidance and more feedback was mentioned.

4. Looking forward

The activity supported student learning in agreement with the learning outcome and most students agreed that it was constructive. However, the instructions for the activity were insufficient and should be improved and visualized more. Although students felt that the activity motivated their preparation, most students were not prepared. The lack of preparation meant that more time was allocated to group work and less to lecturing and feedback. The students experienced this as lack of structure and input from the teacher. For future lessons a better balance between group work and structured feedback should be considered. As student preparation was low motivating out-of-class activities following class may be a relevant alternative.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Alice Puk Skarbye
Epidemiology and Management
Animal Science

Know your tools

- Quickly identifying the right equations for theoretical exercises

Learning Lab

Abstract:

A major learning outcome for the course *Electromagnetism, Waves and Optics* is the ability to solve simple theoretical problems by applying the methods and results from the course. Using a *two-step* flash sequence, this teaching activity trains the students' ability to quickly identify the right equations to apply for the problem at hand, which will benefit them at the written exam. The teaching activity will be implemented next semester near the exam to maximize the benefit of the students. Based on their feedback, the durations of the different parts of activity will be adjusted.

COURSE FACTS

- Course name: Electromagnetism, Waves, and Optics
- Level: Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 15-20
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

In order to solve a physical problem, the student must know which concepts and equations are applicable to the given exercise. This is a special challenge in large courses where students may have a hard time recalling and applying the important points and equations from the beginning of the course. The aim of the teaching activity is to make the students recall important equations and their applications and train their ability quickly identify the correct tools for a given exercise which is a significant challenge in the 4-hour written exam.

2. Planning a teaching activity

The desired learning outcome of the teaching activity is that the students should be able to quickly identify the correct equations needed to solve a theoretical exercise.

The teaching activity is designed in two parts:

1. The students review equations from earlier parts of the course and discuss the type of problems they can be applied to.
2. The students are presented with exercises and discuss which equations are needed to solve them.

The first part of the teaching activity makes the students aware of the tools available to them and trains them in reviewing the material before the exam. The second part then trains the students' ability to quickly determine the right tools for the problem at hand.

3. Trying it out in practice

Teaching activity

The teaching activity is a two-step flash sequence with the students divided in groups of 2-3 people. Using a projector, important equations from the course are shown for 45 seconds each. During this time, the students should write down the applications of the shown equations on a piece of paper.

After all equations have been revealed, a list containing them is given to each group for reference.

A series of simple exercises are then shown using the projector for 3 minutes each. The students should now discuss the strategy for solving the exercises based on the equations discussed in the first part. The students should focus on the strategy and not actually perform the calculations.

Assessment

During the activity, I will monitor the discussions in the groups. After the second part of the flash sequence, the strategies to solve the exercises are discussed in plenum so that everyone learns the smartest approach.

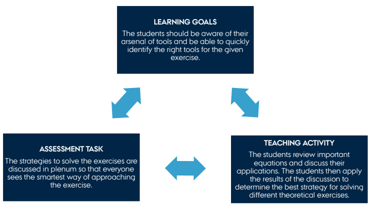


Figure 1: Illustration of the alignment between the learning goals, teaching activity, and assessment.

MAIN POINTS

1. **Main problem/challenge:** Students should quickly identify the correct tools for the problem at hand.
2. **Teaching activity**: Two-step flash sequence.
3. **How did it go?** Yet to be implemented.
4. **What to do next?** Implement teaching activity and adjust the timings of the activity based on feedback.

Feedback

The students will fill out a questionnaire before and after the teaching activity. The questions will explore how confident the students feel about previous course material before and after the activity, whether they felt that the activity was beneficial, and if appropriate time was given for each part of the activity.

$$d\vec{B} = \frac{\mu_0}{4\pi}\frac{I\,d\vec{l} \times \hat{r}}{r^2}$$

Figure 2: Example from part 1 of the flash review showing the Biot-Savart law for the magnetic field of a current element [1].

A copper wire carries a steady 125-A current to an electroplating tank (Fig. 28.4). Find the magnetic field due to a 1.0-cm segment of this wire at a point 1.2 m away from it, if the point is (a) point P_1, straight out to the side of the segment, and (b) point P_2, in the xy-plane and on a line at 30° to the segment.

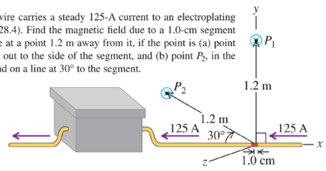


Figure 3: Example from part 2 of the flash review. The students should identify that the Biot-Savart law of figure 2 can be used to determine the magnetic fields at P_1 and P_2 [1].

References

[1] Young and Freedman, University Physics, 13th edition

4. Looking forward

The teaching activity will be implemented next semester when I will be a TA for the course. I plan to implement the teaching activity near the end of semester since a lot of the course material has to be covered before the activity can be successfully executed, and since the activity will be beneficial as preparation for the written exam. I expect the activity to take an hour with 10 equations,10 exercises and the whole class discussion. The biggest challenge for the activity is choosing the difficulty of the problems, so that they fit with the 3 minute discussions. Additionally, the final discussion might take longer than planned so I expect to change the timings, exercises and amounts based on feedback from the students.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Thomas Guldager Skov
Ultracold Quantum Gases Group
Department of Physics and Astronomy

Heating up using a jeopardy game

Refreshing the basics of thermodynamics

Learning Lab

Abstract: From past experience it turned out that students struggled with recalling some of the basic principles of thermodynamics needed during the course. To in a quick, fun and interactive way refresh the students memories, a jeopardy game will be played. With a quick refresh the students will have to spend less time trying to recall the thermodynamics themselves, and focus in the topics important for the course. The activity will be part of a course starting next year, and therefore no results or feedback from students is obtained yet.

COURSE FACTS

- Course name: Nanosynthesis and nanomaterials
- Level: Bachelor
- ECTS credits : 5
- Language: English
- Number of students: 25
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

From previous years, the course coordinator, noticed that the students struggled with the basics of thermodynamics. The students therefore had to spend time recalling the learned material, interfering with what is being thought during the course. So students might be sitting in class, unable to follow the material being taught due to haven forgotten some fundamental background information and will later have to try to close this gap.
The aim of the teaching activity was to quickly refresh the students memory about basics thermodynamics, without compromising too much time during the theoretical exercises.

2. Planning a teaching activity

To achieve this aim a jeopardy game was developed, in which the students must find the question to a given answer. The questions are divided into three topics and three difficulties.
To make sure the students not only can think of the question related to the answer, they are requested to explain the relation. This would likely slow down the game, giving all students time to think and formulate and answer. Furthermore students not answering the question, get an explanation regarding the answer.
To start the game an initial question is posed, which is mostly there to demonstrate the concept.
The group providing the right answer picks the next topic and difficulty, from the screen as shown in figure 1.
The next answer will show and the students have to guess the answer, and explain the connection.
Only if both are correct points are rewarded. The team that has most points in the end would win some refreshments.

Figure 1, Jeopardy game overview screen

3. Trying it out in practice

The topic of the questions are based on input given by the course coordinator. The questions were design to fit within theses topics and be related to synthesis processes.

Before starting the game, the students will be explained the reason for playing the game. After the explanation groups will be formed, and the game is explained. The explanation should take roughly two minutes and to aid in the understanding an initial question will be played.
The game would then play out as described in the previous section.
The learning of the students will be assed, based on the answers given in class and a questionnaire.

MAIN POINTS

1. **Main problem/challenge:** Students struggling to recall thermodynamic principles
2. **Teaching activity**: Jeopardy game
3. **What to do next?** Try out the concept in the class next year

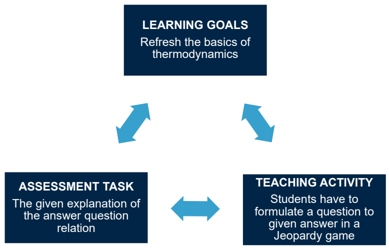


Figure 2, overview of the alignment in the exercise

The answer during the activity will give an assessment of the students understanding of the topics. Groups which have a low score or did not provide an answer in most cases might be struggling with the topic. Potentially this could be used to spend more time on the topic with these groups.
The questionnaire will be part of the course evaluation. By moving it to the end of the course, students have more time to reflect on the activity and if it helped during the remainder of the course.

4. Looking forward

The teaching activity will be tried out early next year, so that would be the real test of the concept. Most likely there will be some changes even beforehand when I get more familiar with the material being thought and the relevance of thermodynamics in that concept.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Järvi Mika Spanjers
Laboratory for Cell Mimicry
Inano

How to realize functionalities

Think-group-share to analyze programming assignment specifications

Learning Lab

Abstract: Oftentimes, there exists some gap between pseudocode and actual implementations, and it is a challenging task to see how practical specifications of the program realize a certain set of theoretical functionalities. We designed an in-class activity that encourages the students to interpret, analyze, and discuss the specified features of weekly programming assignments, so as to improve the quality of their submitted code and reports. After the activity we observed that less number of submissions deviate from the intended distributed system protocols. In the future we will try implementing the activity for multiple assignments and ask for feedback from students.

COURSE FACTS

- Course name: Distributed Systems and Security
- Level: Bachelor
- ECTS credits : 10
- Language: English
- Number of students: 25 per class
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

Our course has weekly programming assignments where each working group (usually consisting of 3 or 4 students) is expected to implement distributed systems with specified features. However, the specifications in the exercise tend to be ambiguous. As such the students in my class often have troubles understanding the exercise questions for programming assignments before they actually start solving them, and they eventually end up with a completely unintended solution that deviates from the specification.

2. Planning a teaching activity

One of the main learning goals for the students is to practically realize a set of theoretical functionalities learned during the lectures/exercise classes by programming distributed systems. The specifications that appear in programming assignments do have corresponding functionalities in the textbook [1], but the exercise questions do not mention that very explicitly.

As students often fail to associate the specifications with the relevant section/pseudocode in the book, we encourage students to carefully analyze and discuss the exercise question in the class before they start working on implementation. In our class we designed a slightly modified version of the think-pair-share activity, which we call *think-group-share.*

References
[1] Ivan Damgård, Jesper B. Nielsen, and Claudio Orlandi. Distributed Systems and Security. 2019.

3. Trying it out in practice

3.1 Activity

1. The students first read the exercise question and try to understand the requirements.
2. Then the TA asks them to discuss in groups to agree on what exactly they are supposed to implement in practice, especially they should identify the most relevant algorithms/protocols in the book and think of how to extend or simplify them to fit in with the specifications. If they're unsure how to approach them they'll ask TA.
3. Next, the TA asks a few groups what their conclusions are, and he writes down their design strategies on a white board to facilitate the whole class discussion. The other groups will learn different perspectives and possibly improve their own design.
4. Finally, the TA will wrap up by giving feedback to each design idea, and telling the groups why their suggested algorithms are (not) compatible with the specifications.

3.2 Assessment

To asses how much the predefined learning goal has been achieved, we counted the number of submitted programs which failed to follow the specifications due to the misunderstanding of questions. Compared to the submissions from the previous assignments, we observed fewer inappropriate submissions as displayed in Figure 2.

MAIN POINTS

1. **Main problem/challenge:** Students fail to understand the specifications in programming assignments, and eventually deviate from the intended solution.
2. **Teaching activity**: Think-group-share.
3. **How did it go?** The number of submissions that implement unintended features decreased to some extent.

1. **What to do next?** Organize the activity multiple times to confirm the effect.

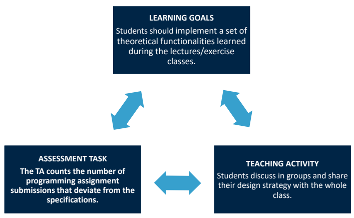


Figure 1: **Constructive alignment**

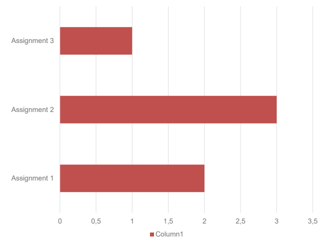


Figure 2: **Number of totally incorrect submissions for each assignment. For the assignment 3 the students submitted programming handins after our think-group-share activity.**

4. Looking forward

After the think-group-share activity and the TA provided feedback to the students, they seem more confident that they are tackling the assignment in an appropriate manner. Unfortunately, we did not have time to implement the activity more than once this semester, and could not compare the results from multiple trials. As such we should organize similar activities next year to evaluate the effect in more detail and ask for feedback from students.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Akira Takahashi
Cryptography and Security
Department of Computer Science

Where is the group?

- Finding and understanding functional groups in a drug molecule

Learning Lab

Abstract: A corner stone in medicinal chemistry is the interaction between a drug and its target in order to understand the mode of action and in the development of new potential drug candidates. Investigation of the functional groups in the molecule and their possible interaction with the target molecule is a key element in the study of a drug candidate. This teaching activity will use a jigsaw model, where the students in groups will investigate a molecule, discuss the functional groups and which interactions they can take part in. Afterwards the students are divided into new groups, where they have to present the key elements they discussed earlier. Training the identification of functional groups, should make it easier for the students to write their final report and also in future chemistry courses. The activity has yet to be implemented.

COURSE FACTS

- Course name: Introduktion til Medicinalkemi
- Level: 1st Semester
- ECTS credits : 5
- Language: Dansk
- Number of students: 15
- Your role: TA in problem solving, report writing and CØ

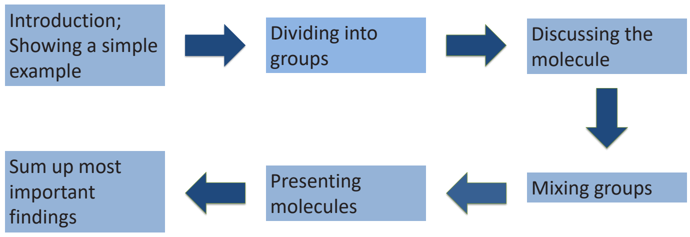


Figure 1: Flow chart over teaching activity

MAIN POINTS

1. **Main problem/challenge:** Identifying functional groups in a drug-like molecule
2. **Teaching activity**: Jigsaw reading applied on molecules
3. **How did it go?** The teaching activity has not performed yet, but will be made in the next fall semester.
4. **What to do next?** After trying it in the beginning of the semester, it would be interesting to try the activity in the end of the course, to see if the students has improved.

TEACHING IN PRACTICE

1. Identifying a problem

Introduktion til Medicinalkemi is the first class the students meet when they begin their education. The students come with different backgrounds and of their chemical understanding is on different levels.
One of the challenges the TA's observe every year is the students ability to identify different functional groups in a drug-like molecule. Furthermore they find it difficult to see the difference between similar functional groups and name these. This is one of the learning goals for the course, and therefor important for the students to learn.

2. Planning a teaching activity

The ability to identify the functional groups in a molecule and predict their chemical interactions is a key element in medicinal chemistry. If the students manage this, they will obtain a deeper understanding of medicinal chemistry, which is very important for their future studies and the final exam.
This teaching activity is divided into two parts. In the first part the students will discuss the functionalities in a given molecule in groups of three.
In the second part the students will be divided into new groups where they will present what they discussed in the first part.
The activity should improve their chemical understanding of a molecule and their general understanding of how a drug works in the body.

3. Trying it out in practice

The students are divided into groups of three, where each groups are given a piece of paper containing a molecule they have met or will meet during the course. Before the students begin their discussion, the TA will show a brief example on the black board.

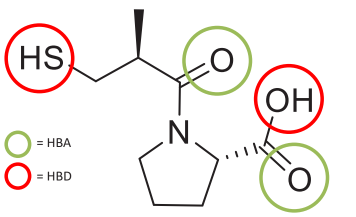


Figure 2: Example on molecule with circled functional groups

In the groups the students should find and name the different functional groups and predict which types of intermolecular interactions the molecule can take part of.
When the students have discussed the molecule in details (15-20 minutes), they will go out in new groups of three (given by the TA), where each group member have their own molecule. In the new group they should present their molecule, the functional groups and the interactions they discussed in the first part (20 minutes).
They will also be able to assess whether they conclusions/interactions are correct.

This gives the students the opportunity to discuss and present their molecule and practice central chemical terms.
In the end the TA and the class will briefly talk about the most common functional groups (5 minutes).

The activity has not yet been implemented.

The evaluation will be preformed in the following TØ session, where they on a piece of paper have to mark (1-10) "if they learnt something", "if the exercise is relevant" and "if it was a good exercise".

4. Looking forward

The activity will be preformed next fall semester in the beginning of the class. In the following TØ session the students will be given a small test, where they have to identify and name some functional groups, and suggest possible intermolecular interactions. Afterwards the students should evaluate the activity.
In one of the last TØ sessions, the students should do a second evaluation (same as first time), but at this point they have finished their final report, and hence know if the exercise was a help.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Department of Chemistry

Graphic organization of information promotes analytical thinking
- Concept map as a tool for reaching deep understanding

Learning Lab

Abstract: A Concept map activity will be implemented in order to promote students learning and analytical thinking, and to improve their performance at the final exam. During the activity students will learn to identify the relationships between such categories as life stages of pigs and risk factors connected with them. Further, students will perform the conceptual grouping of risk factors. The gaining of this skills is one of the main learning outcome of he course and crucial for understanding the etiology/significance of the diseases causing major losses to pig production. The students learning at the activity will be assessed during the plenum discussion and by Mentimeter questions. The Ticket out of door will be used for evaluation of the teaching activity and entire session. The feedback given by students will be used for the adjustment of the future teaching sessions. It is expected that the teaching activity will be implemented in Spring 2020.

COURSE FACTS

- Course name: Livestock Diseases and Disease Prevention
- Level: Master
- ECTS credits : 10
- Language: English
- Number of students: max. 20
- Your role: Teaching assistant (TA), responsible for giving a lecture on the topic : Pig diseases

TEACHING IN PRACTICE

1. Identifying a problem

The lecturing is a prevalent method used in the present course to teach new information. However, it is expected that at the final exam students will be able to present the comprehensive understanding of the obtained during the course knowledge. Thus, students should recognize the relationships between different conceptual categories, and should be able to analyze and to summarize the information. Clearly, for solving this challenge at the exam students should learn how to perform such conceptual analysis .The gaining of these skills is crucial for understanding the etiology and significance of the diseases causing major losses to pig production, and it is also one of the most important learning goal of the course. Considering, that students understanding of the concepts is strengthened when they practice applying and relating to new information. Teaching assistant (TA) aims to encourage students' analytical thinking by getting them to organize obtained theoretical information in a meaningful structure.

2. Planning a teaching activity

The concept map is a great tool broadly used to help students organize knowledge of a given subject. During the teaching session, each group of students will create their own concept map. It expected that group discussion and sharing of the different points of view and ideas would improve students' skills of structural analysis of obtained information. The activity will enable students to gain enhanced theoretical knowledge and will promote students analytical thinking. By implementing the teaching activity, TA aims to improve students' understanding of the main risk factors involved in disease appearance at different production stages and help students gain a deeper understanding of underlying mechanisms involved in disease appearance and abundance. Overall, the activity will improve students' performance during final exam by aligning in-class activities with the learning outcomes.

3. Trying it out in practice

Prior to the class, students will read the relevant literature regarding the main topic: Pig diseases; followed by a lecture in the class. Based on the reading material and lecture slides the students will be asked to create a Concept map in groups. The students will be appointed to the groups beforehand on the AU Blackboard (3-4 per group, it depends on the amount of participants). The Concept map template and the instructions will be distributed to each group (Figure1). The template includes the following information: main topic, such as life stages for different production categories and the relevant subtopics. The students should include all possible risk factors connected with each particular life stage, and then, they need to identify the key ideas/concepts laying behind the listed risk factors. During the activity the TA will circulating among the groups, guiding and/or asking clarifying questions and helping to find the appropriate conceptions. The students will spend around 15 minutes working on their Concept maps; afterwards the groups will present briefly their maps to each other, followed by discussion in plenum. During the discussion, the TA will have a possibility to clarify the misunderstandings/misconceptions if any.

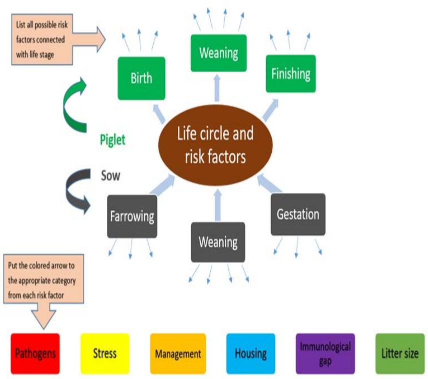

Figure 1: **Concept map template**

MAIN POINTS

1. **Main problem/challenge:** How guide students to think analytically?
2. **Teaching activity**: Concept map
3. **How did it go?** The teaching activity will be implemented in Spring 2020
4. **What to do next?** Perform the analysis of students feedback, use the result for adjustment of the activity/session

The Mentimeter will be used after the discussion in plenum for the assessment of students learning. TA will provide a brief oral feedback on answers uploaded to Mentimeter, to assure that students have understood the topic. To end the teaching session, students will be asked to assess the teaching activity and the entire session by filling out the Ticket out of door (Figure2). The information obtained from the students feedback will be used for the adjustment and improvement of future teaching sessions.

Ticket out the door

1. Was today's activity usefull for your learning ? Please justify your answer
2. Name three things you like/find usefull in today's session and three things which could be better, i.e. what TA could do different?

Your comments will be used for adjustment the future teaching sessions

Figure 2: **Ticket out the door**

4. Looking forward

The teaching activity will be implemented during the Spring semester 2020. Hopefully, the students will find activity useful. Further adjustments of the activity structure and materials used during the activity depend on students' feedback, TA own impression and the main lecturer evaluation of the activity.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Immunology and Microbiology
Department of Animal Science

Strip Sequence

- an easy and effective way of learning laboratory procedures and overview

Learning Lab

Abstract:

The laboratory course in Molecular Biology II consists of one exercise, which is performed during four exercise days. However, the sequence of the operations is changed in order to let the students complete all the operations in four days, which could cause confusing and most of the students find it difficult to know the overview of the entire lab exercise. For this reason, a strip sequence activity was implemented to help the students have a better understanding of the experiment. This teaching activity was an overall success and they got a better understanding and overview of the experiment. The teaching activity could be implemented in the lab manual or have the strip-sequence in the test before the lab exercise.

COURSE FACTS

- Course name: Molecular Biology II
- Level: Bachelor (2ed year students)
- ECTS credits : 10
- Language: Danish and English
- Number of students: 96
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

One learning outcome of Molecular Biology II is that the students should be able to perform and analyse molecular biological experiments. In the related lab exercise, the students are supposed to isolate RNA from HEK293 cells and use this RNA to synthesise cDNA which can be the template in a PCR for cloning the SP1 protein. Finally, they will perform an expression of a cDNA clone carrying the SP1, followed by purification of the recombinant protein.

However, the sequence of the operations is changed in order to enable the students complete all the operations in four days, which causes confusing to the students.

I did a survey before the lab exercise and asked the students about the overview of the exercise. I found that most students were not able to give a brief description of the entire experiment overview. This teaching activity aims to address this problem.

2. Planning a teaching activity

In order to solve the mentioned problem, the teaching activity: strip-sequence has been performed in which the students had to use strips to complete the flow chart of the experiment, followed by a discussion with TA on the first day of lab exercise.

By completing the flow chart with given strips, the students can get a better overview and better understanding of the entire exercise. They can also use the flow chart as a reference to keep track of their operations during their experiment, so they can pay attention to not only the detailed operations, but also the overview of the entire project.

3. Trying it out in practice

In week 39 and 40, the teaching activity was performed in Uracil-lab (24 students). After brief introduction of relevant theoretical background on the first day of the lab exercise, each group were handed a folder containing a sheet with a flow chart (Fig. 1) and some strips (Fig. 2). The students were asked to arrange the strips in the flow chart, which was a good way to encourage their active learning by reviewing the protocol. I would go through their arrangement together with the students while the students were asked to explain their reasoning and describe what happens in each step of the protocol. After that, they would keep the flow chart as a reference on the bench to keep track of their operations.

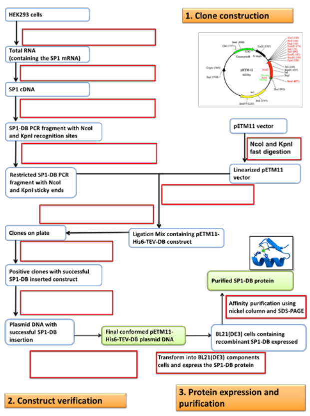

Figure 1: Flow chart of the experiment with some important operations left blank.

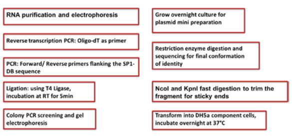

Figure 2: Strips for the "strip sequence"

MAIN POINTS

1. **Main problem/challenge:** The students don't have an overview of the entire experiment.
2. **Teaching activity**: The students use strip-sequence to complete the experiment flow chart, followed by a discussion with TA.
3. **How did it go?** The students were very positive about the activity according to the feedback.
4. **What to do next?** Try to incorporate the flowchart in the lab manual or have the strip-sequence in the test before the lab exercise.

Assessment

I could evaluate the student's learning via the quality of the strip-sequence and give them feedback. The discussion was also the ice-breaker between me and the students and gave me insight into the level of knowledge of the students.

At the end of the lab exercise, the students were given a "ticket out the door" (Fig. 3) to evaluate the teaching activity.

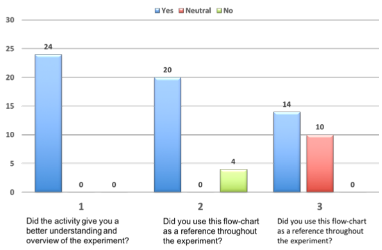

Figure 3: Ticket out the door.

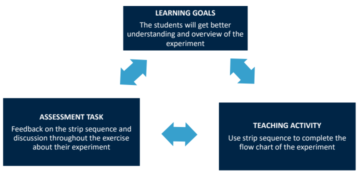

Figure 4: Constructive alignment

4. Looking forward

The teaching activity was an overall success and addressed the problems as planned. It gave the students better understanding and overview of the experiment.

To Improve the exercise in the future, peer feedback could be incorporated into the teaching activity and let the students solve the questions before the TAs giving instructions. The teaching activity could be implemented in the lab manual or have the strip-sequence in the test before the lab exercise.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Esben Lorentzen's group
Department of Molecular Biology and Genetics

What is MCq the abbreviation of?

❑ Motorcycle Club qualification ❑ Multiple Choice question
❑ quantum Memory Card ❑ Miley Cyrus quotes

Learning Lab

Abstract: By using a familiar teaching tool (multiple choice question) in a reverse fashion the students are provided a fun and safe environment to phrase a multiple choice question in English on their own and train writing skills while recapitulating on topics in the curriculum. The activity was positively received by the students and the majority experienced an improved understanding of the curriculum by phrasing a MCq and by answering and discussing each others MCqs. The majority felt they received useful feedback on their MCq by their peers. The activity facilitates recapitulation of curriculum and could be relevant in many courses and could be expanded with more questions pr. student, rotation of groups etc.

COURSE FACTS

- Course name: Introduction to Molceular Biology
- Level: Bachelor
- ECTS credits : 5
- Language: Danish
- Number of students: 75
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

There are no written assignments in this course, however it is a great place to introduce and practise scientific writing. At the same time, an activity based on writing and phrasing scientific subjects would improve the learning outcome for the students. By phrasing a multiple choice question (MCq) individually and presenting it in small groups the students will practise their writing skills, present their work and receive feedback in a safe environment and improve their understanding of a chosen topic.

2. Planning a teaching activity

The learning outcome of the teaching activity is to identify relevant concepts/principles/subjects in the curriculum and correctly phrase a written MCq regarding this concept/principle/subject. By presenting their MCq in groups the students will receive feedback on their own work and learn from each other. The teaching activity primarily focusses on the challenge of correctly phrasing an MCq, however it also supports the learning outcome of the course when the students work with the curriculum in a new way.

3. Trying it out in practice

Before the theoretical exercise, students had prepared one MCq on an optional topic within one part of the curriculum. During the first 15 min of the theoretical exercise the students quizzed each other in groups (4-6 members). Each member should come up with an individual answer before discussing their answer with the other members and agree on one common answer. After each question the member that made the MCq explains his/her thoughts behind it and the others provide feedback. Assessment was based on an anonymous evaluation and the students uploaded their MCq for me to make an overview of the quality and topics of the MCqs.

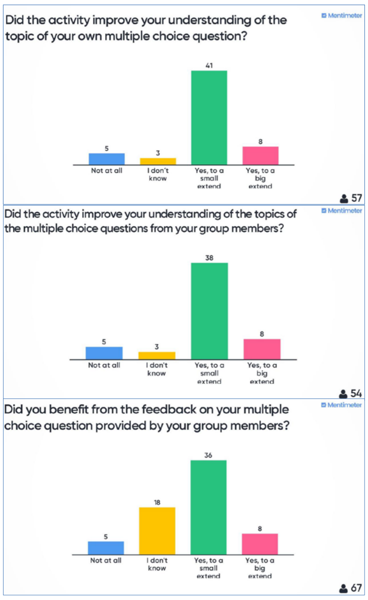

Figure 1: **Evaluation**
This three-question evaluation was performed anonymously by the students immediately after performing the activity

MAIN POINTS

1. **Main problem/challenge:** Improving writing skills
2. **Teaching activity**: Phrasing a multiple choice question in English
3. **How did it go?** The students were positive about the acitivty and the majority felt that they benefitted from peer feedback and improved their understanding of the topic in the MCqs
4. **What to do next?** Implementation of this activity following each major topic in the curriculum supports development of writing skills and serves as a great activity for repetition.

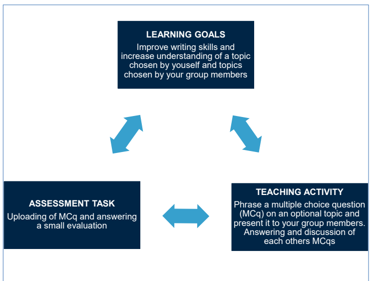

Figure 2: **Constructive alignment**
The activity is designed in order to have optimal alignment with the intended learning goals and an evaluation was performed to assess if the learning goals was achieved.

4. Looking forward

The primary goal of the exercise – supporting development of writing skills by phrasing a multiple choice question in English – was fulfilled. A great side effect was the new way of working with the curriculum that supported the general learning outcomes of the course. This activity could be relevant in many courses.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Enghild Lab
Molecular Biology and Genetics

Accounting for 'Equivalence' in a small class

- Using Jigsaw to explain a geophysical phenomenon

Abstract: 'Equivalences' is a geophysical concept which students are often confused in the class. Jigsaw group technique will be implemented as a teaching activity to deepen students' understanding on this. It is anticipated that students in a smaller group will learn new content by reading material, teaching each other what they have learned, and discussing implications of the reading. In the beginning of next class, TA will assess the quality and efficiency of this method by designing an online quiz. Likely, students will be asked the feedback of teaching activity through a questionnaire.

COURSE FACTS

- Course: Basic hydrogeophysics
- Level: 3rd year Bachelor
- ECTS credits : 10
- Language: English
- Number of students: 22
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

When students are preparing for the final exam in the end of semester, it's a frequent question that how to figure out different causes of equivalence. So I decide to design a special teaching activity for this topic, to help them fully understand this key concept.
This activity aims to induce motivation on exploring a concept by reading lecture notes and discussing with their classmates. The outcome of this method will be assessed by teaching assistant.

2. Planning a teaching activity

The teaching activity is designed to provide students with an environment to learn new content by reading material, teaching each other what they have learned and discussing implications of the reading. It is intended that every student will present a solution during a session.

Combined with assessment by TA in the beginning of next class, this indirect supervision is expected to get students explore a key concept by themselves.

The learning outcomes addressed by this study focus on students' ability to

- Understand the principle of this geophysical phenomenon
- Discuss different types equivalences

3. Trying it out in practice

Jigsaw Procedures :

i. Instructor selects articles, excerpts from books or other text appropriate to course content, and categorize into several sections.

ii. Divide the students into small Cooperative Jigsaw groups (e.g., 3-4 persons in each group).

iii. Have each member of the Cooperative Jigsaw group silently read one different text section assigned. Time: 5-10 minutes.

Figure 1: Jigsaw method illustration

iv. Create new small (2-3) "Expert" groups with the individuals who have read the same material. Allow time for learners to discuss what they have read and how they might teach this when they return to their Cooperative groups. Time: 5-10 minutes.

v. Recreate the original Cooperative Jigsaw groups. Have each person teach the rest of the group the material from the text read. Time: 3 minutes / person.

MAIN POINTS

1. **Main problem/challenge:** Students get confused at one difficult geophysical concept.
2. **Teaching activity:** Jigsaw group
3. **How did it go?** It's expected to improve students' understanding on the key concept.
4. **What to do next?** Plan, implement and modify (if needed) the teaching activity.

Assessment and Feedback:

i. In the beginning of next class, TA will assess the quality and efficiency of this method by designing an online quiz, which includes recognizing different types of the equivalence model and implications of this phenomenon.

ii. Students will do a questionnaire, to see how much they can benefit from the jigsaw classroom approach.

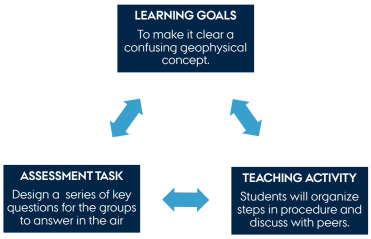

Figure 2: **Constructive alignment**

4. Looking forward

The teaching activity is expected to be successful, when more than 90% of student should be able to pass the assessment. In order to improve the activity, the students will be asked to fill in an anonymous questionnaire to evaluate whether it improved their understanding and was the exercise challenging enough for them. The questionnaire will consist of 4 questions; 1) Was the time perfectly allocated and enough for the activity, 2) Was the activity helpful to clarify points that was not clear, 3) Did the questions challenged their understanding, 4) What can be done to improve the activity .

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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