PROCEEDINGS: TEACHING@ST AUTUMN 2018

11 DECEMBER 2018

AARHUS UNIVERSITY
SCIENCE AND TECHNOLOGY LEARNING LAB

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

14:00-15:00	**Associate Professor Tove Hedegaard Jørgensen:** Closing the gap: teaching generic skills to maximise educational attainment
15:00-16:00	**Poster session with this semester's assistant professors and PhD students** Poster presentations of the participants' teaching experiments.

KEYNOTE BY ASSOCIATE PROFESSOR TOVE HEDEGAARD JØRGENSEN

At the conference, this year's recipient of the Aarhus University Anniversary Foundation Prize of Honour for Pedagogics, Tove Hedegaard Jørgensen, will do a talk on how teaching generic skills can maximise educational attainment. Tove Hedegaard Jørgensen is associate professor at Bioscience. She studies plant adaptations and teaches evolutionary biology.

Closing the gap: teaching generic skills to maximise educational attainment

A lack of generic skills can severely limit student achievement, for example, poor writing skills can massively undermine the quality of written assignments. This keynote will address the gap that exists between the generic skills students gain during secondary education and those required to do well in higher education… and beyond. It will discuss how this gap can be closed by teaching generic skills as an integrated part of – not as an addition to – the curriculum. Examples will be drawn from newly developed teaching at Bioscience that emphasize active learning and includes the use of continuous and formative assessment.

TEACHER TRAINING PROGRAMME POSTERS BY ASSISTANT PROFESSORS

Learning design/ theme	Lectures	Group work* (theoretical exercises/TØ)	Group work* (lab/LØ)	Supervision
Flipped Classroom	Diego Abalos Harnessing the benefits of a flipped classroom to enhance deep learning, p. 7	Klaus Koren Flipped classroom in PhD course Microsensors in Environmental Analysis, p. 12		
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*Also referred to as 'small-class teaching'

Harnessing the benefits of a flipped classroom to enhance deep learning

Diego Abalos
Researcher, Department of Agroecology

Keywords: *Agromicrobiology; Lecture; Flipped classroom; STREAM model*

Pedagogical purpose

By using a flipped classroom approach, my goal is to increase the student's flexibility in time, space and form, to acquire basic knowledge. I also aim to make the course more interactive and to better match their interests by giving them the opportunity to take a leading role in many of the proposed activities

Context

This work would be a new topic of the 3rd semester course Agromicrobiology (10 ECTS), which is part of the Bachelor's Degree Programme in Agrobiology. The course consists of several lectures (2h/week) and class exercises (3h/week). The examination is a 25 minutes oral exam, and the prerequisites for examination participation is handing in and approval of an exercise report.

Learning outcomes and purpose of learning design

At the end of the course the students should be able to:

- Understand the basics of how to quantify greenhouse gas emissions from soils.
- Hypothesize about the effect of contrasting environmental conditions (e.g. drought, flooding, increased CO_2 concentrations, etc.) on N_2O emissions from agricultural soils.

Learning design and Educational-IT

The learning design can be seen in Figure 1. I would use webcasts for brief tutorials on how to use the equipment for measurements of N_2O emissions, demonstrations of individual steps in an experimental procedure, and for instructions for data analysis (Fig. 2). I teach practical lessons on how to measure greenhouse gas emissions from agricultural soils. The methodology to take gas samples and analyze them is rather simple, and I believe I can flip the class by making use of webcasts uploaded to Blackboard. Those webcasts would be demonstrations, and then for the lecture I could move forward to deeper levels of learning by challenging the students to identify contexts/scenarios in which greenhouse gas emissions can be triggered or mitigated.

For the out-of-class activities (following the STREAM model, Fig .3) I would use webcasts for brief tutorials on how to use the equipment during the lab work, demonstrations of individual steps in an experimental procedure, and for instructions for data analysis. The video could be accessed both before class via Blackboard and in the lab (by smartphone).

After the video, there would be a quiz or survey to get an idea of the students' level (e.g. PeerWise), and an open online discussion about what the students find difficult, in order to adjust the content of my lecture during the actual lab class.

During the lecture (in-class) we would start with an open peer-review guided by me. My role would be to re-direct the discussion when the students' reports deviate significantly from the right answers. I would also stimulate their interactions by contributing to the online discussion forum.

In terms of feedback and follow-up activities, I would review or repeat difficult parts according to the out-of-class quizzes and open questions.

Indicators of impact

As proposed in my learning design (Fig. 1), I will guide the online discussion (Activity 1), read and provide written feedback regarding Activity 2, supervise the peer-revision of Activity 4, and read and grade the final report (Activity 5).

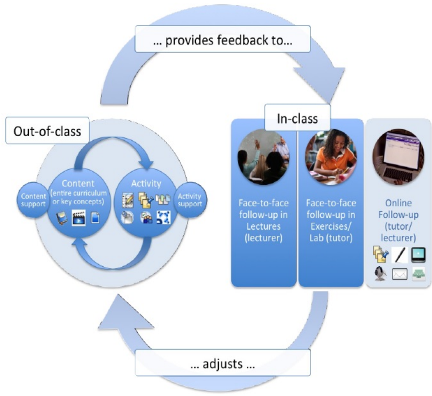

Figure 3. The STREAM model.

EDU-IT role and benefits

By using digital learning materials (webcasts, Kahoot/Mentimeter, open discussions online) my goal is to save time explaining relatively simple concepts and use this extra time to improve the learning objectives and increase the depth of knowledge acquired by my students.

Figure 1. LDTool representation of Ihe earning design I used in Agromicrobiology.

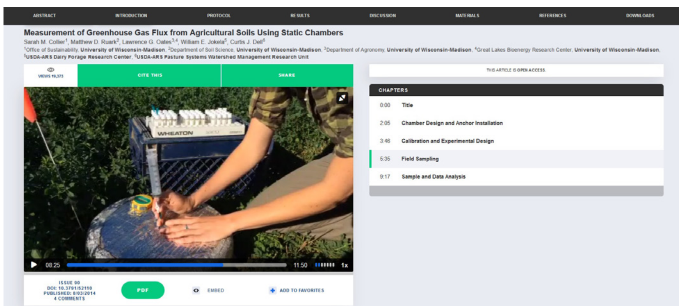

Figure 2. Screenshot of the webcast used to explain how to sample and quantify N_2O emissions.

Looking forward

Some of the most important lessons I have learnt are that (1) it is important to keep a relatively low number of activities and to teach a limited number of concepts to make sure the students are able to fully acquire the required knowledge (less is more!), (2) that activities such as kahoot and mentimeter quizzes may be a double sword tool because the students lose concentration after the activity, and (3) group activities are a powerful strategy to engage students if planned properly.

References

Webcast: Collier, S. M., Ruark, M. D., Oates, L. G., Jokela, W. E., Dell, C. J. Measurement of Greenhouse Gas Flux from Agricultural Soils Using Static Chambers. J. Vis. Exp. (90), e52110, doi:10.3791/52110 (2014).
GodskM. STREAM: a Flexible Model for Transforming Higher Science Education into Blended and Online Learning , E-Learn (2013)

Effective supervision of the course projects

Mahdi Abkar
Assistant professor, ME, ST

Keywords*: Fluid Mechanics and Turbulence; Master student supervision; IT-Tools; Scientific report preparation*

Pedagogical challenge/purpose

The main goal of this project is to maximize the student level and mode of participation and involvement in the project. One of the main challenges is to make sure that all the students achieve the learning outcomes as mush as possible.

Context/course facts

Course: Fluid Dynamics and Turbulence (10 ECTS). Master level. Number of Students: 24. I am the coordinator for the second half of the course which is related to turbulence.
Turbulence is like a century-old unsolved mystery and many consider it as the toughest open problem in physics. The goal is to bring this challenge to the attention of students, to give a basic understanding of the engineering approximations to turbulent flows and of the statistical
properties of fully developed turbulent flows. The course is also intended as a preparation for subsequent courses on computational fluid dynamics. As part of this course, the students are required to use "OpenFOAM", which is an open source software, to simulate a fluid dynamic problem (e.g., lid-driven cavity ow in this semester as shown in Figure X) under two different conditions: laminar and turbulent regimes. Note that OpenFOAM is one the most widely-used open source software used by the fluid mechanic community. Hence, it would be very useful for the students to have a basic knowledge about this program.

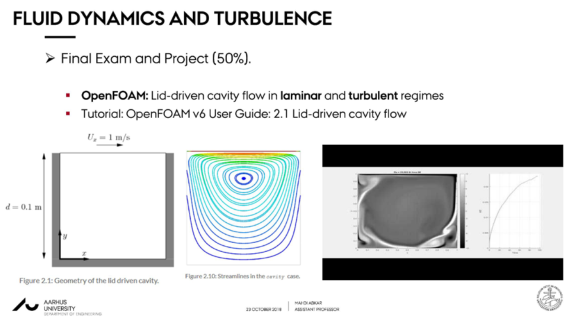

Figure X: Project description slide as presented in the course.

Learning outcomes and purpose of learning design

At the end of the course, the students should be able to

***Describe** how to use the program and being able to set up a basic case.*
***Explain** deferent engineering (or turbulence) models that can be used to simulate turbulent flows.*
***Analyze** the uncertainty in the engineering models due to deferent physical assumptions behind them.*
***Write** a well-structure scientific report at the end of the project.*

Learning design and Educational-IT

This learning design uses a combination of in-class and out of class activities where the students work in a group.
In this project, the students are divided in groups with maximum four students per each group to work on the project together. Each group is required to submit a midterm progress report and a final report at the end of the semester. A template for the report is posted in Blackboard, and the students know how to submit and provide feedback on their project reports. In one the first sessions of the course, I explained the project to the students, and provide all the needed information about the project in the BB as well. In particular, the project description, the objectives, the learning outcomes, different tasks and the due date for each phase of the project, and the framework of the final reports are clearly defined and provided for the students. The students in each group are required to work together and submit one report. During the project, the supplementary materials (including papers and online materials, e.g., YouTube, Coursera, etc.) is provided for the students in the BB.

Indicators of impact

In order to monitored/assessed/evaluated my students learning outcomes during the activities, the following tasks are used:

- *Receiving continuous feedback from the students (during the class, during the meetings, and via Mentimeter),*
- *Receiving feedback from the peer's in the teaching training program and the instructors on this project,*
- *Having an external observer (one of the colleagues who already finished the teaching training program).*

An example of receiving feedback from the students during the course is provided in Figure Z.

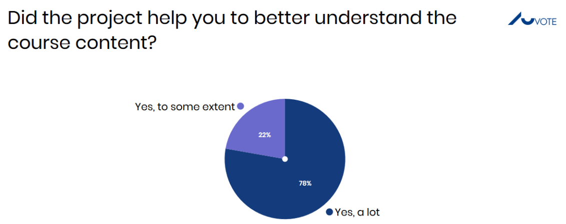

Figure Z: *Indicators of impact of learning design and the use of educational technology.*

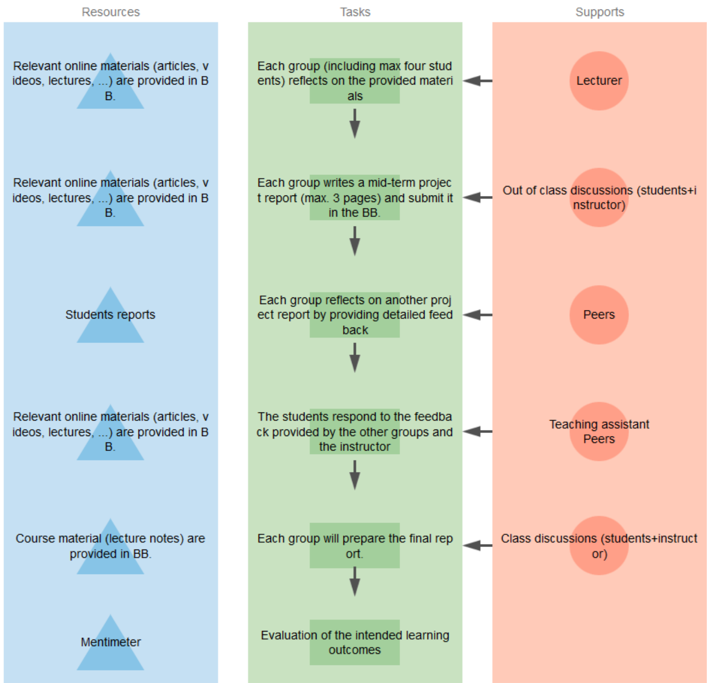

Figure Y. *LDTool representation of learning design used in* https://needle.uow.edu.au/ldt/ld/wRzXUUzd

EDU-IT role and benefits

During this project, I mainly use BB, and all the needed information and communications is posted in BB. An online forum is also designed for this project, thus, the students can discuss the challenges they might have during the project. I actively follow the discussion to make sure that communications are in the right track. If I notice there is particular issue that most of the students are dealing with, I explain that in the next session of the course and will also post the clarication in the BB. I use YouTube a lot in this project. Especially at the first step of the project, I provide some online videos from YouTube that the students can follow to install the software and set up a basic case in the program step by step.

Lessons learned and looking forward

The main lessons I learned and my future plans for the use of educational technology and development of the teaching practice are as follows:

- *Alignment between different teaching activities, and also alignment of the expectations between the students and me.*
- *Using different IT tools to support teaching and supervision activities.*
- *Giving feedback to the students and receiving continues feedback from the them and also from the other colleagues to improve the teaching and supervision.*

References

Hicks & Foster (2010): "SCORE: Agile Research Group Management". Communications of the ACM. P.1-2.

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Learning Design for ERTS course

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Keywords: *embedded systems; design patterns, real-time scheduling UML model-based design, hardware/software co-design*

Context/course facts

"Embedded real time systems" is a 10 ECTS course for Master students in Computer Engineering. We have 23 students enrolled in the course, most of them are actively attending the in-class activities. The course is shared with another colleague, each of us has a workload of 5 ECTS. The course is about learning design theory and techniques for embedded systems, and use the corresponding technology and tooling to implement one full system, including software and hardware [1]

Learning outcomes and purpose of learning design

The learning outcomes I am pursuing with this learning design are how to analyse, theorize and implement software systems for critical applications safety and with a low cost. Different IT educational tools have been used to design and run the course activities. Online tools such as Blackboard, and webcasts are used to communicate the information to students in an efficient and concise way. Mentimeter, Peerwise and Gradewise tools are used to improve the students engagement and measure their learning. The expected learning is achievable via both in-class and out-of-class activities designed in a Stream model style [2], where the feedback and progress on each activity reflects on the context and content of the other activities. The challenges tackled are making the students learning trackable in an easy way, and enable students to learn from each other thanks to peer feedback and webcasts. The teaching/learning activities are lectures, theoretical exercises , work groups and offline labs..

Thus making a strong alignment between learning goals and teaching/learning activities. Both in-class and out-of-class activities requiring students engagement in terms of Contribution, feedback and reflection. In-class and out-of-class activities have recursive reflection and feedback relation, so that the in-class activities can be tailored and restructured according to the learning measurement and feedback of the out of class activity. In turn, the out-of-class activities can be tailored according to the agreements and conclusions made in the in-class activity. Figure3 depicts and example of the aforementioned alignment between second and third weeks. So that based on the design decisions made in the in-class activity, students use the corresponding analysis tool in the out-of-class activity. If such a design in not efficient or unsafe, the next in-class activity should address this issue and update the design decisions. Designs are uploaded online for peer feedback using Peerwise, later on a Mentimeter quiz (Figure2) used to vote the design choices.

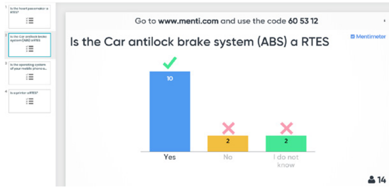

Figure 2: Driving in-class activity based on outcome from out-of-class activity.

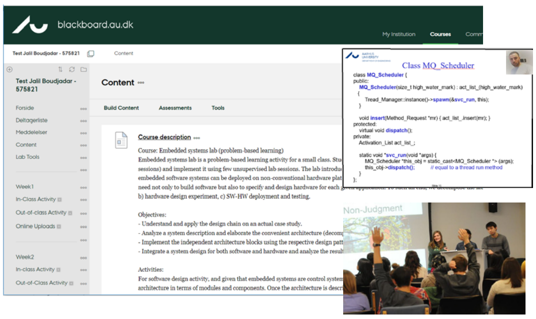

Figure 1: *Digital learning and in-class feedback activity.*

Learning design and Educational-IT

The learning design has partially been inspired by the different concepts, tools and techniques introduced in Module2 and Module3 of the teacher training course. The different models such as JITT and Stream have been successfully used to make the teaching activities much more dynamic and tailored to fit the given class/progress levels. The teaching/learning activities have been distributed between in-class and out-of-class activities according to the expected learning outcomes.

Pedagogical challenge/purpose

As a purpose I have been working on how to make small class teaching much more dynamic and get students well engaged. What was challenging how to create a better harmony between the use of different tools and reduce the overhead workload for the teacher.

Indicators of impact

The teacher makes a measure of every week participation rate. Similarly, to track the learning and practicality of the given feedback, a lightweight *Menti* evaluation is used. The evaluation is made as three questions about the usefulness of feedback, the difficulty to make the assignments and potential challenges. The use of IT educational tools improved the overall learning as depicted in Figure4. The improvement, achieved following the SAMR model [4], is calculated as a comparison between the course evaluation for this semester and 2017.

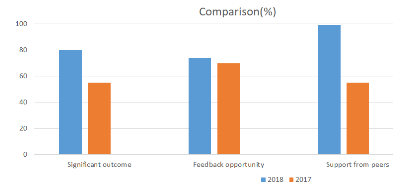

Figure 4: Comparison of learning/engagement before and after using IT educational tools.

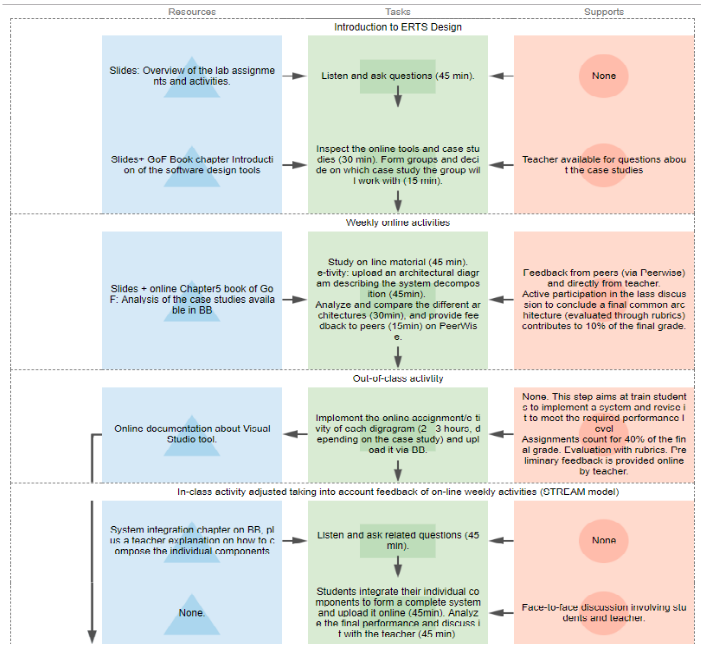

Figure 3. *LDTool representation of learning design used in ERTS course [3]*

Lessons learned and looking forward

IT educational tools helped in improving the course by automating the measurement of learning outcomes, reducing the overhead for teacher and diversify the students learning resources (peer support).

EDU-IT role and benefits

In this design attempt, different digital learning tasks and tools have been used such webcast for online learning, Stream model to establish the consistency between in-class and out-of-class and LDTool for the alignment between the in-class and out-of-class activtties. Fillped class room style and JiTT have been used to run problem-based learning sessions. Blackboard has been used as main support for documents sharing . Menti has been used for socializing and voting. Peerwise and Gradewise have been used to improve students engagement and track their learning.

References
[1] https://kursuskatalog.au.dk/en/course/83379/Embedded-Real-Time-Systems
[2] STREAM: a Flexible Model for Transforming Higher Science Education into Blended and Online Learning, Mikkel Godsk 2013.
[3] https://needle.uow.edu.au/ldt/ld/oEXNnsNb
[4] SAMR model, https://sites.google.com/a/msad60.org/technology-is-learning/samr-model

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Mathematical modeling for applications to science and engineering

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Keywords: *Mechanical Engineering; Traditional lecturing; Experimental work and empirical observation; Application of mathematical principles and project work.*

Pedagogical challenge

We develop a series of activities rooted in empirical observations with the goal to motivate and frame the technical nature of applied mathematics. Develop analytical skills by solving problems inspired by experiments, by using mathematical tools. Applied concepts in project development.

Context/course facts

Mathematical Modeling for Applications to Science and Engineering is a 5 ECTS elective course with 17 students. Currently, oral exam is applied.

The intent of this course is to broaden students' perspectives on analytical skills and methods for solving Differential Equations (ODEs and PDEs), Complex Analysis, and Differential Geometry. Despite current heavy emphasis in FEM commercial packages, increasingly complex problems (often multi-physics) of our time require researchers to master some level mathematical techniques, which are essential to allow them to better formulate a broad range of problems and interpret their results with a solid physical intuition. The goal of this course is to expose mechanical engineers, physicists, and mathematicians to a few of such techniques.

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 a big gap in their knowledge when it comes to mathematics, but most importantly they do not show the right motivation and attitude in learning how to apply mathematics to real world problems. Here, I would like to develop an activity so as to address these issues.

Describe the analytical methods to compute solutions of ODE and PDE. Explain the main techniques in asymptotic methods and Perturbation Theory, Complex Analysis, and Differential Geometry. Students should be able to discuss, summarize and explain the results and their validity in comparison with experiments and empirical observations.

Learning design and Educational-IT

Empirical observation and the ability to model natural phenomena is at the heart of applied mathematics. As R. Courant put in 1965: "Applied mathematics is not a definable scientific field but a human attitude. The attitude of the applied scientist is directed towards finding clear cut answers which can stand the test of empirical observations." Therefore, in light of this quote, my goal here is to develop a series of activities rooted in empirical observations, which will frame each topic to be discussed in class. By incorporating the following steps, it is expected that this scientific approach teaching will align the course outcome to the objectives.

Each topic is introduced by cycling through the following steps:

- *Observation: the initial motivation is hinged on observation and discussion of natural phenomena and/or empirical analysis of a particular prototype experiment.*
- *Theory: this provides to the students a powerful language to describe what has been observed through mathematical modeling. This will be done in a more traditional class setup, where the theory necessary to model a particular phenomenon is introduced and the students will get to practice and refine their understanding of mathematics.*
- *Project: in this stage, the students will take on a project where they will test their modeling understanding to either reproduce a certain experimental setup and/or design a prototype that emulates the phenomenon introduced in the first stage, observation.*

Activity example: Kinematics of falling maple seeds and their helical motion. Maple seeds are ubiquitous in this part of the world and a common, however striking, observation is that they fall from the maple tree in an helicopter-type motion. The observation consists on allowing the students to explore in hands-on activities this seed and initiate the debate of how this phenomenon can be explained in terms of mathematical language. This sets the stage for introducing the mathematical tools of fluid-structure interaction. Once the a appropriate tools are in place and the attempt to model the phenomena is accomplished in the lectures, the students will take on projects to measure the kinematics of the seed motion in space and/or create their own mechanical analog of the maple seed in order to test the theory.

I partially ran a test activity over the period of two weeks (two lectures) in the context of "Dimensional analysis & Scaling Laws" and "Similarity methods, nondimensionalization, and scaling". These ideas have certainly appeared abstract to the students when they were initially introduced in the traditional class setting. With the goal to illustrate these principles, I showed to the students an experiment in class about capillary forces and how they can deform elastic solids—these are known as elastocapillarity phenomena. They were asked to think about the problem and, as a homework activity, they were also asked to attempt to model what they had observed in the experiments. Up until that point, i.e. before introducing the observation, I noticed that the number of students that actually dedicate significant effort in homework activities was minimal. However, the outcome of showing the experiment surprised me since most of them had attempted to solve the problem by applying the principles they learned.

Indicators of impact

The most important outcome of this experiment was clearly a higher degree of participation in class Q&A and discussion as well as that the vast majority of the students attempted to solve the problem by directly applying the principles they had learned.

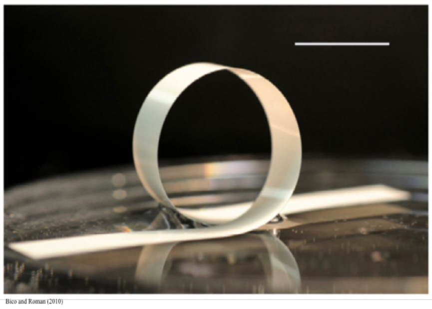

Figure 1: Representative picture showing the elastocapilary phenomenon.

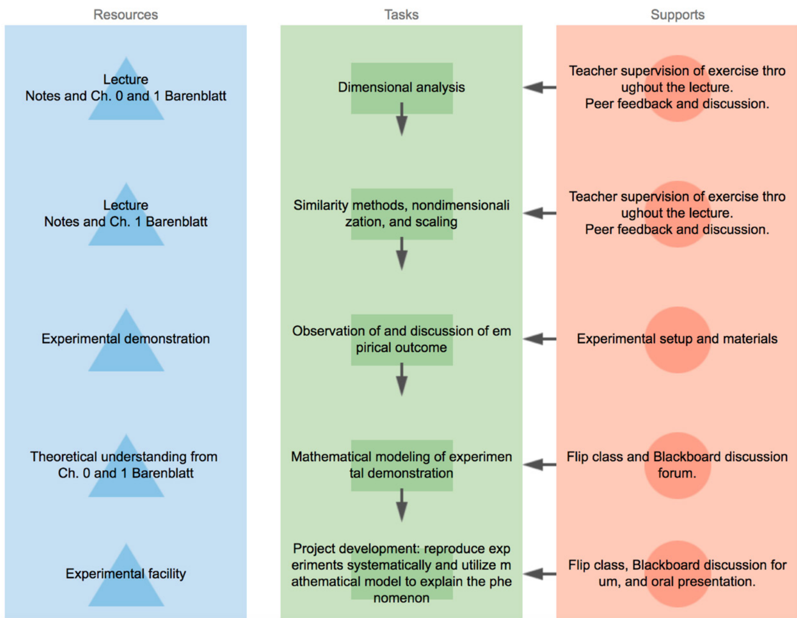

Figure Y. *LDTool representation of learning design used in https://needle.uow.edu.au/ldt/ld/X2ifs8Ie*

Lessons learned and looking forward

In order to succeed, this must be an on going effort. The way I have laid out the teaching-learning initiative is already an upgraded version from what I have been able to test in my classroom this semester. Implementing the activities by keeping the order observation-theory-project is in my experience a better approach than what I implemented this time around, i.e. theory-observation-project. I would continue to have a work flow that encourages problem solving.

EDU-IT role and benefits

Blackboard can help to organize group discussions in a wiki format, but it is not essential to the activity. Video recording the derivation of mathematical equations and proofs may help to guide the students' focus on the technical subject. The technology involved in these types of activities that are most relevant are those that could help with setting up the experiments.

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Optimized supervision and management of a research group

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Keywords*: Science and Engineering, Supervision, supervision letters, video tutorials and group-based supervision; optimized supervision, increased student-student feedback*

Pedagogical challenge/purpose

Improving supervision of Bachelor, Master, and Ph.D. students at AU Engineering in a research group setting working with different academic and industrial collaborators

Context/course facts

Students often form an important part of research groups in natural and technical sciences. Good student supervision and efficient group management is therefore often closely linked.
Tools for optimizing supervision of Bachelor-, Master- and Ph.D. thesis students was here developed in a research group setting. The students are all part of my research group "Microbial Conversion Technologies" and include students that work within a range of fields. The students furthermore often do their experimental work at different geographical locations - at internal academic partners (AU) or at external industrial collaborators.

Learning outcomes and purpose of learning design

The students work as scientists and engineers during their projects and perform valuable work, which we strive to publish in scientific journals, or in other ways use to further the research of the group (e.g. through development of new knowledge or hardware). Although these broad academic and industrial collaborations are extremely valuable they also pose a range of challenges that has to be tackled as supervisor to secure that students are on track and not lost in the process.

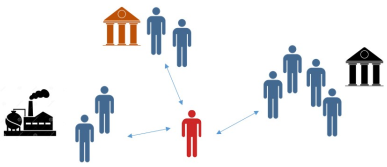


Figure 1. The supervisor as a key figure in a research group with students associated with other research groups as well as industrial collaborators.

Supervision within natural and technical sciences covers several aspects, (1) from the more overall supervision of the students scientific progress and personal development as a scientist or engineer; (2) to practical hands-on supervision on use of e.g. analytical equipment and laboratory setups. Whereas the former often follows the model described as the *partnership model*, the latter often follows the *apprenticeship model* (*Wichmann-Hansen, G. & Jensen*, T. W., 2015). Successful supervision of the student therefore require a multifaceted approach to cover all the aspects of supervision in a research group setting.
In this study I covered different approaches to optimize supervision of students within my research group "Microbial Conversion Technologies". An important point was to facilitate the students entry into the group and to increase interaction between the students and technical staff in the group so that I as supervisor was not their sole anchoring point (Figure 1).

The approach was multifaceted and covered several aspects of supervision all designed to improve and structure student supervision, and setting the scene for good supervision in a research group setting:

1. **Matching the student-supervisor expectation** through the use of an introductory "Supervisor Letter".

2. **Optimizing laboratory-based supervision,** and streamlining the students introduction to the laboratory, by creating a video tutorial for handling complex samples and analytical procedures

3. **Efficient supervision of internal and external students** associated with the group by implementing a setup based on "SCrum fOr REsearch" – **SCORE** (Hicks & Foster (2010). The core in this approach is a weekly short oral status on "objective", "results" and "next step" for each of the group members.

Although these approaches were all very different, they were all designed to improve supervision of the students in the research group, and exploit the different resources present in the group.

Learning design and Educational-IT

labbook

The main focus of project has been the implementation and test of the SCORE model setup. However, the development of an IT-based platform is currently underway. As part of this platform a video tutorial was made (Version 1.0) to further facilitate the assimilation of new students in to the laboratories of the research group, and to decrease the resources needed for introduction of new students to complex laboratory equipment. The concept is still under development but the intended setup is depicted in Figure 2.
The tutorial videos will be added to the material in the virtual lab-book setup (www.labbook.au.dk) which is currently under construction. The Labbook will contain analytical protocols, data for quality assurance, and other relevant information for the group and the associated laboratories.

Indicators of impact

In addition to the video tutorials, supervision is based on the student-supervisor interaction. In a research group, student-student, or student-technician interactions plays an almost equal role to the student-supervisor interaction (and in some instances even more important). To facilitate these student-student interactions, and to ease the challenge of keeping an overview of a very diverse group of students and projects, the SCORE model was implemented and tested to optimize the supervision of each student. The goal was to easily get an overview of each student's progress and possible challenges to hereby quickly identify where my time and attention as supervisor is most needed.

As the SCORE model is interaction-based, the model was evaluated both by me as supervisor as well as by the involved students in a group-based interview. The usefulness of SCORE was evaluated based on observations of group dynamics and interactions. Prior to implementation of SCORE, the group meetings included only practical info with limited interaction amongst the students. After implementation of SCORE, group meetings now include both discussions and peer-feedback to the students. Especially senior students have been very active in these discussions with valuable experience and technical information to more junior students. These student-student interactions (1) improve the overall supervision of junior students and (2) facilitate the task of managing a research group (figure 3).

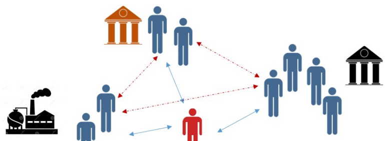
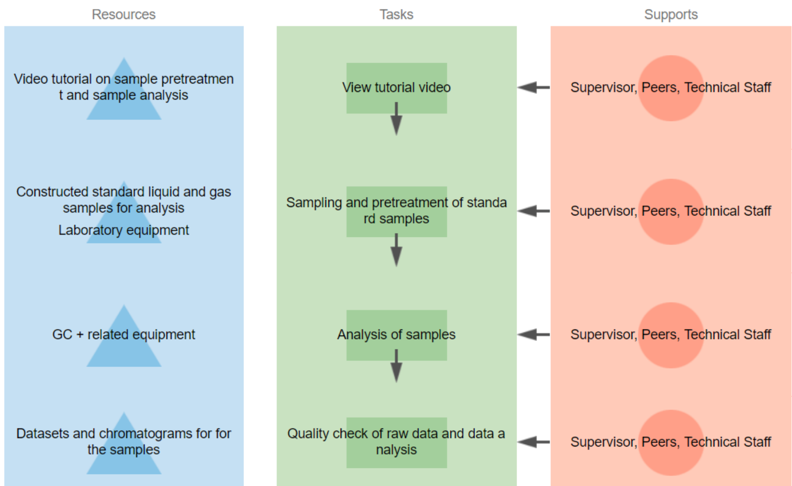


Figure 3. The supervisor as part of a research group with increased student-student interactions

The status reports have furthermore improved supervision since they help to identify the potential problems that needs my attention as supervisor before the problems become critical – or before the project takes a different direction than planned. This is especially relevant for students that are involved in projects at industrial collaborators – **SCORE is here to stay!!**.

For solving problems which need more time than that allocated at the group meeting, I have now pre-booked a one-hour timeslot right after the group meeting, for impromptu one-to-one supervisor meetings.



Lessons learned and looking forward

The research group of Microbial Conversion Technologies is newly started and many changes and optimizations is still expected. The group will continue its work with both academic and industrial collaborators through joint projects at Bachelor-, Master- and Ph.D. level. Optimization of this process has only started and will continue with the aim of improving the process for each of the students while optimizing their development as scientists. Implementation of a multifaceted approach with Supervisor letters, video tutorials and the SCORE model setup is here seen as the first step in this continued process of optimization and will continue with the new students starting up in the group in 2019.

References

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Flipped classroom in PhD course Microsensors in Environmental Analysis

Klaus Koren
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Keywords: *PhD course, redesign, out-of-class and in-class teaching,*

Pedagogical challenge/purpose

I want to try a flipped classroom like approach in a PhD course.
The challenge is to provide the students with the essential basics before the course starts to enable a deeper learning experience at the course.

Context/course facts

This project deals with a 5ECTS PhD course held every 2 years jointly between AU and Copenhagen University. The course is limited to 20 participants and held in a 2 week block in a field station. The students learn state of the art analysis methods using microsensors and related techniques. The course splits in lectures and a practical project where the students use the tools learned in a self-determined project.
The project described here focuses on the lecturing part.

Learning outcomes and purpose of learning design

In recent years I have seen that the students are overwhelmed with the lectures and cannot absorb the information provided. To overcome this I want to use educational IT to:

- Increase the understanding of the students
- Enable them to learn at their own pace
- Provide an online recourse for the students
- Increase deeper learning and more advanced discussions of the topic as the students have more time to learn the basics.

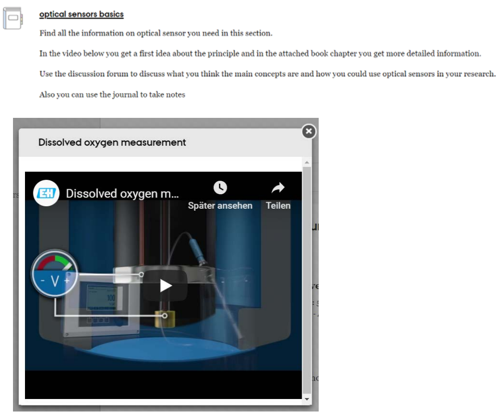

Figure 1: *Digital learning materials include short videos, papers and webcasts. A discussion forum will facilitate exchange between the students.*

Learning design and Educational-IT

The idea is to use a flipped classroom approach [1].
I will provide the students with material electronically before the course starts. Based on the methods learned during the course I will start a socialization process online. Afterwards we will go through the material and I will follow the progress via short quizzes and be reading the discussion forum, where students will discuss the material.

The material will be diverse and include videos, papers, book chapters and short webcasts. See figure 1 for some exemplary figures on teaching material I already uploaded on blackboard.

Indicators of impact

The flipped classroom approach will enable the students to catchup with the basics before entering the residential course.
I will measure the success of this approach by following the students progress prior to the course. Also I expect to see a changed behavior in the classroom. I expect o have a more discussion based interaction with the students. Also I expect the students to be better prepared for the projects.

An after course evaluation will show how the students felt about the flipped classroom approach.
I will ask explicitly if the students think that the out of-class activities prepared them well for the course.

Figure 3: *By flipping the classroom there will be more time to do experiments and projects*

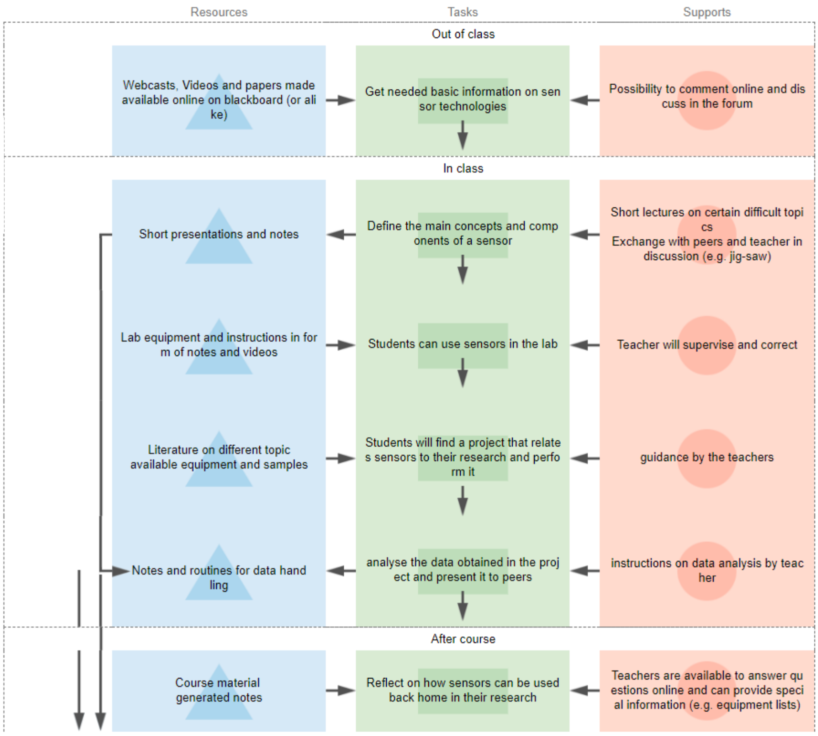

Figure 2: *LDTool representation of learning design used in the flipped microsensor course*

EDU-IT role and benefits

This project really builds on EDU-IT. By providing the students with the material online I want to really change the way the information is transferred to the students.
I plan to use videos (either some that are available, or self-made), blogs, book chapters, papers and webcasts.
Via the discussion forum I want to socialize the students and enable an exchange about the content. Also EDU-IT will allow me to follow up on the students progress and find out which topics to focus on in class.

Lessons learned and looking forward

Unfortunately I had no chance to test this design yet. The course is held every 2 years (next in mid 2020) so I have some time to further develop the out of-class activities and to text the EDU-IT. A challenge will be the

References

[1]edtechmagazine.com/higher/article/2012/09/prerequisites-flipping-classroom

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Accounting for "disciplinary diversity" in a small class: a teaching design based on the STREAM model

Nicola Lanata
Assistant Professor

Keywords: *Physics; materials simulations, Density Functional Theory, small-class teaching, pencasts, STREAM model, learning design, asynchronous learning.*

Pedagogical challenge:

How to activate all students and provide all of them with the necessary theoretical background in a disciplinarily-diverse small class?

Context/course facts

I have designed a small-class 5 ECTS PhD course in *"Materials simulations: Introduction to Density Functional Theory (DFT),"* which will begin in February 2019 and will likely be attended by about 10-15 participants. The course is divided in 3 modules.
In this project I focused on Module 1, whose learning outcomes constitute the basis for the following 2 modules of my course.

Learning outcomes and purpose of learning design

The main purpose of the learning design outlined in this poster is to provide all students with the theoretical background necessary for the following 2 modules of my PhD course.
From the pedagogical standpoint, the main challenge is to activate *all* participants, taking into account the "disciplinary diversity" of the group (as the course will be attended by both physics and chemistry students).
Specifically, after Module 1 of my PhD course all of the participants should be able to:
- Account for the formulation of the many-electron problem in second quantization.
- Construct tight binding Hamiltonians of solids and molecules.
- Solve free-fermion models.

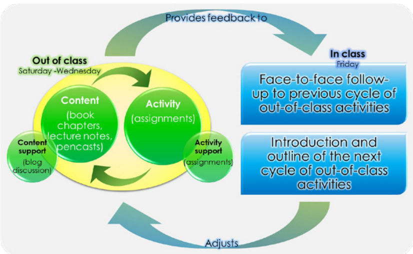

Figure 1: *Schematic representation of my teaching format (largely inspired to the STREAM model [1]).*

Learning design and Educational-IT

This learning design is based on the work initiated in module 2 of the "Teaching training program". The "transfer of content" occurs mainly in the out-of-class phase (from Saturday to Wednesday) through literature sources and *pencasts, which are* organized as concatenated series of short explanations constructively-aligned [2] and alternated with mandatory individual assignments.
For all assignments (to be completed by the end of Wednesday) the students are requested to describe the procedure used (metacognition). Out-of-class support is provided by teacher and peers in the course blog. Furthermore, preliminary individual feedback on the assignments is provided by the teacher before Friday.
The out-of-class activities are followed on Friday by 1 weekly face-to-face lecture consisting of the following activities: (I) revising the subjects that the students found more challenging and/or useful, (II) applying actively the content (with whiteboard exercises, discussions, study groups), and (III) introducing the topics of the following week and of the related out-of-class activities.

EDU-IT role and benefits:

In the out-of-class phase, *pencasts* organized as concatenated series of short explanations are constructively-aligned and alternated with mandatory individual assignments. This design can improve performance and provide a higher degree of flexibility, e.g., because it allows students to absorb and activate the content at their own pace.

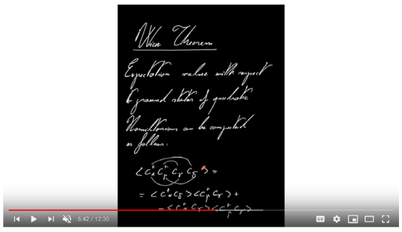

Figure 2: *Screenshot of one of the pencasts that I developed for this course.*

Students are allowed to re-upload their assignments after receiving feedback in the face-to-face class on Friday. The deadline for re-uploading the assignments is Tuesday of the following week at midnight.
The grades are assigned based on criteria clearly established through rubrics (provided on Blackboard along with each assignment). In order to pass the course it is necessary (and sufficient) to obtain a grade > 6/10 for all assignments, from the beginning to the end of the course.

Indicators of impact

The distribution of grades among students across the different subjects covered in the course (resolved with respect to the academic background of the students) will constitute a first quantitative indicator of impact.

Furthermore, students will be asked to fill a course evaluation survey (not only at the end of the course, but also at the end of each module). From time to time, I will also ask students informal opinions about my teaching strategy (which may also help to make adjustments along the way).
Active participation in class (e.g., research-based discussions between participants with different disciplinary backgrounds) will also be a key criterion of success. In order to document this aspect I will systematically observe student's behavior making sure that all students take part to the discussions.

Lessons learned and looking forward

Educational technology paves the way to a broad spectrum of pedagogical practices with virtually infinite implications on teaching and supervision. The teaching design outlined here exemplifies how technology-enabled asynchronous learning can facilitate the task of teaching in a disciplinarily-diverse small class.
In the future I plan to apply educational-technology tools also within different pedagogical contexts besides small-class teaching (e.g., for designing bachelor or master courses as well as in supervision).

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[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.
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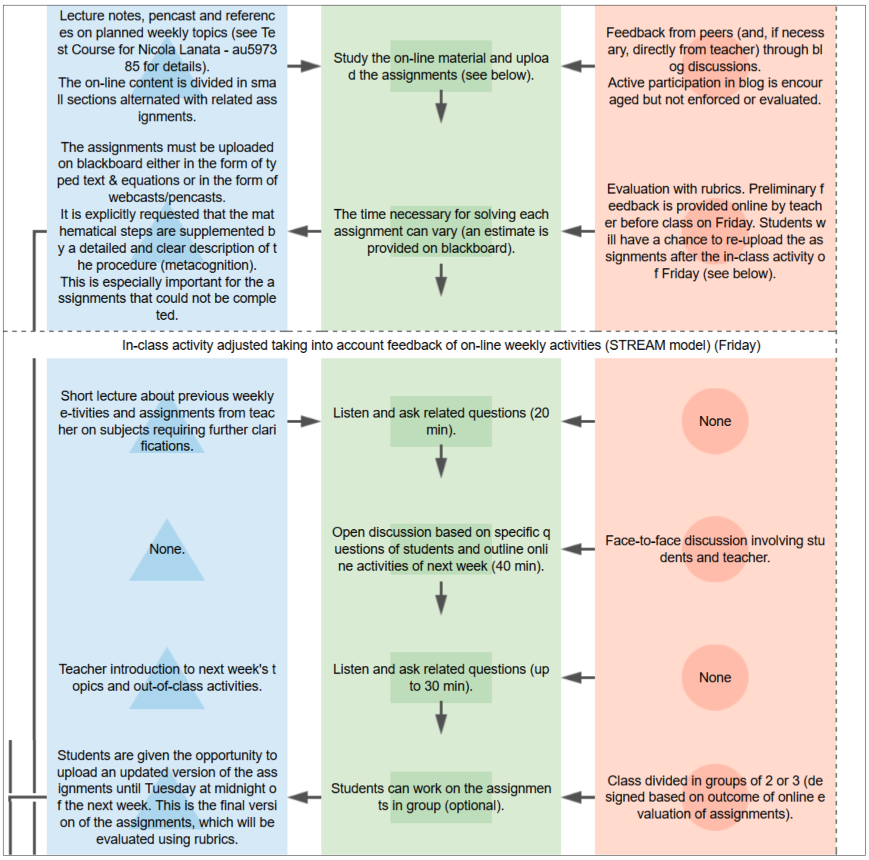

Figure 3: Selection of *LDTool representation of learning design: structure of typical in-class / out-of-class weekly cycle.*

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STREAM-lining out-of-class and in class activities to facilitate effective learning

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Researcher, Department of Environmental Science

Keywords: *Environmental Economics; Lecture; STREAM model, E-tivity*

Context

The learning design is proposed as part of the learning activities for a 10 ECTS course "Environmental Governance: Policy Processes and Economic Dimension" offered to Masters students in Biology. The course runs through the Spring semester (late January – late June). Twenty two students are enrolled for 2019. This puts the course at the 4th place of the total 15 courses offered at Biology master level in the spring (based on the number of participants).

Purpose of learning design

The overall purpose of the learning design is to provide the students with structured out-of-class activities that are closely linked with in class activities in order to enhance their learning process. The pre-lecture activity will help students better acquainted with key micro-economic concepts which will in turn help them engage better in the lecture. The post-lecture e-tivity provides a platform for the students to apply the concepts covered in the lecture through a collaborative mode online.

Learning design and Educational-IT

The proposed learning design adopts the STREAM approach (Fig. 1) reinforcing close linkage between students' out-of-class learning activities and inside class lecture sessions. To meet this objective, the design includes two main activities: pre-lecture activity and post-lecture e-tivity (Fig. 2).

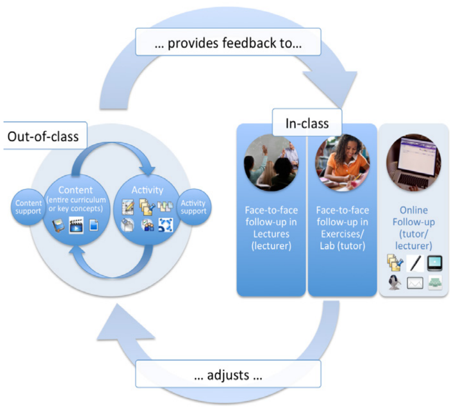

Figure 1. *The STREAM model*

Pre-lecture activity
Students will be provided with links to a series of youtube videos and podcasts that cover key microeconomic concepts. The information will be structured through learning path and deadlines for watching and completing associated tasks will be detailed out.

For each of the concepts, students will be given several tasks. Task 1: Each student is to make notes summarizing each of the key economic concept. The notes must be submitted online. Task 2: Students will be assigned into groups where they are to write joint summaries. Task 3: Towards the end of the series, students will be required to post at least one question and to evaluate their fellow students' answers through PeerWise.

I will then use what they have produced (joint summaries, questions and answers posted) as a basis for deciding whether there is need to "visit" certain key concepts at the beginning of the lecture. The same architecture of pre-lecture activity can also be implemented on a weekly basis where students are required to undertake the aforementioned three tasks using the readings assigned for a given week. Alternatively, students may be provided with a list of questions to guide their reading.

Post-lecture e-tivity
Following a lecture on "methods for non-market valuation of ecosystem services", students will have the opportunity to design a discrete choice experiment (DCE); it is one of the prominent methods for valuing non-market ecosystem services.

Using online meeting room via Adobe Connect, I will introduce the e-tivity. Students will be split into four groups and each group is assigned a case where they can apply DCE method. Once they are clear about their tasks they will be sent to break-up according to their groups. In their respective groups, they are required to discuss the key elements for setting up a DCE: 1) list of potential choice attributes, 2) define the attribute levels, 3) identify potential stakeholders for focus group discussion, and 4) identify the target population for the study and subsequently the sample and the strategy for sampling. They will be given 1 hour to work in their group. After that they will have to upload the notes from their group work and they will be required to provide feedback to the works of at least two other groups.

Finally I can provide comments and feedback either directly via Adobe Connect or as follow up at the beginning of the lecture in the following week.

Pedagogical challenge/purpose

Large share of the students enrolled in the course have limited (if any) economics background. The key challenge is therefore to aid students' comprehension of basic microeconomic concepts, which will make it easier for them to follow the environmental economics components of the course. A structured pre-lecture activity is proposed.

An important element of the course is for the students to critically evaluate and apply different methods (e.g. non-market valuation methods). There may be a scope for realizing this objective through an e-tivity.

Indicators of impact

For pre-lecture activity, I will be able to assess students' outputs for the different tasks assigned. In addition, I will be able to observe to what extent the pre-lecture activity has an impact on their level of active engagement in the class.
For the post-lecture e-tivity, students' notes from the group work and the feedback they provide to other groups form the basis for evaluating the impact of the e-tivity.

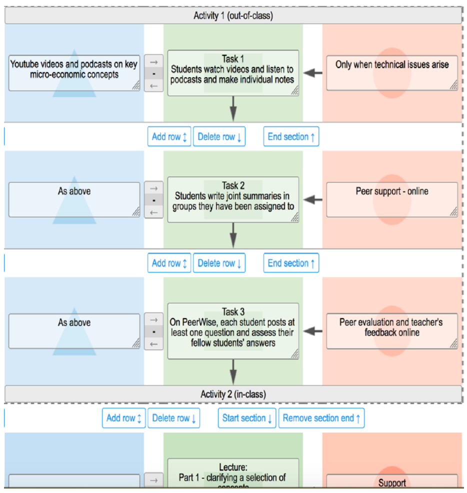

Figure 2. *LDTool representation of learning design used in STREAM-lining out-of-class and in class learning activities*

EDU-IT role and benefits

For the pre-lecture activity, students will have access to series of youtube videos and podcasts which explain various micro-economic concepts. In addition to making individual notes and joint summaries, students will be required to post at least one question and to evaluate their fellow students' answers; this activity will use PeerWise platform. The post-lecture activity will take place in online meeting room using the Adobe Connect platform and submission of results from group work and feedback to other groups on Blackboard.

Lessons learned and looking forward

The course is only offered in the Spring semester hence does not coincide with the timeframe of the teacher training program. Consequently, the proposed learning design is yet to be implemented from the end of January 2019. It would be interesting to see how students react to the proposed design and the implications for their learning.

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

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IMPROVING STUDENT PRESENTATIONS USING THE STREAM MODEL

A learning design implemented in the 3rd year course: "Geological Reconstructions of Climate and Environment"

Christof Pearce
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Keywords*: Presentations, STREAM-model, feedback, webcast, marine Geology and paleoclimate, peer-feedback, group discussions*

Context/course facts

Course: "Geological Reconstruction of Climate and Environment", 10 ECTS, 3rd year BSc, 19 students, exam is a written take-home assignment.
This course includes a lot of hands-on teaching. The students produce data themselves in the laboratory and they will base their final exam partly on the presentation and interpretation of this information. During the previous weeks, the students in this course have gradually built up a dataset based on analyses of a marine sediment core from the eastern North Atlantic Ocean. The sediment core represents ~60,000 years of ocean and climate variability in the region. In this project, students will work on the interpretation of their results and the formulation of a discussion based on comparison with other studies.

Learning outcomes and purpose of learning design

With this exercise I want to improve student presentations so they will be useful for the other students. By giving feedback on a first draft, I eliminate big mistakes and/or meaningless content, and make sure that they include the main message I was aiming for when I chose their specific topic.
By building this exercise around content that is relevant to all students, I hope to engage all of them. Rather than just staring at someone else's presentation exercise, they are actually getting information from their peers that is useful for their own final exam.

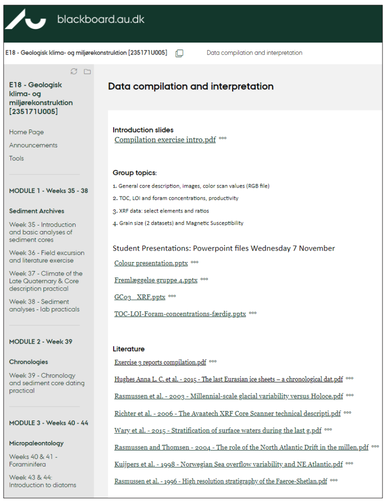

Figure 1: Screenshot of Blackboard page with basic instructions for the practical. All students are divided in 4 groups and assigned specific topics. Scientific literature is provided for background reading.

Learning design and Educational-IT

This learning design is the result of exercises done in Modules 2 and 3 of the teacher training programme and follows the STREAM model (Godsk 2013). The design flips back and forth between in-class and out-of-class activities and makes use of Blackboard as a communication platform and MS Powerpoint with narration tools as a way to record webcasts.

Indicators of impact

One of the easiest ways to measure the impact of this exercise was to compare the difference in quality between the presentations uploaded to Blackboard for review and the actual presentations given in class. The extra round of feedback from the teachers and TAs significantly improved the final presentations. Some initial presentations had missed critical conclusions or had overlooked to include specific datasets. By stepping in before in-class presentations, we avoided missing this information.

Another indicator of success was the interest shown by the students towards the presentations of their peers. By adding the round of feedback, we did some quality control and turned the students into teachers. The entire data discussion was driven by the presentations given by the students themselves. Students were seen actively taking notes and an lively discussion followed all the presentations. Students asked to share all presentations and will use them as a resource for their final exam.

Pedagogical challenge/purpose

Student presentations are sometimes of poor quality or miss the point. After watching several presentation, students often loose interest.
In this learning design, I have added an extra online feedback session to this normal setup. Students record their presentations as webcasts and they get detailed instructions on how to improve, before presenting in class.

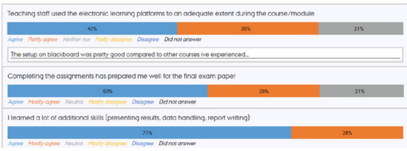

Figure 3: Answers in the course evaluation, related to the use of the assignments and electronic learning platforms. Students were overwhelmingly positive and felt that they improved on their presentation skills.

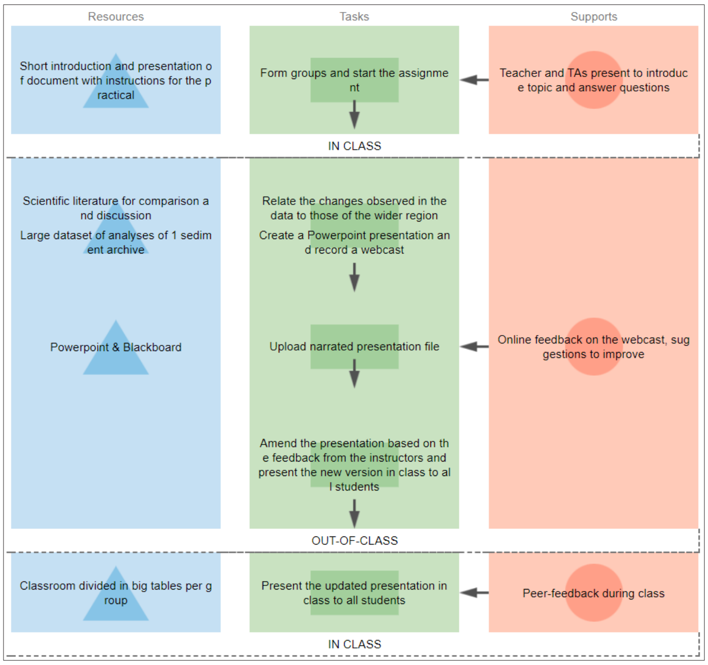

Figure 2. *LDTool representation of learning design used in Geological Reconstruction of Climate and Environment.*

EDU-IT role and benefits

By using webcasts, this teaching design allows students to record a draft presentation and fine-tune each slide with narration until they are satisfied. Recording a webcast forces the presenter to put more thought into the spoken presentation. The webcast is uploaded to the teaching team who sat down together and reviewed all presentations. This feedback was shared online and students managed to create final presentations that became a useful resource for the other students, effectively turning the students into teachers in this specific module of the course.

Lessons learned and looking forward

An extension of this design will be to turn the outcome of the presentations and discussions into a student-built Wiki page. This was an initial plan, but not implemented this year. The Wiki will be an extra student resource for the final course exam, but will also serve the purpose of a monitor of success of the exercise for the teaching team.

References

Godsk, Mikkel (2013). STREAM: a Flexible Model for Transforming Higher Science Education into Blended and Online Learning
Figure 2 was created using LDTool ©University of Wollongong.

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Group Supervision In Project-Based Courses Using The Scientific Peer Review Process

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Keywords: *Engineering; Group supervision; Peer feedback; Research practice*

Pedagogical challenge/purpose

The goal of this research is improving students' skills in authoring and reviewing scientific publications. Improving these skills could be valuable in student's thesis work, especially if they want to publish their findings in a conference or journal venue.

Context/course facts

The study was conducted in a graduate-level course on sustainable design and production. This is a 10 ECTS course which is open to all students within the faculty of science & technology. In the semester the study was conducted, 15 students were enrolled in the course. The students were from diverse programs, including software engineering, mechanical engineering, civil engineering, and computer science. A central portion of this course is a group-based, semester-long project where in students apply concepts from the course to a technical problem in their education domain.

Learning outcomes and purpose of learning design

Learning outcomes for the conducted study include,

1. analyze research work structured as technical publications
2. criticize methodology and results in technical publications
3. formulate feedback for technical publications
4. justify adopted methodology and results produced in technical publications

Students provided peer feedback for each others mid-term project. The report acts as a interim check where students can evaluate their progress and reconsider future plans. This report (as well as the final report) is structured as a technical publication. This enables students to practice their technical writing skills; a necessary aspect of their education as all students within the the faculty of science & technology subsequently work on a thesis project.

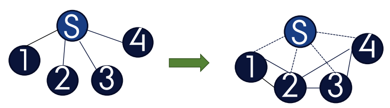

Figure 1: Transformation of the mid-term project review activity into peer feedback. Here, 'S' represents the supervisor and the numbers represent project groups

Learning design and Educational-IT

The overall plan for the exercise is listed below and is also illustrated using Figure 2 & Figure 3. Figure 5 shows the LD tool representation of the peer review exercise

1. Each student team will submit their mid-term project report to the instructor through Blackboard
2. The instructor will assign two other mid-term project reports to each student team to review
3. The instructor will conduct an in-class presentation on how to review technical publications
4. Each student team will review two other project reports in a provided IMRAD rubric [1]
5. Each student team will submit their feedback on the two other project reports on Blackboard
6. The instructor will anonymize and collate all the feedback for a specific project, include their own comments and upload them on Blackboard.
7. Instructor will conduct an in-class session discussing the feedback and evaluating this learning approach

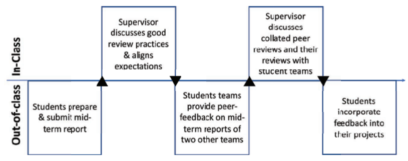

Figure 2: Out-of-class and in-class activities relevant to the proposed project. Please note that the outcomes from one type of activity feeds into the other.

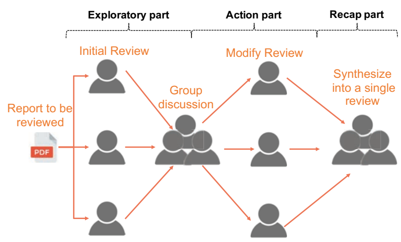

Figure 3: Peer supervision guidance model adapted from Nordentoft et al. [2]

Indicators of impact

A online survey was distributed at the end of the course to evaluate the peer feedback exercise (see Figure 4). The response rate for the survey was 10/15 students .

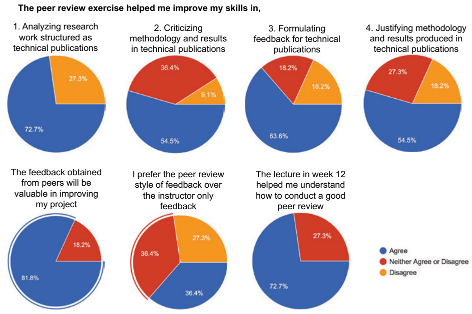

Figure 4: Survey results indicating students perception of the peer feedback exercise

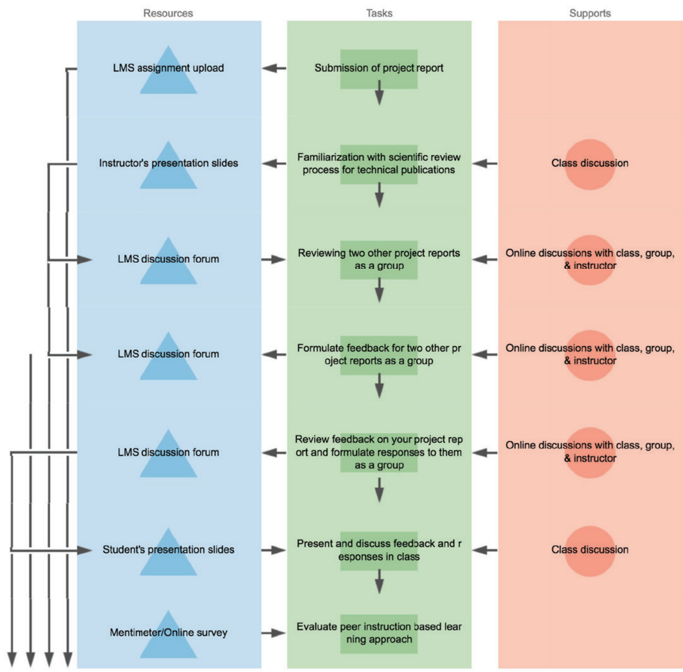

Figure 5 LDTool representation of learning design used in the peer review exercise

EDU-IT role and benefits

By changing the process of providing feedback for the mid-term project reviews, the peer review task transformed the course and its associated learning objectives. The peer review exercise could be represented a a `modification' of the course using educational technology [3]. This is because the activity (providing feedback on project reports) was transformed to support peer instruction using educational technology (i.e., Blackboard, and Web-based survey instruments). On Conole's three dimensions for mapping tools-in-use [4], the peer review task can be classified as social, active, and experience This is because it involved students working in a team to evaluate other project reports and synthesize their feedback.

Lessons learned and looking forward

Peer feedback is a promising avenue for enabling group supervision in project-based courses. A majority of the students indicated that such feedback was valuable in helping improve their projects. However, student also indicated the need for direct instructor supervision and feedback in addition to peer feedback. Future work should explore means to balance these two types of supervision.

References

1. Bioskriv, IMRAD Rubric, Accessed: 01-12-2018, https://tinyurl.com/imrad-guide
2. Nordentoft, H. M., Mariager-Anderson, K., and Anne, S., 2016. "Kollektiv Akademisk Vejledning En Introduktion", DPU, Aarhus Universitet.
3. M. Godsk, "Efficient learning design-concept, catalyst, and cases", in Ascilite, 2014.
4. G. Conole, "New schemas for mapping pedagogies and technologies," Ariadne, no. 56, 2008.

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Disrupting student silos with STREAM in Software Engineering

Carl Schultz
Assistant Professor

Keywords: *software engineering; lectures and group assignments; STREAM, flipped classroom; disrupting group silos*

Pedagogical Challenge

to engage students from a technical degree in critical analysis and argumentation, and to exercise "soft" communication skills – engage students in activities with other students **outside of their own groups** - and for them to feel that the activities are a worthwhile use of their time.

Context/course facts

The course is "Software Engineering Principles", a 5 ECTS Masters level course, ~35 students. It is organized as lectures, but underlying the lectures is a semester-long small-group project (3-4 students per group) which is the main focus. During semester students submit reports approximately every 2-3 weeks that address topics discussed in the lecture. These report assignments are evaluated as pass/fail, and students must pass all assignments to sit the final exam. My learning design project lesson was on "architecture design patterns".

Learning outcomes and purpose of learning design

- **Analyse, compare,** and **argue** for or against application of architecture design patterns to a software development project, demonstrated in their next report assignment that they submit;
- exercise **critical analysis** via peer **feedback** in forum posts and in-class discussions.

Challenge: disrupt student "silos" that form due to on-going group work. Also difficult to motivate students in applying these "soft" skills given the technical character of the degree programme, e.g. 2017 student evaluations:

- *"The course content is very fuzzy [..] the course does not have a real life application scenario presentation. […]".*

Concept*: students learn by doing (Biggs 2012), and giving feedback is a highly effective learning activity (Hatte 2015). I am aiming for transformation/modification in the SAMR model with emphasis on group activities (see Figure 4).*

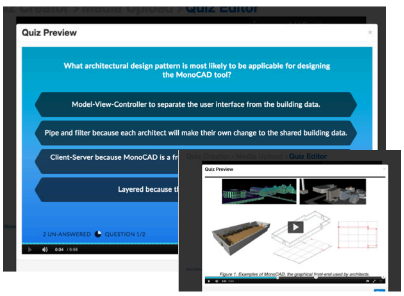

Figure 2: *Kaltura video quiz experimented with during development of this learning design project.*

Learning design and Educational-IT

This small-class activity will tie in with group project assignment to align with assessment. I will employ the STREAM model (see Figure 1): students engage in peer-assessment both out-of-class and in-class, and build on feedback they receive in a follow-up assignment (which is formally assessed). I will apply learning technologies to make the material more engaging: videos, online quizzes (see Fig. 2), and to help with the logistics of peer-review (forums). The detailed e-tivity is presented in Appendix A, also see Figure 3.

Out-of-class content: textbook reading, webcast of case study a software project (1 min), online multi-choice quiz
Out-of-class activity: [A+B] apply architecture patterns to own project as forum post (in groups), [Respond] give feedback on two posts (individuals)
In-class tutorial: (1) tutor gives feedback on the forum activity, quiz results, discuss the patterns; (2) an activity in which students present ***another*** group's arguments for Part B of the e-tivity. Students will be organised into small "in-class" groups at the tutorial. Each in-class group will be assigned a "case" project group that they need to report on. If students don't manage the out-of-class task then they have 20 mins during the tutorial to revise, giving additionally opportunities for "Robert"-type students to participate (i.e. less motivated students).

Influences out-of-class: apply feedback to next group assignment (which is assessed).

Indicators of impact

- quantity and quality of student posts in the forum
- Menti-meter to gather student feedback in-class two weeks after the exercise
- quality of the associated assignment on architecture design, which was due two weeks after the project
- compare the student evaluations of the 2018 course to the previous year evaluations

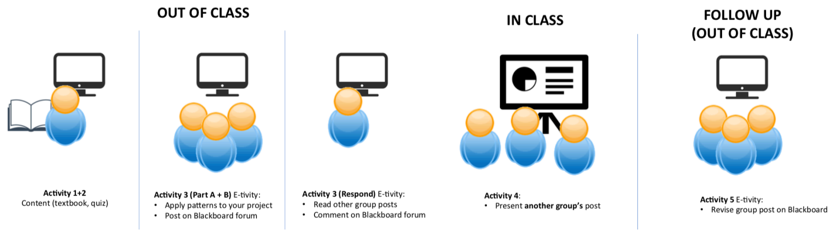

Figure 1. *STREAM model used to coordinate out-of-class and In-class activities, and group and individual work.*

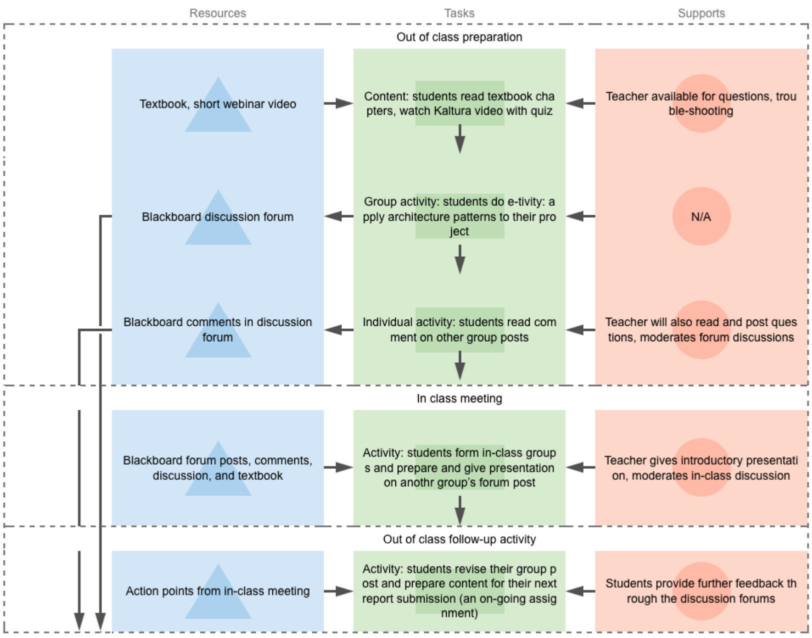

Figure 3. *LDTool representation of learning design used in Architecture Design Pattern e-tivity.*

EDU-IT role and benefits

*E-tools for active group work with individual, information components (Figure 4). Engage and activate learning using **online quizzes**, **webcasts**. Logistics of peer-feedback handled with online forum posts. Gather in-class student feedback and stimulate reflective discussion using menti-meter.*

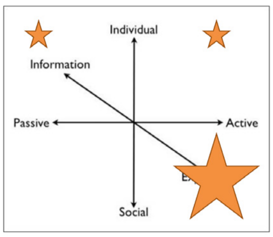

Figure 4. *This learning design emphasises active group work (Conole's framework).*

Lessons learned and looking forward

Activities (videos, quiz, posts) and peer-feedback are powerful learning tools. Students engaged with material and peer-feedback in reflective, critical manner, and silos were disrupted, e.g. from Menti-meter feedback:

- *"In class, it was **fun** to work with **new** people and **we learned** a lot as well"*

Next challenges: try menti-meter for in-class discussion on quiz answers; use activities in whole course without losing diversity.

References

- John Hattie (2015) *Teacher-ready research review: The Applicability of Visible Learning to Higher Education*, Scholarship of Teaching and Learning in Psychology 1:1 79-91
- John Biggs (2012) *What the student does: teaching for enhanced learning*, Higher Education Research & Development, 31:1, 39-55

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Peer Evaluation of Design Iteration Videos

Jo Vermeulen
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Keywords: *computer science; human-computer interaction; mobile programming; lecture; flipped classroom; peer assessment; screencasts; STREAM model; improving based on peer feedback; highlighting issues*

Pedagogical challenge

It is too impractical and time-consuming to organize peer feedback with presentations for a large class (~150 students).
This e-tivity transforms such an existing non-digital activity, making it feasible via in-class and out-of-class activities. It can thus be situated on the **Modification** level in the revised **SAMR model** [2].

Context/Course Facts

2nd year Computer Science / IT (144 students, 10 ECTS)

In the course "**Introduction to Human-Computer Interaction (HCI)**", CS and IT students go through an iterative design cycle in a group project to design and implement a mobile application for the Android platform.

The group project consists of several phases. **Before this activity**, the students created an interactive prototype. In their TA classes, they evaluate each other's prototypes using "heuristic evaluation", resulting in a structured report of improvements to be made to the design. This activity documents the modified version of the design based on peer feedback. A video clarifies and motivates the differences between the original and modified design, reflecting on design choices and referring to the peer feedback.

After this activity, students get feedback from the teaching staff on their improved design and video, and the students start with the actual implementation of the Android application.

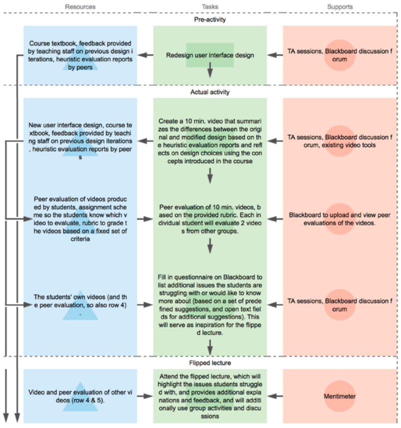


Figure 1. LDTool representation of the learning design.

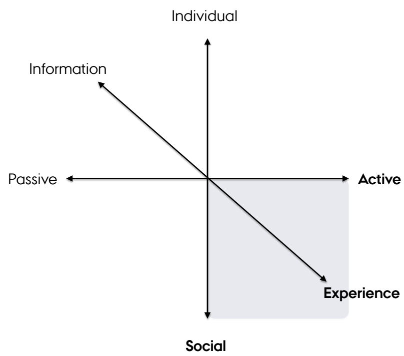


Figure 3. Learning design within Conole's 3 dimensions.

Learning Outcomes and Purpose of Learning Design

The learning outcomes that this activity addresses are:

- name, define and use HCI theories, principles and guidelines to analyze and criticize user interfaces and motivate user interface design decisions
- evaluate user interface designs with respect to usability
- prototype interactive systems

The purpose of this learning design is to apply design principles and techniques to critically analyze and motivate interface design decisions made in a design iteration.

Learning Design and Educational-IT

This learning design is based on the teaching experiment from module 2 in the Teacher Training (Figure 1).

In terms of STREAM's **in-class and out-of-class activities** [1]: the creation of the video and revision of the design and the peer evaluation of the video takes place ***out-of-class***. These out-of-class activities inform the ***in-class*** activity — the follow-up **Flipped Classroom** lecture in which I discuss the most common mistakes and general feedback. This also relates to **JiTT** in terms of using out-of-class activities as a way to get an idea of the level of the students and what they are struggling with most. I extract this from the rubric and from input from a questionnaire.

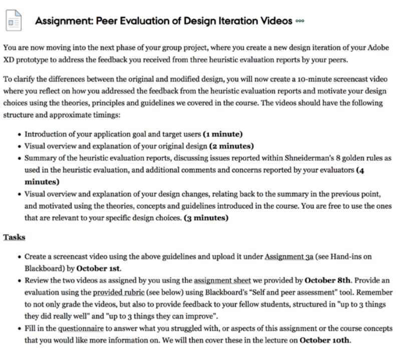
In terms of **Peer Instruction**, students help each other by providing feedback and improving their own skills by better understanding the grading criteria and seeing other video examples, i.e. strategies that other students used. Within **Conole's 3 dimensions** [2] (Figure 3), this activity would be mapped on the ***active***, ***social*** and ***experience*** positions, given that the focus is not on information transfer (experience), students actively create videos and actively evaluate the results of their peers (social).

Activity Description

In this activity, the students create 10-min. videos, showing a summary of the changes in their design iteration and how they addressed the peer feedback of the heuristic evaluation (Figure 2). They motivate their design decisions using concepts introduced in the course.

Next, each student performs a peer evaluation of 2 other 10-min. videos. A rubric is provided to do this based on a fixed set of criteria. Based on the rubric, I will be able to see which aspects students struggle with most. The same rubric will be used to grade the final 10-min. videos.

I will organize a lecture to highlight the aspects students didn't do so well on, and provide additional feedback. Before the lecture, I will also provide opportunities for the students to bring up additional issues, which I will then use to prepare the topics I will address in my lecture.



Assignment: Peer Evaluation of Design Iteration Videos

You are now moving into the next phase of your group project, where you create a new design iteration of your Adobe XD prototype to address the feedback you received from three heuristic evaluation reports by your peers.

To clarify the differences between the original and modified design, you will now create a 10-minute screencast video where you reflect on how you addressed the feedback from the heuristic evaluation reports and motivate your design choices using the theories, principles and guidelines we covered in the course. The videos should have the following structure and approximate timings:

- Introduction of your application goal and target users **(1 minute)**
- Visual overview and explanation of your original design **(2 minutes)**
- Summary of the heuristic evaluation reports, discussing issues reported within Shneiderman's 8 golden rules as used in the heuristic evaluation, and additional comments and concerns reported by your evaluators **(4 minutes)**
- Visual overview and explanation of your design changes, relating back to the summary in the previous point, and motivated using the theories, concepts and guidelines introduced in the course. You are free to use the ones that are relevant to your specific design choices. **(3 minutes)**

Tasks

- Create a screencast video using the above guidelines and upload it under Assignment 3a (see Hand-ins on Blackboard) by **October 1st**.
- Review the two videos as assigned by you using the assignment sheet we provided by **October 8th**. Provide an evaluation using the provided rubric (see below) using Blackboard's "Self and peer assessment" tool. Remember to not only grade the videos, but also to provide feedback to your fellow students, structured in "up to 3 things they did really well" and "up to 3 things they can improve".
- Fill in the questionnaire to answer what you struggled with, or aspects of this assignment or the course concepts that you would like more information on. We will then cover these in the lecture on **October 10th**.

Figure 2. Assignment description on Blackboard.

Indicators of Impact and Reflection

Unfortunately, I did not have time to implement this activity in my class as students needed more time for their other assignments. However, this activity could be very useful to facilitate peer instruction, provide more engagement with the material, and to understand topics students are struggling with. It could replace a current assignment on writing a report on the design iteration, since the students mentioned that there was too much writing. Creating a video could be an interesting variation and provide the same learning outcome.

A similar assignment that I was able to do this year consisted of peer-grading written feedback using a rubric. The students felt uncomfortable peer-grading each other and felt not qualified to do this, which will be important to take into account for this exercise. One way to address this would be to perform this exercise on a hypothetical written example in class before the exercise, and not take into account the peer grading marks in the final assessment but use it as a way to improve the students' learning.

Measuring Impact
To measure the impact of this activity, I will ask a specific question about this activity in the course evaluation. Since this activity impacts the design aspect of the assignments, the grade distribution for this criterium in the course project and for related questions on the written exam could provide a good indication of success in terms of the impact on students' learning. Finally, potential differences in the course evaluation results will also be an additional indicator of success.

Lessons Learned and Looking Forward

Digital learning activities that make part of the learning asynchronous and in-class activities informed by out-of-class activities are important learning tools to consider. The can also make learning activities feasible that are nearly impossible to do in a traditional way with large classes.

EDU-IT role and benefits

I will use **online quizzes** , **screencasts** and **Blackboard rubrics** to facilitate the activity. The digital learning materials consist of a rubric for (peer-)grading the videos, Blackboard for its self and peer assessment tools , to upload the videos, and for questionnaires to list questions/topics that I will address in the flipped classroom lecture after the activity.

References

1. Godsk, M. (2013, October). STREAM: a Flexible Model for Transforming Higher Science Education into Blended and Online Learning. In *E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (pp. 722-728). AACE.
2. Godsk, M. (2014). Efficient learning design-concept, catalyst, and cases. In Ascilite.

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SCIENCE TEACHING COURSE POSTERS BY PHD STUDENTS

Visualization of mathematical functions

- Use of odd and even functions to solve tasks in quantum mechanical problems

Learning Lab

Abstract: Quantum Mechanics TØ classes often have exercises that need understanding of certain mathematical functions (for example: even/ odd functions) to solve them. Students often feel burdened to understand them in a conventional way because it could feel that they're doing a math and a quantum mechanic course at the same time ! This teaching activity aims to reduce the burden by making it part of the course through a visualization tool called Quantum Composer and through a gamified quiz. The learning goal is to make students visualize odd and even functions and their properties using visualization tools that can be used in solving exercises in quantum mechanics.

COURSE FACTS

- Course name: Quantum Mechanics
- Level: Bachelor
- ECTS credits : 10
- Language: English
- Number of students: 18
- Your role: Teacher Assistant (TA)

TEACHING IN PRACTICE

1. Identifying a problem

Quantum Mechanics TØ classes have exercises that need understanding of certain mathematical functions (for example: even/odd functions) to solve them. Students often feel burdened to understand them in a conventional way because it could feel that they're doing a math and a quantum mechanic course at the same time ! Students often get immersed in the heavy mathematical concepts and do not realize the quantum mechanics learning behind the exercises. If we have some teaching activities that could simplify the burden of tedious mathematics, then that would give them more time and capacity to absorb the physics learning behind the exercises.

2. Planning a teaching activity

My teaching activity was planned to introduce mathematical functions through visualizations and a quiz. The idea behind using visualizations is to provide intuition to the students about the mathematical functions without getting into vigorous calculations and theory. This will reduce the burden that they might would have otherwise felt.

I planned to make the activity innovative by introducing drawing and visualization of mathematical concepts that might otherwise seem difficult to grasp. I had chosen to focus on even and odd functions as they are widely used for integration in quantum mechanics exercises.

References

Visualization tool: www.quatomic.com

3. Trying it out in practice

The teaching activity was planned in the following way:

1. A short theory was introduced about the mathematical functions and their properties.
2. Students were shown pictures on the screen with different functions followed by a short activity of sorting the pictures based on their understanding.
3. The interactive visualization tool Quantum Composer was introduced to the students where they entered functions of their choice.
4. At the end, a gamified quiz was conducted where a function was shown and the students had to sketch it on paper. They were given scores based on how close it was with the function given to them.

Learning goals:

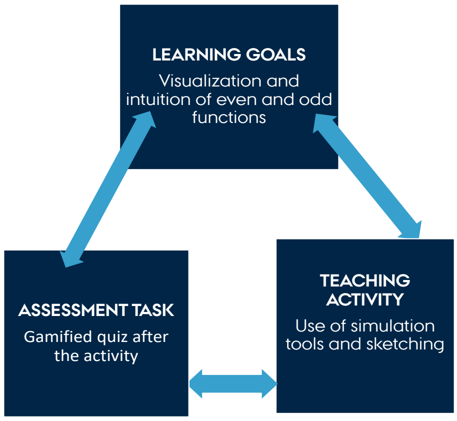
1. Intuitive understanding of mathematical functions

2. Application of these functions to solve quantum mechanic exercises.

The gamified quiz was an assessment tool for me if the students had understood the concepts or not. I found that 80 % of students had successfully drawn the functions correctly on paper. The activity can be improved by adding another level of difficulty and/or engagement.

MAIN POINTS

1. **Main problem/challenge:** Tedious mathematical concepts in Quantum mechanics exercises
2. **Teaching activity**: Visualization and a gamified quiz
3. **How did it go ?** 80% success rate.
4. **What to do next?** Add another level of difficulty or engagement.



4. Looking forward

A quiz after the teaching activity validated it that the activity worked to a great extent as 80% of the students could answer correctly. However, I felt that the activity was a little short. Perhaps, I could add another level of engagement by having a discussion or raising the difficulty a bit so that it would be a bit more challenging.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Shaeema Zaman Ahmed
ScienceAtHome
Department of Fysik og Astronomi

From milk to cheese
- Supporting student's learning

Learning Lab

Abstract: High school students from different schools are coming to our labs for one days trying different analyses with milk and cheese. The main challenge is that hey have different background knowledge beforehand and they often lack the capability to couple theory with lab work. The aim of this teaching activity was to align the level of background knowledge and couple this to the laboratory exercises by use of STRIP sequence. Overall, the activity was evaluated as a good tool to ensure a good understanding of their work in the lab. Thus, this activity could successfully be implemented as a part of the course in the future

COURSE FACTS

- Course name: Fra mælk til ost
- Level: High School
- ECTS credits : 0
- Language: Danish
- Number of students: 8
- Your role: organizer and instructor

TEACHING IN PRACTICE

1. Identifying a problem

High school students visiting our department to try various analyses in the lab, are introduced to a large amount of information. It is difficult for them to couple background knowledge to what they are testing in the labs. Moreover, they seem to forget what the have been told in the introduction before going to the labs. Therefore, the **aim** of this teaching activity was to
1. Ensure similar levels of background knowledge
2. Get a better understanding of the theory behind the exercise

2. Planning a teaching activity

Traditionally, a brief introduction to the background of the laboratory exercise was given without any interaction. Furthermore, as the student come from different high schools, it has been difficult to know their existing level of knowledge. To align the level of knowledge and thereby easy the work in the laboratory, a **STRIP- sequence** was used as teaching activity.

Learning goals were to be able to couple background theory with steps in the laboratory protocol. An evaluation of the course day was made for feedback.

A: Mælken sættes i vandbad på 80°C i 5 min	**1:** Denaturering af valleproteiner hindrer enzymatisk kløvning af k-casein
B: Juster pH til 6.5 ± 0.02	**2:** Neutralisering af casein micellers ladning giver hurtigere gelering og fastere gel
C: tilsæt 100 uL 10% $CaCl_2$ til 50mL mælk	**3:** Ændrer på ladningen af casein micellerne og binder dem sammen. Det giver en hurtigere gelering og fastere gel.
D: Analysen kører ved 33°C	**4:** Her er de mest optimale koaguleringsbetingelser
E: Analyserne køres på skummetmælk	**5:** Geldannelsen er baseret på koagulering af proteiner

Figure 1: The **STRIP-sequence** the students had to do. A-E are steps taken from the protocol, while 1-5 are the corresponding theory behind the protocol.

3. Trying it out in practice

The teaching activity was performed during the presentation of background theory behind the exercise before going to the lab. **In pairs**, the students had to match a sentence from the protocol to the theory behind.

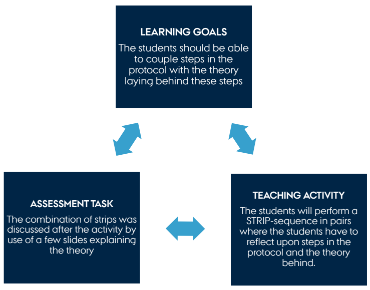


Figure 2: **Constructive alignment**

MAIN POINTS

1. **Main problem/challenge:** Different levels of knowledge on beforehand and lack of understanding of a laboratory protocol
2. **Teaching activity**: STRIP-sequence combining main steps in the protocol with theory
3. **How did it go?** Overall, the activity fulfilled the aim
4. **What to do next?** The course will be run again in spring 2019, and a activity like this would definitely be useful to use again

The strips used, are shown in figure 1. After a short time, they **discussed with neighbor group** on which they agreed and disagreed on.

The students **responded positive** to the activity and had good discussions, both in pairs and afterwards with the neighbor group.
From the evaluation made at the end of the course day, they said it made them obtain a **good understanding** of the theory behind the exercise by having to think them self instead of just listening to the teacher.

However, it was clear that students who were well prepared when they arrived at our department were finishing mush earlier and more eager to discuss the strips.

4. Looking forward

At the end of the day, the students filled out an evaluation about their impression of the day. Overall, they were satisfied with the activity as they had time to discuss the theory which gave them a good idea of what the exercise was about. All in all, a STRIP-sequence test like this test would be useful in future teaching to secure the understanding of the laboratory exercises and could definitely also be implemented for the other laboratory exercises they have to perform.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Marije Akkerman
Food Chemistry and Technology
Department of Food Science

Structured problem solving

Teaching a different strategy for answering difficult exam like questions

Learning Lab

Abstract: Going through long and complicated assignments can often be a challenge to students, so when doing these assignments students organize into groups to solve them. While this is not a problem by itself it does not prepare students for exams or later on in their studies where they have to work alone. To help students prepare for doing assignments alone we have developed a tool to help the students go through an assignment in a structured way and later on asses their own progression through the assignment.

COURSE FACTS

- Course name: Physical Biochemistry
- Level: Bachelor, 1st semester
- ECTS credits : 5
- Language: Danish
- Number of students: approx. 22
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

When students work with assignments for theoretical exercises they usually do so in a group where several group members can give input to how a problem is best solved. Later on in their studies or during exams student do their assignments by themselves and this can lead them to getting stuck doing assignments. To prevent this I want to help the student learn to evaluate their own progress through difficult exercises, to better evaluate their own strategy when solving assignments.

2. Planning a teaching activity

To help students asses their own workflow I will make students do one of the exercises for the next theoretical exercise by themselves at home, while filling out a workflow-ark which explains which steps we would like them to follow when going through the assignment while also writing down the time they use at each step and if they get stuck dong the assignment.
In the following session one group will then go through the exercise and in the end present their findings from assessing their own activity. In the end if time allows a whole class discussion can be had on how the students used the tool for better completing the assignment.

3. Trying it out in practice

At the end of a theoretical exercise the TA will give the students a short explanation about the exercise and with it a document explaining the exercise step by step. The student are to reserve a problem for the next session to do with the activity. The activity is to be done alone and without discussing with other students. The exercise asks the students to note down time for each step of the “Structured problem solving” and to note down if they get stuck during the exercise and why.
At the next session the normal time used for going through the problem will be used to discuss the exercise with the students while simultaneously answering the problem used for the exercise.

1. Write down time consumption at each step of assigned problem
   a.Read the assignment, get an overview min
   b.Note down relevant information min
   c.Find out which chapter/subject it relates to min
   d.Search for information min
   e.Draft an answer for all subproblems min
   f.Revise and correct min
2. Read the assignment, get an overview
3. Note down relevant information
4. Find out which chapter/subject it relates to
5. Search for information in relevant chapters
6. Draft an answer(s) for the assignment
7. Revise, correct, and write as a short, concise, coherent answer

Figure 1: Workflow of the activity as presented to the students

For evaluating the exercise a mentimeter evaluation will be conducted where the student anonymously can give feedback to the exercise. Besides this, during the discussion of the exercise the TA will encourage the students to discuss experiences from the activity, how it can help them approaching an exam like question and overcome getting stuck in said question.

MAIN POINTS

1. **Main problem/challenge:** Teaching student how to asses their own strategy when answering an assignment by themselves.
2. **Teaching activity**: Structured problem solving and self assessment
3. **How did it go?** Only a few student completed the activity.
4. **What to do next?** Improve the activity to better fit to the course or implement it for another course with longer and harder assignments i.e. not a first year bachelor course.

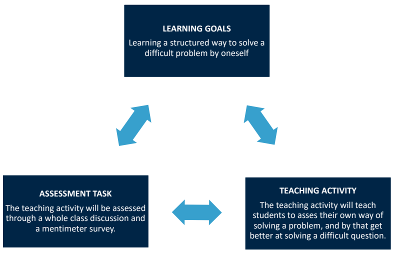


Figure 2: Constructive alignment
The figure show how the learning goal eg. training students to solving hard questions are supported by the teaching activity. Together with the exercise being evaluated through mentimeter, discussion in a class among students and TA.

4. Looking forward

Unfortunately I only had a low turnout of students who ended up during the whole assignment at home. This could either be because the students did not see the necessity to do exam prepping exercises since they have not had many exams yet, or as one students stated that she had not had a long and difficult question yet which this teaching activity demands.
To improve on the activity it probably has to implemented in another course or better structured to the assignments given in this course.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Søren Kirk Amstrup
Ditlev Brodersen Lab
Department of Molecular Biology and Genetics

Mind Mapping and role-playing

Teaching students about the limits of voice and sound

Learning Lab

Abstract: Teaching students about how to design interactive products with diverse modalities can be challenging. Modalities are about how products can convey information so people can understand it through their senses (output) and how people can control products (input). Hence, I included small activities such as creating a collective mind map with students, asked students to act, and watch videos of Voice User Interfaces (VUIs), products that use voice as input and output. The students evaluated the lecture positively and shared 1-3 key takeaway(s) on menti.com which covered some of the important aspects. Finally, students handed in their individual reflection on important design decision for VUIs which did fulfill the learning goals.

COURSE FACTS

- Course name: Multimodal Interaction
- Level: Master's Degree
- ECTS credits : 10
- Language: English
- Number of students: 26
- Your role: TA giving a lecture

TEACHING IN PRACTICE

1. Identifying a problem

Multimodal interaction is about designing products with interfaces that appeal to more than one of the human senses. Students can have a hard time relating to how a product and user perceive one another; products need clear operations from a user (input) while users need clear feedback from the product (output). This is important to explore in an early design process as it uncovers technical challenges, problematic interactions, and more.

2. Planning a teaching activity

To ensure that students both learn important aspects of VUI design and get ideas on how to explore modalities beyond only voice, I decided to use following activities:

- **Mind map**: Helps students to share what they understand so far in the lecture and for me to ask class about important things I just mentioned or showed.
- **Videos**: Supports students' understanding about important concepts in concrete examples.
- **Role-play**: Enables students to experience first hand e.g. difficulties products or users have when interacting through a particular modality.

Learning goals:
- **Explain** what a VUI is.
- **Identify** what the contextual challenges are for VUIs.
- **Reflect** on how a multimodal interface can address these challenges.

3. Trying it out in practice

As an icebreaker, I started the lecture with the **mind map** by establishing a baseline for what students know about VUIs – students shared what they associated with VUIs. This was followed by a relative short monologue and a short **video** about today's VUIs. I then went back to the mind map and asked students to share what else is related to VUIs. This I repeated three times throughout the lecture as milestones. This opened for discussion and questions that both I posed to the students and vice versa.

I asked the students ones during the lecture, to **role-play** as a means to understand what it means to be able to differentiate between voices. The students went into groups of 2 where one student would talk about their morning while the other would try and listen into another conversation next to them without looking at the people.

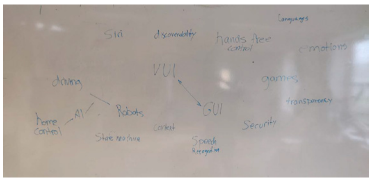


Figure 1: Mind map constructed throughout the lecture.

This gave perspective on how difficult it can be to distinguish voices with background noise e.g. rest of the class talking. I summarized the lecture by asking the students to share their key takeaways as well as evaluate the quality of the lecture. Lastly, I assessed **seven students' individual reflection** to assess whether they fulfilled the learning goals. My overall impression was positive since the reflections included many of the considerations we talked about during the lecture.

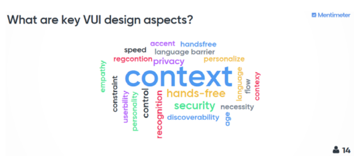


Figure 2: Menti.com Students' key takeaway from the class.

MAIN POINTS

1. **Main problem/challenge:** How to make it easier for students to explore both a system's and user's point of view with respect to modalities?
2. **Teaching activity**: Mind map, role-play, and watching videos.
3. **How did it go?** The students evaluated the lecture as positive. Since only a few handed in their exercise, it is difficult to generalize their understanding of VUIs, however, those that did hand in did an overall good job.
4. **What to do next?** I will consider designing more acting activities to increase students' understanding of systems and their own senses so students can use this technique themselves to explore design decisions.

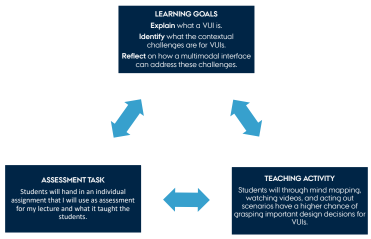


Figure 3: **Constructive alignment**
Alignment between learning goals, teaching activity, and assessment to improve learning outcome.

4. Looking forward

Videos seemed to be effective in conveying challenges as the students referred to them when contributing to the mind map. While role-playing indicated to be effective in conveying some concepts, I believe that next step is to experiment with role-playing to increase engagement in groups. It would also be great to ask students to apply the role-play in their design process.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Mirzel Avdic
Ubiquitous Computing and Interaction
Department of Computer Science

Practicing data analysis: calculating FT50

Learning Lab

Abstract: The students conduct a lab exercise, where they investigate the effect of copper on the feeding rate of an amphipod, *G. pulex*. Students are asked to write a report based on their experiments. To write this report the students must properly analyse their data and discuss their results. However, the students at this stage have only limited experience with data analysis. My teaching activity seeks to improve the ability of the students to analyse their data. After the teaching activity the students felt better prepared to analyse the data.

COURSE FACTS

- Course name: Ecotoxicology
- Level: 3rd year Bachelor students
- ECTS credits : 10
- Language: Danish
- Number of students: 3-4 pr group
- Your role: Assist with the lab exercise

TEACHING IN PRACTICE

1. Identifying a problem

When students participate in this course they have only had very little experience with data analysis. Students are asked to determine the mean time for *G. pulex* to eat 50 % of the eggs for each copper treatment. Experiences from past years have shown that many students struggle to find a proper solution to this problem. This is particularly problematic if their results are very variable, a common problem for this exercise.

2. Planning a teaching activity

I seek to help the students analyse their data. This is done by dividing student groups into 2 pairs. For each pair I introduce the activity including some data for them to analyse. The data is fictional and generated by me and is intended to simulate some of the problems they are likely to encounter with their own data.

3. Trying it out in practice

I asked them to work on the problem individually before they discussed it with their partner. Finally after about 10 minutes I discussed their solutions as well as other possible approaches with the students. During the course of this discussion we located an optimal approach to analyse the data, and the students implemented this approach on their own data in their report.

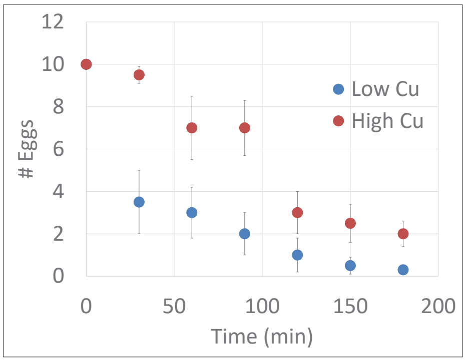


Figure 1: Two examples of data that the students are asked to analyse. Data is made up by me but represents data similar to what they might get from their own experiment

The learning goal was assessed by:
1) A yes/no questionnaire
2) Asking the students about the exercise
3) The quality of the data analysis in their report

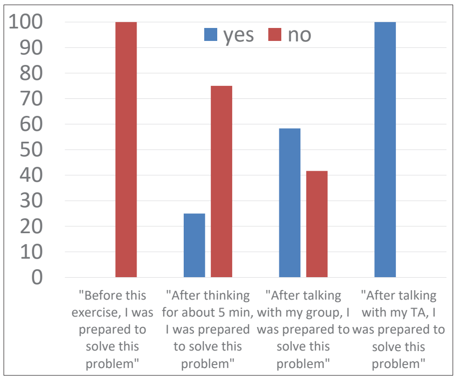


Figure 2: Assessment of the teaching activity (response of 12 students)

MAIN POINTS

1. **Main problem/challenge:** Students are inexperienced with data analysis
2. **Teaching activity**: Providing a data analysis challenge
3. **How did it go?** The feedback I received was very positive
4. **What to do next?** Do the same exercise next year

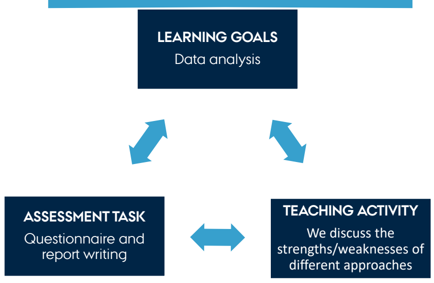


Figure 3: **Constructive alignment**

4. Looking forward

The feedback I got from the students was very positive. The students agreed that they did not have much experience with data analysis and they felt that this had improved after our discussion. The students felt that the discussion with their partner or the TA was more useful than the time they spent thinking individually. However, they also agreed that it was best to give everybody some time to think before discussions started. In the future I will consider if more can be done to spark the creativity of the students more: most students only suggested 1-2 possible solutions to the problem and no students thought of the solution I recommended

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Jeppe Seamus Bayley
Zoophysiology
Department of Bioscience

Sedimentological quiz

An active way of learning

Learning Lab

Abstract: In order to stimulate students to master their basic knowledge, a quiz was accomplished. The students learn in an interactive way, with a direct assessment of the knowledge they have gained so far. The evaluation of the students was positive and they feel like they are prepared well enough for the oral exam. The plenum discussions after every question and after the whole quiz gave students the opportunity to fully understand the study material.

COURSE FACTS

- Course name: Sedimentology
- Level: Bachelor, 1st semester
- ECTS credits : 5
- Language: English
- Number of students: 34
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

It is essential for students to master basic knowledge to solve geological problems and understand geological processes. Students don't always recognize the benefits of mastering this knowledge. The knowledge is furthermore needed to successfully pass the exam. The challenge is to teach them the knowledge in an active way and engage all the students.

2. Planning a teaching activity

During previous lectures and practicals, the students worked with different schemes and tables that help them to identify sedimentary rocks. In order to test whether they studied the material and to encourage the students in learning it, I created a quiz. Lectures are giving for every category of sedimentary rock, but the quiz mixes all the knowledge that they need to know for the exam. The exam is oral and part of the final grade that the students get for the course. Furthermore, the quiz results give me an indication of the difficulties that the students still have. By evaluating the outcomes, the students know their strengths and weaknesses and what to work on to pass the exam.

3. Trying it out in practice

The teaching activity consist of a Kahoot! quiz that tests the students on their sedimentological knowledge. I created a quiz on Kathoot! that comprises fifteen questions on knowledge that the students need to know by heart, like characteristics of specific rocks and details of classification schemes.

Table 1: **Quiz results**
The results of the Kahoot! quiz that was carried out on the 30th of October. The quiz was completed twice, since the class is divided into two groups.

Kahoot quiz	Round 1	Round 2
Students #	15	18
Correct answers	65,14 %	59,52%
Highscore	13/15	13/15

The students can sign up on a website, which makes them participate in the quiz. The questions are shown on the screen and the students choose the correct answers (a, b, c or d) on their phone or computer within a time limit. The majority of the questions is accompanied by an image to clarify the problem. Directly after a question was answered or the time was up, the correct answer was shown on the screen. Also the amount of students that choose a certain answer was shown on the screen. This gives me the opportunity to do a first assessment and discuss with the students why certain answers are correct or wrong. Since all the students participated in the quiz, they can all be part of this discussion.

MAIN POINTS

1. **Main problem/challenge:** *basic knowledge.*
2. **Teaching activity**: *A quiz to motivate students to study in an active way.*
3. **How did it go?** *Good, the students were enthusiastic.*
4. **What to do next?** *Practice the exam to see whether the students remember the knowledge.*

The second assessment is carried out after the quiz. I discussed the difficulties that I think the students have and discuss it with them. An explanation of topics that I thought were still difficult was given again. I asked the students if the quiz helped them and they told me it was very useful. We agreed on practicing a real exam the week before the oral exam.

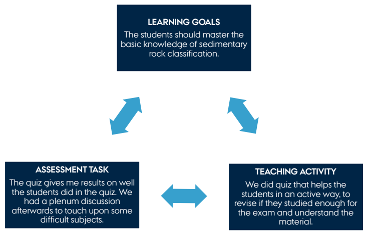


Figure 1: **Constructive alignment**
The relation between the learning goals, teaching activity and assessment tasks. The quiz tests students on their knowledge and the results give me an indication on how much they know so far and what I could do to have them all mastering the knowledge.

4. Looking forward

The teaching activity went very good. The students were enthusiastic and they thought the quiz was an efficient way of testing knowledge. The quiz results and the discussion after the quiz gave me an insight in the strengths and weaknesses of the student. I explained difficult subjects again in a plenum discussion. The next step is to put the knowledge into practice and mimic an exam.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Carlette Blok
Sedimentology
Department of Geoscience

The Android Activity Lifecycle

Predicting the order of execution for activity lifecycle methods

Learning Lab

Abstract:

Understanding the Android activity lifecycle and using lifecycle methods correctly when implementing Android apps can be a challenge for students. This teaching activity aims to provide students with a better understanding of the Android activity lifecycle. In an exercise, students predict the order of execution of lifecycle methods for different scenarios and then check their own predictions on the basis of a sample Android app. During the teaching activity, students were engaged and further evaluation of their code will show whether they were able to apply the concepts addressed in the TA session in their own projects.

COURSE FACTS

- **Course name:** Introduction to Human-Computer Interaction
- **Level:** Bachelor
- **ECTS credits:** 10
- **Language**: English
- **Number of students:** 20
- **Your role:** Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

Students have struggled with understanding and applying the Android activity lifecycle in the last edition of the course. Android activities are the main building block in Android apps and represent one screen in an app. It can be difficult for students to comprehend why their apps behave in certain ways when activities change state. The students need to be able to use the lifecycle methods correctly and adhere to Android best programming practices when they are developing an Android app as their final project. This is important so that their apps do not waste battery and CPU life.

2. Planning a teaching activity

The learning goal of the teaching activity is for students to understand the Android activity lifecycle so that they can apply those concepts to their own Android apps. This relates to the course learning outcome of being able to implement a variety of Android apps. The teaching activity aims to connect theory with practice: students first have to predict how Android activities behave in different scenarios and then check with a provided Android app if their predictions were correct. By trying this out in practice, the students can get a better understanding of how their apps behave. A discussion afterwards on how to implement this in their projects helps students with applying what they learned to their own apps.

3. Trying it out in practice

After a quick recap of the course material related to the exercise, students got the exercise sheet and the activity lifecycle. They had to predict the order in which different lifecycle methods are executed for common scenarios (e.g. start app, accept call, rotate phone) The exercise was solved in pairs. After finishing the exercise, the students were provided with a sample app that logs the lifecycle methods which they could run on their phones to act out the scenarios and observe and check whether their predictions were correct. Afterwards, we discussed with the whole class whether there were cases the students were surprised or unsure about or that they got wrong and could not explain. Those cases or general questions were clarified and explained to clear up uncertainties.

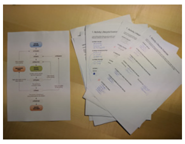


Figure 1: Filled out exercise sheets and activity lifecycle

Figure 2: Students checking their predictions with the app on their phones

In the second part, the students got together in their project groups to discuss what operations they need to perform in the lifecycle methods of their own app projects. Meanwhile, I collected the students' exercise sheets to check their predictions to see if there were additional issues that needed to be addressed or discussed with the whole class or individual students.

MAIN POINTS

1. **Main problem/challenge:** Lack of understanding of the Android activity lifecycle
2. **Teaching activity**: Predict and observe activity behavior for different scenarios
3. **How did it go?** Students were engaged and understood the concepts
4. **What to do next?** Further evaluate student learning by assessing the code of the next hand-in

The student learning was assessed by evaluating the exercise sheets which showed that students understood the concepts and that common issues were addressed in class discussions. To assess the learning goal of students being able to apply the concepts to their own projects, I will evaluate the code for their next project hand-in. I additionally evaluated the teaching activity by asking the other two TAs of the course for feedback as they also implemented the exercise in their TA classes.

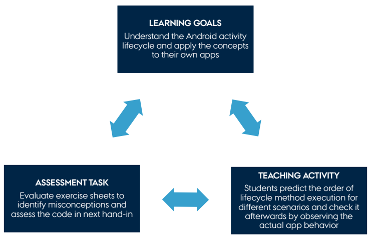


Figure 3: Constructive Alignment

4. Looking forward

The students were engaged during the exercise, actively discussed the solutions with each other and asked me questions about the material. The next step is to further assess their learning in their next hand-in and check whether they were able to apply the concepts from the exercise to their own projects. Based on the feedback from other TAs, improvements to the exercise could be to make students also write down their reasoning for their predictions so that they might realize mistakes even before trying it out in practice. The exercise sheet could also be expanded by adding checkboxes on whether their predictions were correct/incorrect/surprising to prepare them for the class discussion

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Nathalie Bressa
Ubiquitous Computing and Interaction
Computer Science

Structured Exam Simulation

- Tool to self-analyse and improve complex problem solving

Learning Lab

Abstract:

There is often a big gap between how theoretical problems are handled throughout and during a course, and how they are treated at the end of the course at the exam. We here present a tool to help the students analyse and optimize their approach and methodology to an exam-like question that during theoretical exercises would be solved in groups, but expected to do alone at the exam. The activity was well received and students felt it improved their performance.

COURSE FACTS

- Course name: Biomolekylær Struktur og Funktion
- Level: 2nd year Bsc. students
- ECTS credits : 10
- Language: Danish
- Number of students: 25
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

Aligning your course activities to your exam is at the core of successful teaching.

In our course, students are on a weekly basis during theoretical exercises introduced to a range of questions they might encounter at the exam.

The "problem" is that many solve these in groups, which has several benefits we do not want to remove, but it is also not representative of the what they will encounter at the exam, namely that these will be solved alone.

2. Planning a teaching activity

Based on these problems we have decided to develop a workflow and a set of conditions we will give the students in preparation for a selected problem for next session. The students are then expected to do the activity out of class and alone.

Our teaching activity is designed to both give the students an opportunity to practice their individual workflow, and also give them tools to analyse and correct their process.

Our hopes are that this activity will improve how they approach difficult questions posed, both taking their methodology and sense of time into consideration.

References

- Active learning and adapting teaching techniques (from the University of Toronto)
- Classroom assessment technique examples (By Angelo and Cross from Classroom Assessment Techniques: A handbook for College Teachers)

3. Trying it out in practice

At the end of a theoretical session the TA will tell the students the basis for the activity and explain it. They are to reserve the final problem for next session for the activity. They are told to do it alone and without discussing it with other students. The TA will provide a sheet with tasks to do when they work through the problem, together with a workflow that they are asked to time. The normal time spent on preparing and presenting the problem that had been selected for the activity will be used to discuss the activity with the students and collect data for further improvement of the activity.

1. Write down time consumption at each step of assigned problem
   a. Read the assignment, get an overview ___ min
   b. Note down relevant information ___ min
   c. Find out which chapter/subject it relates to ___ min
   d. Search for information ___ min
   e. Draft an answer for all subproblems ___ min
   f. Revise and correct ___ min
2. Read the assignment, get an overview
3. Note down relevant information
4. Find out which chapter/subject it relates to
5. Search for information in relevant chapters
6. Draft an answer(s) for the assignment
7. Revise, correct, and write as a short, concise, coherent answer

Figure 1. Workflow. Initial workflow as presented for the activity.

The last 10 to 15 min of the following session was reserved for an open discussion and a mentimeter evaluation of the teaching activity. Students were encouraged to discuss experiences from the teaching activity. In essence, the menti and discussion was to get the students to consider how they approached an exam-like question beforehand, how they pass roadblocks, if they felt any improvement after the exercise, and ideas for improvement of the activity. In general several students said that structuring the problem solving was to their benefit.

MAIN POINTS

1. **Main problem/challenge:** Students not being able to solve exam-like problems individually.
2. **Teaching activity:** Process analysis combined with structured problem solving.
3. **How did it go?** Students found it useful and applicable in a exam.
4. **What to do next?** Repeat and revise the workflow and conditions to make it more applicable.

We decided to include time notation both to to give students a concept of time consumption, and also as a tool to restrain their the focus towards completing the assignment, thus simulating the time pressure at an exam.

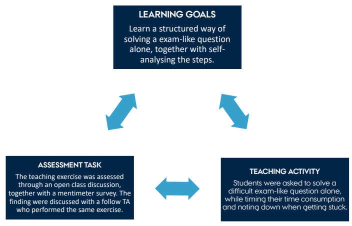


Figure 2. Constructive alignment. The figure show how the learning goal eg. training students to solving hard questions are supported by the teaching activity. Together with the exercise being evaluated through mentimeter, discussion in a class among students and TA, and discussion between two TA's who performed the same Teaching Activity.

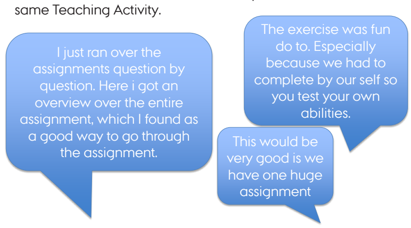


Figure 3. Example comments of the survey and discussion: In general were the student positive towards the activity, and asked for it tried on harder problems.

4. Looking forward

For future iteration we will incorporate the comments from the students which were mainly on the design of the hand-out and the choice of problem. They made it clear that they wanted hard assignment to apply the activity on. Several students indicated that they enjoyed the exercise which indicated that we have addressed a problem that was also relived.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Bærentsen, R. L.*, Bøgholm, N.*

Special thanks to Ditlev Egeskov Brodersen and Esben Lorentzen for financing this work

Department of Molecular Biology and Genetics
*contributed equally to this work

SHARE YOUR KNOWLEDGE WITH OTHERS
- PROGRESS TOGETHER

Abstract: In order to solve the problem of inactive atmosphere in theoretical exercise course caused by different students' knowledge background, group study is performed as teaching activities. Knowledge sharing among group members can effectively help them keep up with the learning progress.

Learning Lab

COURSE FACTS

- Course name: Nanoscale Bioimaging and Single Molecule Biophysics
- Level: Master
- ECTS credits : 10
- Language: English
- Number of students: 14
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

The students with different knowledge backgrounds sometimes causes that **nobody want to share their solutions or answers** on blackboard, E.g., for the knowledge related to atomic force microscopy, students with a background in nanoscience have studied these parts, while students with a background in chemistry and biology lack relevant physical fundamentals. This problem makes the classroom atmosphere very inactive.

2. Planning a teaching activity

Let students with different knowledge backgrounds reach the same level as soon as possible, which is not an easy job for TA. In order to make full use of class time and after-school time, it is an effective way for students with different knowledge backgrounds to share knowledge with each other. **According to the student's knowledge background, they are divided into groups** to discuss and complete assignments. It can help students who lack a background in relevant knowledge to supplement the basic concepts they need as quickly as possible. At the same time, it can improve the understanding of students who are more familiar with the relevant knowledge.

3. Trying it out in practice

Students will introduce themselves in the first theoretical exercise course including their knowledge background. The members of each group will be confirmed in this course according to their knowledge background. There will be 3-4 people in each group, and **at least one student has nanoscience background and other one has biology or chemistry background.**

For the assignments or questions, students will have a discussion in group firstly. They can share their own answers or opinions to each other, and it will help the students without nanoscience background be clearer to the knowledge. Then one student without nanoscience background will be asked to answer the question or try to solve the problem, and two students with nanoscience background from other groups will be asked to evaluate the answer or solution and share their own answers. If most of the students have nanoscience background, this process will be completely random.

A "**discussion record book**" will be introduced into the theoretical exercise course. Each group will have their own discussion record book, which they can use to record and evaluate the classroom behavior of other groups. Specifically, for assignments in the classroom, each team can evaluate the answers and reviews of other groups. The evaluation criteria will be based on correctness, completeness, and teamwork, and the evaluation results will be implemented in the form of 1-10 points.

MAIN POINTS

1. **Main problem/challenge:** Inactive class caused by different backgrounds.
2. **Teaching activity**: Study in group.
3. **How did it go?** Students with different background shared knowledge with each other in their group. Discussion record book encourage students to take part in group discussions and learn more actively.
4. **What to do next?** Further improve the learning initiative of students through group study.

The assessment of each group will base on the average of other groups' evaluation, and TA will show the assessment results on blackboard website each week and have a discussion with professor to adjust the content of next theoretical exercise course.

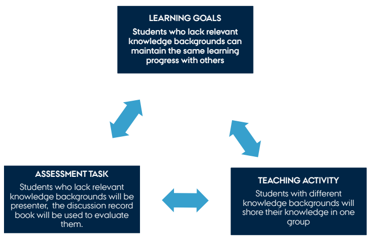


Figure 1: **Constructive alignment**
Alignment between learning goals, teaching activity, and assessment improves learning outcomes.

4. Looking forward

Knowledge sharing among students with different knowledge backgrounds not only can help students who lack relevant knowledge to keep up with progress of learning, but also can improve the scientific communication skill of the instructors. Based on this, the active learning of students will be enhanced. It is also convenient for students to integrate the knowledge of optical microscopy, electron microscopy, and scanning probe microscopy.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Xiaochen Chen
Bio-SPM
iNANO

Set-theory and set-relations

- Using Venn diagrams as a heuristic tool

Learning Lab

Abstract: Set-theory is gaining momentum in comparative studies. However, it is very different from mainstream quantitative and qualitative methods. Therefore, students often struggle to understand set-relations. To make this topic easier, I have tested whether Venn diagrams are useful heuristic tools when introducing people to set-theoretic analysis. It worked quite well, so I have developed a teaching activity that resembles the *strip sequence* exercise, where students have to transform a fuzzy data matrix into a Venn diagram.

COURSE FACTS

- Course name: Environmental Policy and Regulation
- Level: master
- ECTS credits : 7.5
- Language: English
- Number of students: 20-30
- Your role: TA / lecturer

TEACHING IN PRACTICE

1. Identifying a problem

Set-theory is useful when analyzing complex problems such as sustainable environment development. However, it is often difficult for students to get an intuitive understanding of set-theory, because it deals with causal complexity very differently from mainstream methodological approaches. The learning outcome is therefore to understand the basic notions of set-membership and Boolean algebra, and illustrate set-relations through Venn diagrams.

2. Planning a teaching activity

I have planned an activity where students are going to transform a fuzzy data matrix into a Venn diagram displaying the overlapping sets of a case distribution. The exercise is a modified version of the *strip sequence*.

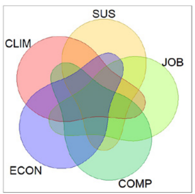
I hand out empty diagrams and tokens (e.g. poker chips) representing the cases in the matrix. Students work in small groups (4-5 persons). Their task is threefold. First, they need to identify all configurations in the data matrix by applying the basic rules of Boolean algebra. Second, they need to count the number of cases within each configuration. Third, they need to map this case distribution onto a Venn diagram by placing the tokens in the correct intersections.

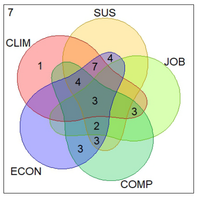
The students have 20 minutes to complete the exercise before discussing their answers with another group. At the end of class, we discuss solutions in plenum, and I draw the correct solution on blackboard with inputs from students.

Table 1: Data matrix, Danish Bioeconomy

Cases	CLIM	SUS	JOB	COMP	ECON
Electricity_poplar	0,00	0,40	0,48	0,99	0,91
Electricity_eucalyptus	0,00	0,40	0,48	0,99	0,91
Electricity_forest loggin residues	0,01	0,60	0,48	0,99	0,98
Electricity_wheat straw	0,81	0,60	0,48	0,99	0,98
Electricity_stemwood	0,01	0,40	0,48	0,99	0,91
Electricity_wood industry residues	0,15	0,60	0,48	0,99	0,98
Electricity_agricultural residues	0,88	0,60	0,48	0,99	0,98
Electricity_dairy cow slurry	1,00	0,80	0,48	0,99	0,98
Electricity_biowaste	0,01	0,80	0,48	0,99	0,98
Electricity_food waste	0,98	0,80	0,48	0,99	0,98
Bioethanol_cereal mix (non-maize)	0,00	0,00	0,01	0,39	0,24

The table above is an excerpt of a fuzzy data matrix from my study of the Danish bioeconomy. Each column corresponds to a policy goal, and the fuzzy score indicates the degree to which a case of biomass conversion fulfills the policy goal. The Venn diagram to the left is the hand-out, and the diagram to the right is the correct solution to the exercise.



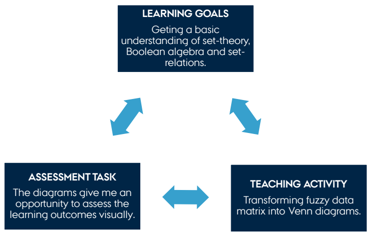


3. Trying it out in practice

I did not have the opportunity to try out the teaching activity in a real class-room setting. Instead, I attended two different seminars and designed my presentations to test whether the use of Venn diagrams would enable a more intuitive understanding of set-relations among the audience. At the seminar where I used the diagrams, the audience was more engaged in the discussion afterwards. Therefore, I am optimistic that Venn diagrams are useful heuristic tools when introducing people to set-theoretic analysis.

MAIN POINTS

1. **Main problem/challenge:** Understanding set-relations.
2. **Teaching activity**: Transforming a fuzzy-set data matrix into a Venn diagram.
3. **How did it go?** My test indicated that Venn diagrams are useful heuristic tools for understanding set-relations.
4. **What to do next?** I will implement the teaching activity and develop a way to evaluate it.



The teaching activity consists of 3 steps. First, the students get together in groups to transform the data matrix into a Venn diagram. This is a hands-on exercise, where students have to agree on the placement of the tokens. Next, they split up and form new groups and discuss their solutions. Did all groups have identical diagrams? If not, they return to their first group to revise their solution. Lastly, I follow up with a classroom discussion, and I draw the correct diagram on the blackboard using inputs from the students.

4. Looking forward

A Venn diagram is an easy and intuitive way to illustrate basic set-theory. I will definitely use this teaching activity in the course that I will be teaching next year. However, I consider using crisp data instead of fuzzy to simplify the data transformation process.

References
Schneider & Wagemann 2012: *Set-Theoretic Methods for the Social Sciences: A Guide to Qualitative Comparative Analysis.* Strategies for Social Inquiry. Cambridge: Cambridge University Press.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Lotte Dalgaard Christensen
New Nordic Ways to Green Growth
Department of Environmental Science

Quantum measurements
- More than a mathematical concept

Learning Lab

Abstract: This teaching activity seeks to give new students of quantum mechanics an intuition about quantum measurements and an understanding of the concept spin. This is done by presenting them to a thought experiment followed by qualitative discussion of the possible outcomes, first in groups and then in plenum. The activity was overall a success.

COURSE FACTS

- Course name: Quantum mechanics
- Level: Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 17
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

Quantum mechanics is a very theoretical course, and the understanding of how it influences the real world can be hard to achieve by only doing math related problems. Spin is a notoriously hard concept since it has no macroscopic counterpart. Additionally, the concept of spin is covered by a video lecture on Black Board, and I have the fear not all students see it. I talked to the course lecturer, and he also has the concern that the physical understanding is sometimes weak with the students.

2. Planning a teaching activity

Therefore my teaching activity will consist of a mini lecture on "the discovery of spin" of 5-10 minutes. I will briefly cover the famous Stern-Gerlach experiment that proved the existence of spin. After my presentation I will make the students discuss related questions in groups, and we will discuss their answers in plenum. The questions will be possible to answer with no or very little calculation, since the focus is to make them think about the more philosophical consequences of quantum mechanics: To understand *physics* rather than only math.

LEARNING GOALS

- Quantum measurements
- Spin-1/2 (qualitatively)
- Stern-Gerlach experiment

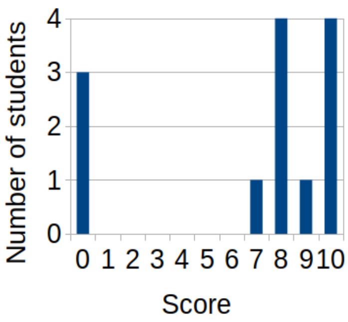
References:

- Griffiths, *Introduction to Quantum Mechanics*, 2nd ed.
- Sakurai, *Modern Quantum mechanics*, 2nd ed.
- Friedrich and Herschbach, *Stern and Gerlach: How a Bad Cigar Helped Reorient Atomic Physics*, Physics Today (2003)

3. Trying it out in practice

The activity started with random group formation by the well-known counting method. I did this on purpose since the students rarely mix. My hope was to make them more focused and have both stronger and weaker students in all groups. All groups were given a stack of questions stabled in one end so only one question was visible at the time: I only wanted the students to look at them when told so. Then I gave my presentation at the black board. After 5 min. I reached the first question in the stack and asked the groups to discuss for 2 min. and write down their answer next to the question. Then I asked for volunteers to share their answer with the entire class. I specifically asked the students not to correct their answer if it was wrong, so that I could later estimate their initial knowledge. The students seemed quite engaged in discussion and posed many further questions. Hence the activity took longer than expected. After 30 min. the class was finished. The students had only answered 5 out of 8 questions. A week later we finished the activity after a short recap. It took 20 min. Then I gave the students the following **ticket out the door:**

A. How useful did you find the teaching activity on a scale from 0 (not at all) to 10 (very)?



Total average: 6.8. The 3 zeros were given by students not present at the first part of the activity. They were very confused even though I tried to give a recap. The remaining 10 students found the activity useful (average 8.8). 14 students were present at the first session and 13 at the second. The 4 students only present at the first session have not evaluated.

MAIN POINTS

1. **Main challenge:** Quantum mechanics is not intuitive, but still real.
2. **Teaching activity**: Group /class discussion about thought experiment.
3. **How did it go?** Successfully, but the activity was too long!

7. **What to do next?** Shorten.

B. Did it give you a better understanding of spin and measurements? Why, why not?

"It gave a much better intuition about it and an opportunity to see how it is in the "real" world and what a measurement could look like." - anonymous student 1.

"Because it was a conceptually hard subject to understand it worked well that one could talk it through. Definitely. It was nice to put it into words yourself and then get the right answer." - anonymous student 2.

When subsequently looking at the question sheets most groups answered most of the questions correctly, but often without good arguments. Since most of them found the activity useful, I believe they now have learned the right arguments from the class discussion.

C. How could the teaching activity be improved?

"It took some time, but I don't know if it is even possible to make it faster. There could maybe be some calculation, since the exam is written." - anonymous student 3.

Other suggestions from students were to make it into a contest and prepare for the activity by reading about Stern-Gerlach and watching video about spin beforehand.

4. Looking forward

The activity should not have been split into two sessions! I wasted 3 students' time due to this. The group discussions must be cut off faster and a couple of questions can be omitted. The activity could be made even more exam relevant by also involving calculation, but it would require student preparation.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Emilie Hindbo Clausen
The Ion Trap Group
Department of Physics and Astronomy

Critical analysis of laboratory work

- Achieving critical thinking about lab experiments' results and applications by think-pair-share activity

Learning Lab

Abstract: During practical courses, the students have difficulties to link their practical work with what they have learnt during theoretical lectures and exercises sessions, then to broaden the scope of their practical, applied work. A "think-pair-share" activity will help the students to discuss with the whole class and critically analyze results, provide a complete and relevant interpretation, and discuss technical applications and limitations of the experiments at a larger, industrial scale. The activity will take place during the last hour of each session and will be evaluated on relevant interpretation of the lab experiments' results and considerations about their industrial applications within reports.

COURSE FACTS

- Course name: Enzymatic Bioproduction
- Level: Master of Science in Biotechnology and Chemical Engineering, 3rd semester
- ECTS credits : 10
- Language: English
- Number of students: 20
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

The goal of the course is to teach students to conduct biotechnological operations to produce and characterize a purified enzyme preparation, and to use it for biotransformation.

However, during practical courses in laboratory, students tend to follow a protocol, perceiving this as exercises confirming some aspects of their theoretical courses, without thinking about what there are learning from these practical applications, especially what they imply at a larger, industrial scale.

In order to help students for developing a critical thinking about the interpretation of their laboratory work and results, a "Think-pair-share" activity will be implemented.

2. Planning a teaching activity

The teaching activity is meant to help the students to learn to critically interpret the results of their different, daily experiments, linking them with theoretical scientific concepts at a broad extent, and to consider the technical applications of their work in chemical engineering.

Consisting in thinking by oneself and then share ideas and interpretations in pairs and in groups, the teaching activity will allow all the students, including those who usually not volunteer or have difficulties to prepare properly by reading and understanding the laboratory protocol, to think about answers then share and analyze them during discussions with their laboratory group, then the whole class at the end of every laboratory sessions.

3. Trying it out in practice

At the beginning of every session of the laboratory class, TA will briefly recall with the students the update of the course (its progression) and the daily experiment (theoretically prepared), then students will work in laboratory by 3-to-4-member groups, collecting their results and interpreting them, with temporary discussions with the TA.

During the last hour of the session, the teaching activity will be performed. For 15 minutes, the "think-pair-share" activity will allow the students to discuss, with a critical mind, the interpretation of their obtained results within their group and to develop ideas about the applications of their work at a larger scale. For the last 45 minutes of the session, the groups will orally discuss their results and interpretation with the whole class, in order to debrief the experiment, including its applications at a larger scale.

The activity will be assess by students under ticket-out-of-the-door forms, in which students will briefly list the main discussed points and provide feedback about the relevancy of the activity at the end of the session.

The students will be evaluated on presenting results with a critical interpretation, linking them with progression of the course and theoretical concepts, and underscoring relevant applications of the experiment and its limitations at an industrial scale.

MAIN POINTS

1. **Main problem/challenge:** Achieving critical thinking from practical course to develop applications within an industrial framework
2. **Teaching activity**: Think-pair-share
3. **Supporting student learning:** This activity will allow the students to share and discuss their ideas and thoughts, so that they could gain critical analytical mind and new perspective from their laboratory work
4. **What to do next?** Evaluate whether the teaching activity is relevant by assessing sudents feedback on the activity and written reports, noting if students are able to "develop" their results and interpretation

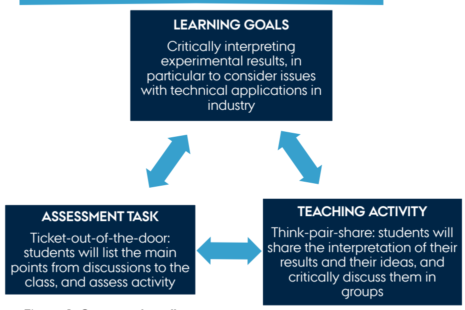


Figure 1: **Constructive alignment**
Illustration of the connection between learning goals , teaching activity and assessment task

4. Looking forward

The practical course will be first implemented in winter semester 2019-2020. The teaching activity will then be applied as a daily and usual part for every session of the course. Feedbacks provide by the students will allow to improve this activity, e.g. by modifying its frequency or duration or focusing on particular debatable issues.

The relevancy of the teaching activity along the course will be evaluated by noting in written reports of experiments if the students are able to provide a critical interpretation of their results, as well as to "develop" it by explaining its scope and limitations in technical applications.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Alex Cordellier
Biocatalysis and Bioprocessing
Department of Engineering

Pandas in Python

- A computer session in data science

Learning Lab

Abstract: In the course experimental physics 3, students are making experiments and performing data analysis. The experiment on Compton scattering is special because it features difficult coincidence analysis. The learning goal is to introduce Pandas in Python, which will help students achieve the coincidence analysis. The teaching activity focuses on a computer session guided by a handout. The assessment is done via teaching activity dialogue, and in the following weeks as experiment and analysis progresses. It was assessed that students learned Pandas. There were computer problems which made the teaching activity messy.

COURSE FACTS

- Course name: Experimental Physics 3
- Level: Bachelor
- ECTS credits : 5
- Language: Danish
- Number of students: 6
- Your role: Laboratory TA

TEACHING IN PRACTICE

1. Identifying a problem

Students are working with two detectors to demonstrate coincidence of nuclear events [1]. The data generated is comprehensive, and the analysis rather involved. Previous years the data analysis has troubled students, and they have struggled to accomplish the task. The problem is to introduce student to suitable computational tools.

2. Planning a teaching activity

Pandas in Python is suggested as a suitable tool. The learning goal is for students to be able to use Pandas, and understand the advantages it offers. A handout introduces Pandas, and example code is written to teach the use of Pandas. The students are to work their way through the handout, and performs tasks with the code. Completing it they have been introduced to pandas and have some experience using it.
The teaching activity takes the form of a brief computer session. A challenge is to find time for it, while the rest of the laboratory class is still running. Two groups are performing two different experiments in parallel.

References

[1]https://blackboard.au.dk/webapps/blackboard/content/listContentEditable.jsp?content_id=_1868414_1&course_id=_116885_1&mode=reset

3. Trying it out in practice

In practice the teaching activity was a mixed success. The teaching activity made students participate and learn Pandas. However the computer session had some computer problems, and there was not enough time to solve them. There was time pressure to keep up the experiments.

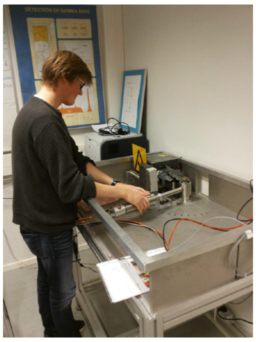


Figure 1: Student working on the experiment with Compton scattering and coincidence detection. One of the detectors is being handled by the student.

On the positive side students were interested in being introduced to Pandas, and appreciated a new way of working with large datasets. They worked their way through the handout and learned concepts and functionalities of Pandas.
On the negative side the computer session was disturbed by computer problems. There were compatibility problems with different Python versions, and students could not run all example code. Also the backup computer failed to turn on this day.

MAIN POINTS

1. **Main problem/challenge:** Learn "Pandas", a computational tool useful for analysis of large data sets.
2. **Teaching activity**: Computer session with handouts .
3. **How did it go?** Students did learn, and there were computer problems.
4. **What to do next?** Think about computer problems.

From dialogue I assessed that they were able to use Panda-code and understood the example code. However, the computer problems made this introduction to Pandas messy. The group choose not to use Pandas, but rely on a well-known, slower computational tool.
A smoother introduction might inspire students to try Pandas in practice.

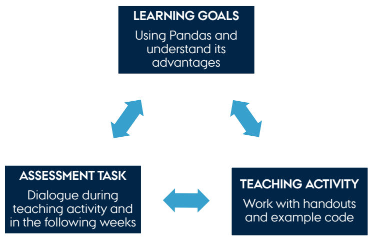


Figure 2: **Constructive alignment**
The goal is to learn students using Pandas in Python. It was taught via a teaching activity focusing on a handout and example code. Student learning was assessed from dialogue during the teaching activity and the following weeks.

4. Looking forward

The idea of having students in a computer session, learning a tool for their experiment was OK. The students were highly motivated as the subject is very relevant for their experiment. I will try it again next year. Improvements will focus on the technical problems. Avoid running code on student computers where versions may differ. Having more backup computers available could also be an idea.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Thomas Schrøder Daugbjerg
Aarhus AMS Centre
Physics and Astronomy

Software Development Peer Review

- Improving students ability to apply methods to develop flexible and reliable software

Learning Lab

Abstract: Being able to develop flexible and reliable software that can be easily extended is one of the main learning goals of the course. To develop software this way, the students must apply a lot of different methods taught in the course and it is crucial that they do this correctly. I present a peer review activity, that I believe could improve the students' ability to do this. Implementing the activity went well, however it is not clear that doing the activity was better than a normal TA session. I think implementing this activity course-wide would improve the outcome.

COURSE FACTS

- Course name: Software Engineering and Architecture
- Level: Bachelor
- ECTS credits : 10
- Language: English
- Number of students: 16
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

A problem I have experienced as a TA is that for each hand-in there are often multiple mistakes that the majority of the groups have made. These are often caused by students incorrectly applying one or more methods to develop flexible and reliable software.

As the students work on a big project during the entire course, with multiple "milestone" hand-ins, it is crucial to ensure that the students apply the correct methods, when coding their solutions instead of just blindly coding until it seems to work.

2. Planning a teaching activity

The hope is that the students will find mistakes in how they have applied some of the methods used in their hand-in, while doing the peer review. They can also get inspiration from the other group's solution and discuss if they are both valid.

A secondary goal is that while reviewing the hand-ins, the students will get a better feel for how the TA grades their hand-ins and use this to improve their hand-ins before handing them in.

3. Trying it out in practice

After an introduction to the activity, each group was paired up with another random group. Then they were given two peer review sheets with space to write feedback for each grading criteria for the current hand-in. Each pair of groups then peer reviewed the first group for 30 min and then the second group for 30 min, while filling out the peer review sheets. During the first peer review one student was responsible for writing the feedback and another was responsible for ensuring all criteria was looked at. For the second review two new students were assigned these roles.

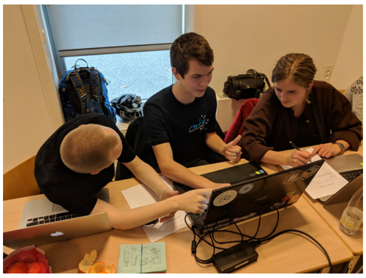


Figure 1: **Students peer reviewing**

After the peer review, I took a picture of the sheets and for the remaining time the groups could use the feedback to improve their solutions to the hand-in.

After looking at the copies of the peer review sheets, it seems like a lot of mistakes have been caught by the peer review activity, that would not have been found otherwise.

MAIN POINTS

1. **Main problem/challenge:** Students applying methods incorrectly
2. **Teaching activity**: Peer review
3. **How did it go?** The activity went well, however the result isn't very convincing.
4. **What to do next?** Consider implementing the activity as a mandatory part of the course.

Comparing the hand-ins for this class with another class', which did not do this activity, it seems like the activity didn't make that big of an impact.

To evaluate the activity, the students were given a link to an anonymous online questionnaire.
Based on the 14 answers it is clear that almost all of the students felt that the peer review activity had improved their hand-in.
However the majority of the students would have preferred to have a normal TA session instead.

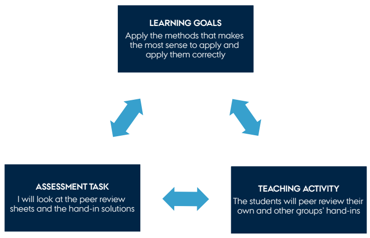


Figure 2: **Constructive alignment**

4. Looking forward

It worked well that different students had different roles during the peer review. I think having a student be responsible for navigating the code would have improved the activity.

I think implementing this activity in a specific week of the course in coordination with the lecturer and the hand-in for that week would make the activity a lot better and improve the outcome. I also think this would decrease the number of students who would prefer to have a normal TA session instead.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Asger Hautop Drewsen
Algorithms and Data Structures
Department of Computer Science

Mind map exercise

- Structuring of knowledge for protocol design

Learning Lab

Abstract:

Mind-mapping is an effective way of creatively and logically organizing complex knowledge and ideas in a manageable way. A supervised mind map session was designed to help students boil vast theoretical knowledge down to essentials for use in a practical laboratory setting. By collectively constructing a mind map in small groups, students will engage discussions and knowledge-sharing.

COURSE FACTS

- Course name: Experimental physics 3
- Level: Bachelor
- ECTS credits : 5
- Language: English
- Number of students: 7
- Your role: TA (pretend)

TEACHING IN PRACTICE

1. Identifying a problem

In this course, students are given questions to address experimentally. Students have to design their own protocol (from an existing theoretical background) for addressing these, and need to be aware of experimental errors and should design their experiments in a way that these are minimized. Students are divided into groups of 3 and 4, respectively, doing different experiments, making classroom-level discussions unfeasible. An exercise that promotes self-help and takes little planning and time to complete is desired.

2. Planning a teaching activity

This teaching activity is intended to help students organize their knowledge in a way that facilitates formulation of a protocol. At the same time, it gives the TA an opportunity to gauge the students' level and understanding

3. Trying it out in practice

The teaching activity is to be implemented on the first laboratory day. The task is briefly presented on a projection screen, and the TA exemplifies with a generic mind map for inspiration. Students are then given 15 minutes (should be enough to get started and have a draft, but short enough that time is not wasted) to construct a mind map.

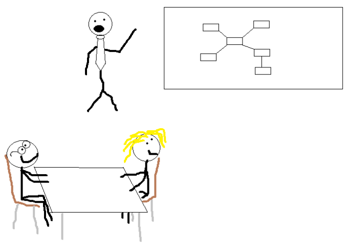


Figure 1: Students are eagerly listening and paying attention while the TA presents the task at hand.

After 15 minutes TA walks around, assessing mind map and answering questions. After TA's feedback, students should know which areas to brush up on, and the protocol design will begin. The amount and type of help needed by the students during protocol design indicates whether exercise was successful.

MAIN POINTS

1. **Main problem/challenge:** Difficulty translating from theory to practice.
2. **Teaching activity**: Supervised mind map session.
3. **How did it go?** Has yet to be implemented.
4. **What to do next?** Implement it.

Activity is concluded by a "ticket out the door"-type evaluation, where students are asked to give their opinion on the exercise.

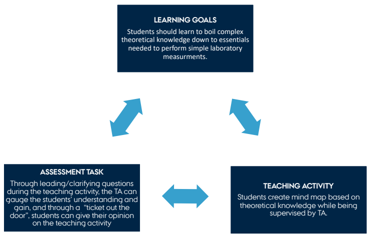


Figure 2: **Constructive alignment**

4. Looking forward

Group-base mind mapping can be a quickly implementable tool in situations where structuring of knowledge is needed, and is ideal in settings where whole-call discussions are unfeasible. This teaching activity has yet to be implemented, but is expected to improve the quality of the students' protocol design as well as their independence in the lab.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Hans Dyrnesli
Nanobiointerfaces Group
iNANO

Understanding the influence of sensitivity functions on geoelectrical data and modelling

Learning Lab

Abstract:

A common misconception among students is that data collected by the geoelectrical method are averages of the subsurface resistivities, while it is in fact a *weighted* average of these. The data is weighted by the sensitivity function which depends on the geometry of the setup, and is important to keep in mind when looking at and modelling data. The teaching activity described on this poster will try to address this misconception through interaction and discussion. Students will come to learn of the geometry dependence of the sensitivity function through arranging them with pieces of colored paper, and discuss relevant questions about the influence of the sensitivity for specific resistivity distributions. The activity has not yet been implemented, hence no data is available.

COURSE FACTS

- Course name: Basic Hydrogeophysics
- Level: Bachelor's course
- ECTS credits : 10
- Language: English
- Number of students: 20
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Introduction

In Basic Hydrogeophysics students are taught how to conduct geophysical surveys using various methods and the theory behind these methods. One such method is the geoelectrical method. Here data is collected by placing an electrode setup on the surface of the earth consisting of four electrodes; two electrodes for injecting a current and another two to measure the potential difference due to the this current. The potential difference measured is directly relatable to the resistivity distribution of the subsurface, through the so called sensitivity functions (Figure 1).

Identification of the problem

An all too common misconception made by students is that the potential difference measured is an expression of the average of the subsurface resistivities, while it is in fact an expression of the *weighted* average, a very important detail in understanding how this data can model the subsurface.

To alleviate this misconception the students will be interacting with the sensitivity functions. The distribution of the sensitivity functions depends on the geometry of the electrode setup (Figure 1), and this will be the point of entry for the teaching activity.

2. Planning a teaching activity

The aim of the teaching activity is to make the students aware of how sensitivity functions depend on the geometry of a given setup, how it influences the measured data, and how it plays a role in the modelling of the data.

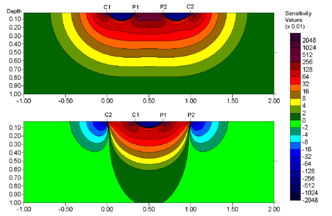


Figure 1: Examples of 2D sensitivity functions for two different electrode setups. C1 & C2 symbolize the the current electrodes while P1 & P2 symbolize the potential electrodes. The sensitivity functions show how sensitive the setup is to changes in the resistivity. (From M. H. Loke: 2D and 3D electrical imaging surveys.)

By using a hands-on approach described in section 3, students will first become familiar with how the sensitivity distribution depends on the geometry of a given setup. Through group discussions and examples shown by the TA during the activity, the students will learn how material in very high negative or positive sensitivity can have a profound influence on data. In the same manner they should come to realize why it is important to take the sensitivity into account when trying to interpret raw data, but also how it must be a part of the modelling of data.

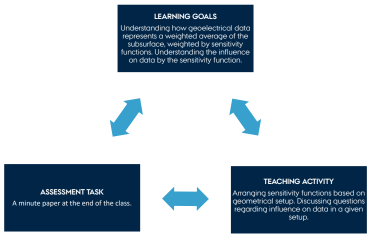


Figure 2: **Constructive alignment**

MAIN POINTS

1. **Main problem/challenge:** Misconceptions about what geoelectrical data represents.
2. **Teaching activity**: Arranging sensitivity functions based on geometrical setup. Discussing questions regarding influence on data in a given setup.

3. Trying it out in practice

The students are divided into groups of 3-4 and given a bag of blue, red and yellow squares representing high negative sensitivity, high positive sensitivity and very little to no sensitivity. These squares will be used to crudely reproduce the sensitivity function of a given electrode setup.

An electrode setup is revealed and the students must reproduce how they expect the sensitivity to look. Shortly after, the true distribution is revealed along with an exaggerated resistivity structure (high localized resistivity contrast). They students are now asked to discuss and answer what the expected measurement for the resistivity structure would be, for the given sensitivity distribution. This is repeated for three setups.

The students are asked to do a minute paper at the end of the class for assessment of student learning. They are asked to evaluate the activity in a quiz on BlackBoard.

4. Looking forward

If the teaching activity proves to be successful it may be reused and expanded. A natural next step would be to focus more on the modelling part of the data, and where the sensitivity function comes into play. This would not involve colored pieces of paper but could involve drawing or putting together a flowchart.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Kim Engebretsen
Hydrogeophysics Group
Department of Geoscience

Let's find the way together
- Retrosynthesis in Biotechnology

Learning Lab

Abstract
Often it is a problem to get the students to participate and elaborate a problem in front of the whole class. Therefore, the given exercise was carried out in groups, a PowerPoint presentation was generated and presented in front of the whole class. This gives the students more security in explaining something which is the final goal to understand a topic fully. Only if you can explain something to someone else you have fully understood it!

COURSE FACTS

- Course name: Physical Chemistry in Biotechnology
- Level: Bachelor
- ECTS credits : 5
- Language: English
- Number of students: 13
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

One of the best learning techniques is explaining the learned to others. Nevertheless, as a TA we often go for the easier solution of just asking for the correct answer and then explain ourselves why this is correct/not correct. However, it is often a problem to get the students to give further explanations on the answer.

2. Planning a teaching activity

Letting the students elaborate in groups already includes partially the explaining to others. Moreover, they feel more comfortable presenting the ideas because it is not only their own but from a whole group.
The students will receive some chemical structure drawings. The target compounds have to be synthesized with enzymes (catalytically active proteins). To find suitable ones they have to search in an online database for enzymes that will produce those compounds.
In the end the have to prepare a Power Point presentation to show the way they were going and which data they found on the enzymes.

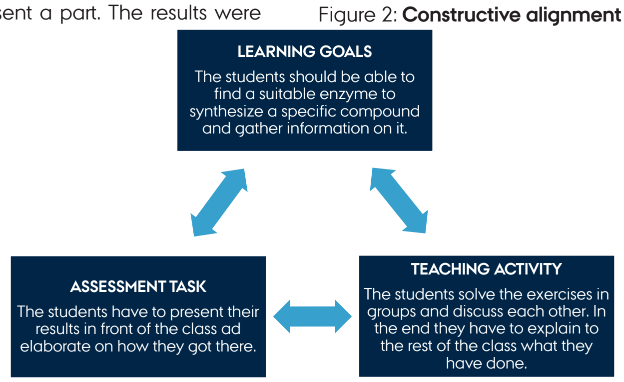
3. Trying it out in practice

The students had to divide themselves into groups which they did simply according to their current seating situation. Afterwards the different target molecules were distributed and the students started their research. To achieve the final goal they had to find three enzymes in total, Therefore, they split up within the groups giving one enzyme to each group member and the last one had to collect all the information. While the students were working in the groups the TA was present and helped with further explanations and discussions.
The students were able to find the ways on their own. However, there were some problems because the lecture was not advanced enough for one part of the task. After I gave them further theoretical background the students were able to continue on their own.
In the end all groups presented their results explaining them. They chose themselves that every group member has to present a part. The results were all correct.

MAIN POINTS

1. **Main problem/challenge:** Students do not like to elaborate in class.
2. **Teaching activity**: Group work with presentation of results.
3. **How did it go?** It went mainly well. The students were enthusiastic to present their results.
4. **What to do next?** Use this method on a topic which needs more theory explanation than this project.

Figure 2: **Constructive alignment**



4. Looking forward

I would like to apply this method on a topic that needs more theoretical understanding. The exercise they had to solve was mainly consisting of gathering information.
When the students have to understand a more complicated topic it would be interesting to do a small test in the end of the activity to evaluate how much they understood.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Jennifer Engel
Biocatalysis & Bioprocessing Engineering

Solving exercises in groups

- Perspectives in mathematics

Learning Lab

Abstract: Most mathematical courses at bachelor level have the same structure. There is two lectures a week. These are used for going through abstract theory. Once a week, there is a two hours theoretical exercises session. The exercise classes are meant to give the students a chance to work with the theory through exercises and for the students to practice presentation techniques. I have been teaching the exercise classes and experience tells me that students are very reluctant to present solutions to exercises in front of an entire class of students. I have therefore tired to implement a group-based model, where students work and present in smaller groups instead of the classical blackboard-based model hoping to get a more open atmosphere. This worked well to active most students and the response I got form the students was good.

COURSE FACTS

- Course name: Perspectives in mathematics
- Level: Bachelor, 1th semester
- ECTS credits : 10
- Language: Danish
- Number of students: 18
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

One learning goal of the course is to be able to orally present simple mathematical arguments. The students have to learn this doing the theoretical exercise classes. Unfortunately not a lot of students are comfortable with presenting their solutions in front of an entire class. This makes the classical blackboard-based exercises session inefficient for activating all students in a class.

What usually happens is that only a couple of students volunteer to go to the blackboard while most of the class passively listens. So the challenge is to find a model that activates all students while allowing them to practice presentations at the blackboard.

2. Planning a teaching activity

The idea of the teaching activity is to break the class into smaller groups (4-5 students) where more people will be comfortable with presenting as well as asking questions. Each group is then assigned an exercises. They will have around 20 minutes to agree on a solution. Afterward one member of each group should join up making a new group with members having consider and solve different exercises. They now take turn presenting their exercise and solution on blackboard or magic paper. When one member of the group presents the others stand around the board asking questions if something is unclear. In this way every student in the class gets a chance to make a presentation in front of a small number of fellow students. At the exam the students have to orally present some theory and the idea with the above activity is to make them more confident with making such presentations.

3. Trying it out in practice

Before class I separated the exercises into two groups. The first containing four exercises where the solutions were short but still interesting and the second containing two exercises with a bit longer and more abstract solutions.

The exercises with shorter solutions would be used for group presentations while the other two exercises would be used for whole class discussion.

In class the students were asked to divide into groups of four students. They did this themselves.

Afterwards each group was assigned one of the exercises I had chosen for group presentations. They were now given 20 min to consider the exercise and agree on a solution. I circulated the class doing this time listing to their discussion, asking and answering questions. Most groups agreed on a solution in this time. One group unfortunately only solved half an exercise. They were therefore asked only to present the part which they had finished.

The class was now asked to form new groups. Each group containing one member from the former. The students managed this themselves.

They were now asked to take turn presenting their solutions. The order of presentations were the same in all groups. I kept time insuring that everybody got through all solution within 20 minutes and walked around listing to the presentations trying not to interrupt. Thereby allowing the students not presenting to ask questions and in this way they could correct and prefect each others presentations. There were only a

MAIN POINTS

1. **Main problem/challenge:** Inactive students
2. **Teaching activity**: Problem solving in groups and group presentations
3. **How did it go?:** It went very well based on feedback from students and TA.
4. **What to do next?:** I will implement it in classes in the future.

Some groups finishing before others. These groups were asked to consider the two exercises I had chosen for whole class discussion.

When everybody had finished presenting I talked to the whole class about problems I might have spotted when listing to their presentations. There weren't very many.

We ended the class by two students presenting a solution to the last two exercises on the blackboard and discussing the solutions. In this discussion I experienced that there were more students asking questions to the presented solutions. It therefore seemed that the group presentations had made the atmosphere more open and relaxed.

Before the class was allowed to leave each student had to write two things which worked well in this class and two things that wasn't working on a piece of paper and handing them to me. On reading the comments I learned that the students in general thought that it was a good way of going through exercises where the solutions were simple and short. I also

4. Looking forward

The new teaching method worked well. The responses I got from the students was in general positive. I think this is a good way of going through less complicated exercises to give all students a chance to say something. I might implement it as part of my teachings in the future such that e.g. every third class has the above structure and the rest have the classical blackboard structure.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Your name: Rikke Eriksen
Research group: CSGB
Department: Mathematics

Mind maps for experiment planning

Helping students to write their own protocols

Learning Lab

Abstract: Experiment planning is an important aspect of this course, and is a daunting task that undergraduate students do not practice often. This simple mind map exercise helps students take the first steps towards planning an experiment to address given research questions by breaking down the process into smaller pieces, and allowing them to draw connections between their theoretical knowledge and how to apply this in practice. This task has not been implemented yet.

COURSE FACTS

- Course name: Experimental Physics 3
- Level: Bachelor
- ECTS credits : 5
- Language: English
- Number of students: 7
- Your role: Lab Instructor

TEACHING IN PRACTICE

1. Identifying a problem

Designing experiments is emphasized in this course. Students in this course are given a list of research questions to address, but no protocol for how to do this; they must therefore design their own measurement plan to address the given questions over a 3 week period. This is possibly the first time that students have been asked to do this. The task can be daunting, and students have previously reported that they felt lost and did not know how to begin making a plan.

2. Planning a teaching activity

Students will learn how to break down the process of designing an experiment into smaller chunks, making the task more manageable and helping them learn experiment planning as required by the course learning outcomes. See Figure 2 for more details on alignment.

Students will be given 15 minutes in the first lab session to work in their groups to make a mind map about the experiment. They must fill in details such as what tasks need to be addressed, their theoretical knowledge on that topic, the equipment, and ideas on how the equipment can be used for the experiment. The TA will discuss the mind maps with each group and give pointers if needed. The students can use their mind maps to make the measurement plan.

3. Supporting student learning

By making a mind map the students will be able to connect their theoretical knowledge to the experiment tasks and break down the experiment into smaller steps. This will help the students decide in which order to do tasks and plan how to divide their lab time between the tasks. If the students are not able to fill in parts of the mind map, then they can use this to determine which topics they need to go and research first.

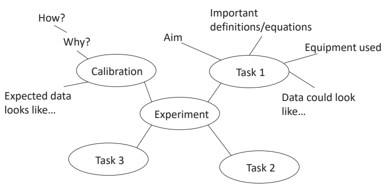


Figure 1: The TA will provide a mock mind map such as this on the board that students can use as inspiration to get started with their own mind maps.

The TA can assess student's learning via the quality of the mind maps and discussions, the amount of help students need in the lab, and the quality of the student's data collection and reports. The TA will evaluate the students work by providing feedback on the mind maps, which will also give students the chance to ask questions, and the discussion will give the TA insight into the level of knowledge of the students and assess how much assistance will be needed in general.

MAIN POINTS

1. **Main problem/challenge:** Students must plan their own experiments to address given research questions, but they feel lost and do not know how to begin.
2. **Teaching activity**: Mind map exercise to plan experiments.
3. **Supporting student learning:** Breaks down experiment planning into smaller steps and allows students to connect theory and practice
4. **What to do next?** Implement the activity, and use the evaluation and assessment results to make improvements.

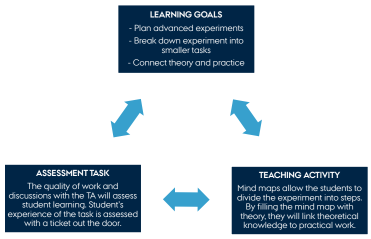


Figure 2: **Constructive alignment**
Alignment between learning goals, the teaching activity, and the assessment of student learning.

The TA will evaluate the student's experience of the task with a ticket out the door with the following questions:

1) Did the activity help you make a measurement plan? Y/N
2) Would you like to do the activity again? Y/N
3) Reasons for yes or no answers:

4. Looking forward

The next step is to implement this teaching activity and hopefully it will enable the students to effectively make measurement plans and feel less intimidated by the task. Assessments and evaluations of the students learning and experiences can then be used to improve the activity for future students. One problem could be students still having no idea how to begin, but the example mind map helps here. Students could also have no or few ideas for how to fill in the mind map, but this can be used to direct them to further reading they need to do.

Dominique Evans
The Biofilm Group
Nanoscience

Using an advanced strip sequence to improve student performance of the cytochrome P450 ECOD activity *in vitro* assay

Laboratory teaching activity by Thorsten Gravert

Abstract: The *in vitro* cytochrome P450 ECOD activity assay involves a multitude of steps which need to be performed fast, in a specific order. An advanced strip sequence teaching exercise was developed for the MSc Toxicology and Ecotoxicology course, to help students organize and visualize the complicated steps involved and improve performance. The advanced strip sequence decreased the number of errors during experimentation, increasing the overall speed of the assay and engaged students by allowing them to influence the experimental design. Following the semester, this teaching activity will be implemented for all course groups.

COURSE FACTS

- Course name: Toxicology and Ecotoxicology
- Level: M.Sc.
- ECTS credits : 7.5
- Language: English
- Number of students: 5
- Your role: Lab supervision

TEACHING IN PRACTICE

1. Identifying a problem

Based on the evaluation by earlier teaching assistants (TA), students are overwhelmed by the multitude of steps in the P450 ECOD activity assay. Two separate measurements have to be prepared and perform simultaneously and without breaks[1]. If the students need to interrupt the experiment to discuss which step is next or perform steps in a wrong order the assay fails and needs to be redone. This activity should teach how vital preparation and structure is in toxicology assays.

2. Planning a teaching activity

The strip sequence bridges the gap between preparation at home and laboratory work.
Transferring theoretical knowledge into practical experimentation is an critical learning outcome of the this course.
During the activity, students are in the lab, with the material in front of them, organizing their assay. They can influence the experimental design which increases motivation, engagement and understanding.
Discussing the sequence in the group and with the TA makes sure students do not merely follow a manual, but reflect the specific order and use of steps. Finally, filling specific gaps with variables, ensures all steps, concentration and solutions are considered and prepared..

3. Trying it out in practice

The developed advanced strip sequence states all independent steps required for this assay. These need to be sorted into a reasonable order. Further, strips contain gaps which students have to fill, e.g. with concentrations or pipetting volumes. Students in groups of 5 had 15 minutes to order the sequence and fill in the gaps. Then the TA discussed the suggested order with the group and clarified questions or errors, before starting the assay.
To evaluate the efficiency of this activity, the required time to finish the assay was compared between two groups: one prepared with the advanced strip sequence (incl. the time for the activity), and one without, directly starting the assay.

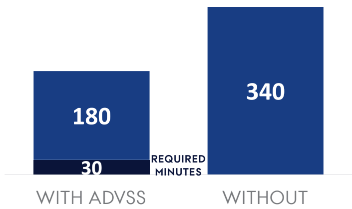


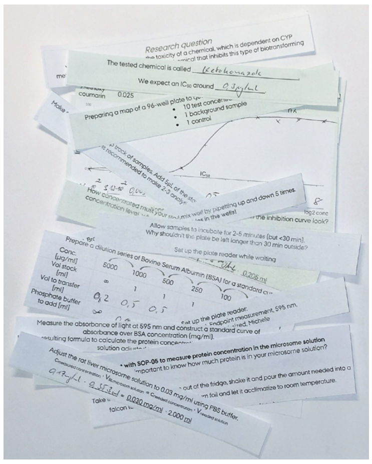
Figure 1: **Comparison of required minutes to perform the P450 ECOD assay, a) with preparation by advanced strip sequence and b) directly starting the assay. (n=1)**

The advanced strip sequence increased the assay speed by 180 minutes, by avoiding mistakes, discussions and interruptions.
However, It is noteworthy that performance is highly dependent on the individual group and their prior preparation at home.

Learning Lab

MAIN POINTS

1. **Main problem/challenge:** Structuring simultaneous complex experimental sequences.
2. **Teaching activity**: Advanced strip sequence
3. **How did it go?** Good. Speed depends on student preparation
4. **What to do next?** Implement in real teaching context.



4. Looking forward

Students immediately understood the exercise and solved it well, even finding an alternative, but the correct solution. The next step will be to implement the teaching activity for all groups in this course. Further, a colour coding will be added, to signalize two different experimental parts and simplify the activity. Future implementations aim to improve students structure and speed up their in vitro ECOD CYP450 assay.

References : R. Poulsen, *Toxicology and Ecotoxicology - Manual for Laboratory Exercises*, University of Copenhagen, **2018**

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Thorsten Gravert
Miljøkemi og toksikologi
Department for environmental science

Flow chart for a enzyme kinetics laboratory exercise

Abstract: The laboratory exercise in Biomolecular Structure and Function engages students in a fun colorimetric enzyme kinetics experiment. The principles behind enzyme kinetics and equations used to calculate enzyme kinetic parameters are challenging for students to comprehend. The TAs of the laboratory exercise have therefore produced a flowchart to support students in their learning. The flowchart is meant as a nonmandatory tool for the students to use, that hopefully that guide them in calculations and understanding enzymatic principles both during the laboratory exercise and report writing. It is clear from student feedback that the flowchart was successful in supporting some students with the exercise in general. Interestingly, students found the chart particular useful during report writing. Furthermore, student feedback will provide a good basis to improve the chart for future laboratory exercises.

Learning Lab

COURSE FACTS

- Course name: Biomolecular Structure and Function
- Level: 2nd year Molecular biology bachelor
- ECTS credits : 10
- Language: Danish/English
- Number of students: 60
- Your role: Laboratory teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

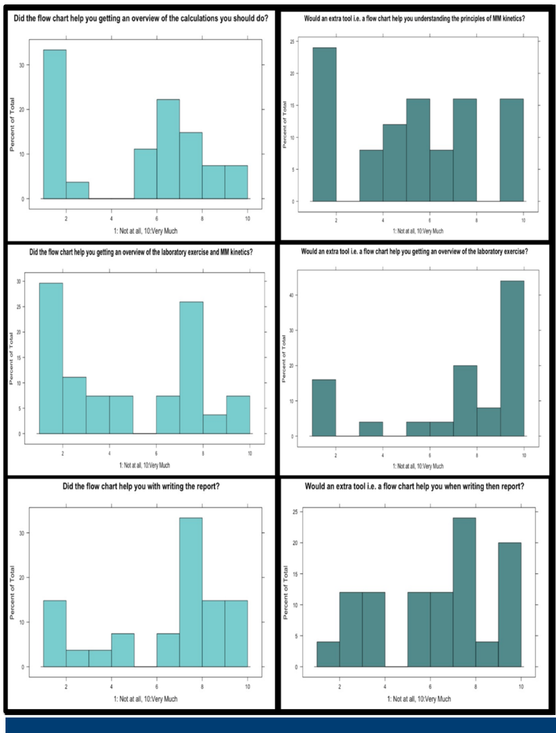
From previous years laboratory exercise, it has been noticed by TAs, that students are challenged in procuring an overview of equations, needed for calculating enzyme kinetic parameters. Discussions amongst the TAs have furthermore concluded that lack in understanding principles concerning Michaelis-Menten kinetics, might be the root of this problem.

2. Planning a teaching activity

I have, together with two other TAs, produced a flow chart/'fill the box' sheet, containing headlines/hints for essential equations and principles, required to complete the laboratory exercise and assist in writing the subsequent report. The purpose of the teaching activity is to help students in clarifying misconceptions concerning the Michaelis-Menten kinetic principles and provide a clear overview of equations to use for their calculations. It is not mandatory for the students to use the chart, but meant as a tool for them to use as additional support or guidance. A final evaluation will gather feedback of students perception on whether the chart have any benefit concerning the principles of Michaelis-Menten kinetics, the practicals of the laboratory exercise or writing the report. Furthermore, a control student group, that did not receive the flowchart, will provide feedback on whether they felt they would have benefitted from such a flowchart.

3. Trying it out in practice

The laboratory exercise consists of a part A and B, performed over two days. Therefore two charts were made and distributed on their corresponding days, the first chart being the most comprehensive with more general principles and equations included. The charts were distributed along with a short description on how to use the chart. We emphasized that the chart was a non-mandatory tool they could use if they wished. It was observed by multiple TAs, that both charts were used by multiple groups both during the actual laboratory exercise and report writing. Students were made aware that questions regarding the charts were welcome, however no or few questions were asked regarding the charts, indicating the charts were clear and precise in their outline. A final evaluation was performed to gather feedback of the effectiveness of the flowchart. 3 questions regarding the flowchart were asked a group of students that had received the chart while 3 questions asking whether a flowchart would had been helpful in the laboratory exercise was asked to a group of students that had not received the chart. Figure 1 shows a diagram illustrating the feedback of our teaching activity. From the figure, it is clear that some students felt they (would have) benefitted in some way from the chart, while there were also a large fraction of students that did not benefit. Based on the evaluation I conclude our activity has been successful in enhancing student learning for a major part of the students and in particular supported report writing.



MAIN POINTS

1. **Main problem/challenge:** Laboratory exercise calculations and enzyme kinetic understanding
2. **Teaching activity**: Flowchart
3. **How did it go?** The activity was successful in improving student learning
4. **What to do next?** The flowchart will be evaluated and optimized by the TAs, based on the feedback from students, to be used in next years exercise.

Figure 1: **Flowchart feedback**
Left column (light green) shows the data from student group that had received the flowchart, while the right column (dark green) shows data from student group that had not received the flowchart. Interestingly, students that had received the flowchart felt they benefitted nothing or some in terms of MM kinetics, calculations and lab exercise overall. This was in contrast to how they overall felt in benefitting from the flowchart in writing the report, where many had great benefit. A somewhat similar trend was found for the student group that had not received the chart. Students in this group felt they would have benefitted most in report writing and getting an overview of the laboratory exercise.

4. Looking forward

The flowchart produced for the laboratory exercise in Biomolecular structure and function have overall shown to be a good tool to enhance student learning. Especially students lacking the ability to put principles of Michaelis-Menten kinetics into context of the exercise and gain an overview of the equations required to determine kinetic parameters benefitted in the report writing. Based upon the feedback from the evaluations, the charts can be optimized to better fit its use in future laboratory exercises.

Simon Boje Hansen
Plant Molecular Biology
Molecular Biology and Genetics

Group presentations

Exercise repetition and oral-exam practice in ONE teaching activity

Learning Lab

Abstract: Often, at the oral exam for this course, students show insufficient understanding of the theory used in exercises throughout the course. In order to aid the students in gaining a better understanding and practice for the exam discussion, I implemented short student-group presentations of the exercises, their solutions, and results as a teaching activity. Although challenged, the students performed satisfactory, and from their answers to a subsequent Blackboard survey, I conclude that the activity was successful in meeting the set learning goals.

COURSE FACTS

- Course name: Reflection Seismics and Well Logging
- Level: BSc (5th semester)
- ECTS credits : 10
- Language: Danish
- Number of students: 13+14 (two groups)
- My role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

My TA role in this course consists of presenting a set of exercises to the students and assisting them in solving these using MatLab. They write a short report consisting of their plots and answers, which may be the subject of discussion during the oral exam.

According to the course teacher, here students often show insufficient understanding of their own report contents and the concerned theory in general. I argue that this is because the students lose the bigger picture and logical progression of the exercise set, when concentrating on writing their MatLab code.

2. Planning a teaching activity

Based on the identified problem, the teaching activity was planned in order to improve the students' **Understanding of the classroom exercises and their solutions** and their **ability to discuss/relate methods and results at the oral exam**.

Group presentations of the exercises and their solutions were chosen as the teaching activity. In order to present and discuss the exercises and their own results "without a script", the students would need a thorough understanding of these.

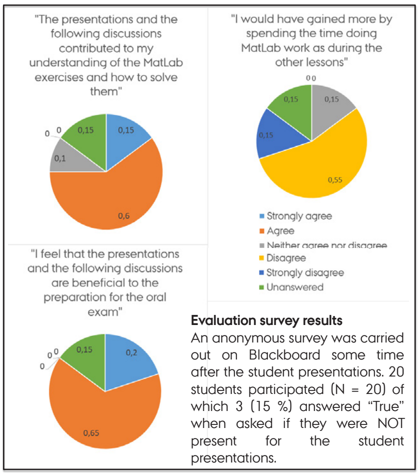
Also, by having to come up with questions for the presenters, the audience would be included in the subsequent (group-group) dialogue. The discussion would serve as practice and give the students an idea about what to expect at the exam.

3. Trying it out in practice

By the end of the exercise classes, the students had worked through most of the exercise set. About a week before the presentations the students split into groups of 2-3 and chose an exercise to present. They were asked to spend 45-60 minutes out-of-class to prepare a presentation of 5-10 minutes.

In each presentation the students should present the exercise, the method used for solving it, their results, and a discussion of these. Hereafter another group, assigned beforehand, would ask one or two "examiner questions" before the rest of the class/TA could ask questions.

The students were later asked to participate in a Blackboard survey to provide data for the assessment of the activity (see below). I conclude from these, that the activity was successful in improving the mentioned criteria.

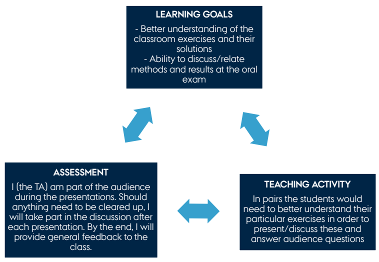


Evaluation survey results
An anonymous survey was carried out on Blackboard some time after the student presentations. 20 students participated (N = 20) of which 3 (15 %) answered "True" when asked if they were NOT present for the student presentations.

MAIN POINTS

1. **Main problem/challenge:** Students' inadequate understanding of classroom exercises
2. **Teaching activity**: Student groups present exercises and solutions near end of course
3. **How did it go?** Relatively successful, according to student answers in Blackboard survey and my own impression
4. **What to do next?** Evaluate effect after course exam and refine activity for next year

Student presentation in progress



4. Looking forward

Many students were clearly challenged by this activity. This owes in part to the fact, that it was planned only shortly before it was carried out. Still, the general performance level was acceptable, and it is concluded from the evaluation survey, that the students found the activity helpful for their understanding of the exercises and their exam preparations.

After the course exam, the teaching activity will be evaluated with the course teacher, based on his experience of the students' performance at the exam compared to previous years. Should it be concluded that the activity had a positive effect, it will be refined and implemented next year as well.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Torsten Hundebøl Hansen
SeisLab Aarhus
Department of Geoscience

Draft – Discuss – Refine

Improving scientific writing skills for 3rd year students preparing for their bachelor's projects

Abstract: The 3rd year of university studies cradles independency of the student, by following experimental procedures that are no longer stringently planned, but rely on the knowledge and observation skills of the student. This change requires concise and intelligible scientific reporting capabilities from students. The teaching activity called Draft – Discuss – Refine emphasizes student-based learning by peer evaluation of experimental reports followed by peer-to-peer discussions that allows refinement of the experimental reports. The teaching activity was well-received by students, but the activity may be improved by allocated class time for the activity and self-pairing of student teams.

COURSE FACTS

- Course name: Organic Chemistry IIIa
- Level: Bachelor's course
- ECTS credits : 10
- Language: Danish
- Number of students: 20
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

Students have a hard time constructing a well written scientific report based on their experimental results in the laboratory. Students look for a "formula" of how to structure their scientific writing to effectively convey their results. A key skill for prospective organic chemists is clear and tangible presentation of experimental achievements in writing. The aim of the activity is to facilitate elaborate peer-to-peer discussions of experimental reports to practice the writing and editing skills of the student.

2. Planning a teaching activity

Successful structure and articulation of scientific experiments is enabled by the experience and critical thinking of the authoring student. To train these skills, a teaching activity where students are to deliver and discuss experimental reports offers an increased learning outcome. Student-centered activities necessitate involvement and decision-making from students, meaning that student-centered teaching activities are favorable. Peer-to-peer report evaluations offer room for discussion among students with clear possibilities for evaluation, with input from both instructors and peers. The teaching activity is well aligned with the learning goal of clear and structured scientific writing.

References

Organic chemistry IIIa: Experimental Organic synthesis. https://kursuskatalog.au.dk/da/course/83174/Organisk-kemi-IIIa-Eksperimentel-organisk-syntese

P.B. Carnwell, L.M Harwood and C.J Moody: Experimental Organic Chemistry. Third Edition.

3. Trying it out in practice

The teaching activity ask students to assess the reports of their peers and to have their own reports assessed.

A report draft is handed in by a two-student team on the due date of the assignment, which is given both to the instructor and to another student team. The reviewing student team has a week to evaluate the report-draft in detail and will give out constructive criticism on the report they have assessed to the authoring two-student team. Following this process, a final draft is handed in to the teaching assistant, for evaluation and comparison with the initial draft.

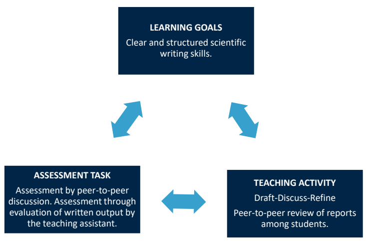


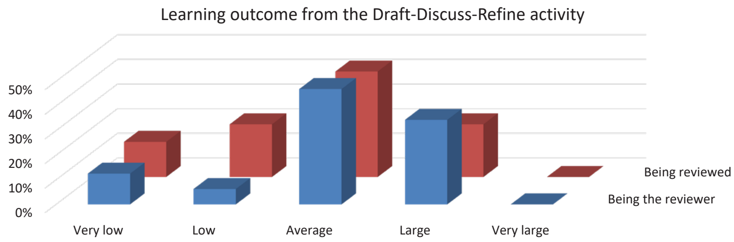
Figure 1: **Constructive alignment**
Constructive alignment is ensured by interplay of the teaching activity and assessment tasks being in coherence with the course learning goals.

MAIN POINTS

1. **Main problem/challenge:** Clear and concise articulation of experimental results.
2. **Teaching activity**: Draft – Discuss - Refine
3. **How did it go?** Good immediate feedback. Key observations were made for improvement of the teaching activity.
4. **What to do next?** Allocate class time for students to evaluate reports. Evaluate both written outcome and quality of the peer evaluation process. Match groups selectively or implement a rolling peer-review rotation scheme.

4. Questionnaire from class

A questionnaire was given to students to assess the success of the Draft-Discuss-Refine teaching activity. 88% of students spent between 16-60 minutes reviewing reports and they report an average to large learning outcome from the activity. The questionnaire prompted students to make suggestions on how to improve the teaching activity and the suggestions have been reviewed carefully.



4. Looking forward

Students are generally positive, with 63% of students suggesting continued use of the teaching activity in class. The possibility for seeing and assessing the reports of their peers is fruitful for students. Students slightly favor the reviewer role over being reviewed. Challenges of the teaching activity include time allocation for the review process and grouping of student of equal skill and engagement. Students express a desire for clear definitions of the structure and requirements of the reports.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Per Hjerrild,
Group of Thomas B. Poulsen
Institute of Chemistry

Practice Test on Blackboard

Feedback for the Students and the Teachers

Learning Lab

Abstract:

I just recently started my PhD and am part of a newly established research group, lead by a newly hired associate professor. It is very fitting that this professor was also appointed to teach a newly established course on Physical Chemistry in Biotechnology. A challenge she was sure to face was to make the course match the students level and prior knowledge. For this purpose I implemented a weekly practice test which was put on Backboard the day after the lecture. This not only gave valuable feedback to the teacher, but also gave the students a chance to repeat the most important points of the lecture.

COURSE FACTS

- Course name: Physical chemistry in Biotechnology
- Level: BSc
- ECTS credits : 5
- Language: English
- Number of students: 20
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

The course I am involved in is implemented like this for the first time this year, as it is part of a new Bachelor's program. This poses the problem that the teachers cannot rely on previous experience when it comes to the prior knowledge of the students. Possible consequences are either bored students, hearing what they already know all over again, or overwhelmed students, facing too much new information at once.

2. Planning a teaching activity

Facing this problem, I turned to Blackboard, which was already in use for sharing the lecture slides with the students. Giving weekly practice tests on Blackboard would provide valuable feedback to the teacher about what the students are having troubles with, and additionally give the students a good opportunity to repeat the essentials of the lecture they recently attended.

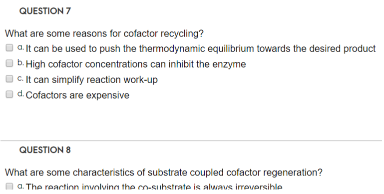


Figure 1. A look at the questions.

3. Trying it out in practice

The practice tests were implemented on Blackboard using the "Test" tool. It offers many different types of questions and I varied their type in an effort to keep students engaged throughout the test. In the time I had until now, I implemented three tests. 10 students in total and eight per test took part. The results obtained were actually quite interesting. I was able to identify several core topics, that the students apparently had not fully grasped yet.

Student	Q 1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
a	10	0	10	10	10	10	10	10	10	10
b	0	0	0	10	10	10	0	0	0	0
c	0	0	0	10	10	10	10	10	10	10
d	0	0	0	10	0	10	10	0	0	0
e	0	0	0	10	10	10	0	0	0	10
f	10	10	10	10	10	10	10	10	10	10
g	10	0	0	10	10	10	10	10	0	10
h	10	10	10	10	10	10	0	10	10	10
	50%	25%	38%	100%	88%	100%	63%	63%	50%	75%

Figure 2. Results of the first practice test, showing how every student did per question and the percentage of correct answers per question.

Looking at the results of the first practice test (figure 2) we can clearly identify two questions the students struggled with. One of them (question 2) was "What are typical characteristics of a biotechnological synthesis by fermentation?" The definition of a fermentation process is important basic knowledge for anyone working in biotechnology and only 25% right answers show that this topic had to be addressed again in an upcoming lecture.

MAIN POINTS

1. **Main problem/challenge:** uncertainty about the level of the students and therefore about their learning progress
2. **Teaching activity**: Practice test on Blackboard
3. **How did it go?** Participation could have been better, but it still provided a general idea about topics that needed further explanations
4. **What to do next?** Continue with the tests, revisit results to find student's weaknesses.

In general I think I can call this activity a success. The turnout was okay, considering that only about 15 of the 20 enrolled people showed up for the lecture each week. However, it could be improved by simply declaring the practice test mandatory to take.

Besides the valuable feedback for both students and teachers, the students were also forced to read and think about what they heard in the lecture, which surely helps them achieve the learning goals.

4. Looking forward

The activity went quite well and provided valuable information about topics, where the students still need more contact with.
Looking forward I will continue the tests for the remaining four lectures. In the end the assessment of the student's answers can also be used by the teacher to find topics to address in the last lecture before the exam.
In the last lesson an evaluation of this quiz by the students will be done.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Markus Hobisch
Biocatalysis & Bioprocessing
Department of Engineering

Planning field sampling activities

- Encouraging students to plan, organize and consider consequences of field sampling activities

Learning Lab

Abstract: Conducting multiple sampling activities in aquatic environments can often be confusing and overwhelming for the students. In the given example, the field protocol presented many different sampling activities - but not the sequence in which these should be collected. The challenge is, that students must plan in which order they execute the sampling collection, considering the consequences when doing so. The teaching activity consisted of a strip sequence, where the students had to plan and organize the field sampling activities. Student learning was assessed by hand rise (before and after the activity) and by an anonymous Ticket-Out-Of-The-Door, in which the former also evaluated the teaching activity. The teaching activity resulted in a less stressful fieldtrip, as it encouraged the students to plan and organize, thus promoting an agreement in the group about the sampling sequence. Overall, the assessment revealed that 90% of the students had a good to very good understanding of the sampling sequence after the activity, and that they felt more confident with the sequence of the sampling procedure after the activity. A future improvement would be to bring along a hard surface for the students to arrange the strip sequence on, because the students lacked a table in the field, and an outside-class improvement would be to restructure the field protocol to improve the student's understanding of the sampling sequence before arriving in the field.

COURSE FACTS

- Course name: Aquatic biology
- Level: Bachelor level, 3rd year.
- ECTS credits: 10
- Language: Danish
- Students: 10
- Your role: Supervision of field sampling

TEACHING IN PRACTICE

1. Identifying a problem

During the course it is expected, that students **learn** how to **collect samples** from aquatic environments. The students are often confused, as the field-protocol present many different sampling activities - but not the **sequence**, in which these should be collected. The challenge is, that students must **plan** in which order they execute the **sample collection**, considering the **consequences** and **effects** when doing so.

Potentially, students can affect the results negatively, because the fieldwork takes place in a stream, hence, activities performed upstream affect activities downstream.

2. Planning a teaching activity

The teaching activity will (hopefully) result in a less stressful fieldtrip, as it will **encourage** the students to **plan** and **organize** their sampling activities, thereby promoting an **agreement** in the group on the most **optimal** sampling sequence.

The students will **learn** to **plan** and **organize** sampling activities, and they must consider the **consequences** of their action, taking into account how the different sampling activities affect each other and how they affect the sampling site.

This teaching activity could be beneficial in their future bachelor and/or master project, as they **practice** how to **contemplate** and **conduct multiple samples** at a field site.

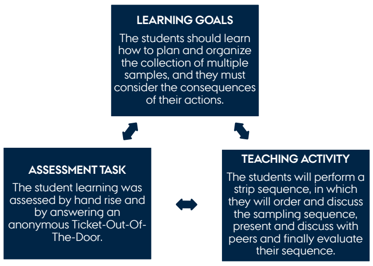


Figure 3: Constructive alignment. Alignment between the learning goals, the assessment and the teaching activity.

3. Trying it out in practice

The teaching activity consisted of a **strip sequence** (figure 1). **First**, the two groups (5 persons in each) arranged the sequence separately (**in groups**, 5 min), **second**, the groups presented their sequence with an explanation to the other group (**plenum**, 5-7 min), **third**, back in the groups, they evaluated their sequence after the presentation (**in groups**, 3 min), and **finally**, I presented an **ideal sequence** and discussed this with the groups (**plenum**, 5 min).

The student learning was **assessed** by 1) **hand rise** (before and after the activity), where the students answered "How many feel confident with the sampling sequence?", 2) **progression** of the strip sequence, as the groups noted their sequences twice, and 3) **Ticket-Out-Of-The-Door,** which both **assessed** the students learning and **evaluated** the teaching activity.

Figure 1 Students working with the strip sequence.

MAIN POINTS

1. **Main problem/challenge:** Students lack an overview of the sampling activities, e.g. the optimal sampling sequence.
2. **Teaching activity**: Strip sequence.
3. **How did it go?** The students planned, organized and considered consequences of the sampling activities, and became more confident in the sampling sequence.
4. **What to do next?** Adjust and implement the teaching activity in future fieldtrips.

Students overall **felt** that the teaching **activity trained** the **learning goal** (figure 2). The evaluation revealed, that **90%** of the students had a **good** to **very good understanding** of the **sampling sequence** after the activity. The hand rise (data not shown) also revealed, that the students **felt more confident** with the sampling sequence after the teaching activity (9 of 10 students) compared to before (2 of 10 students).

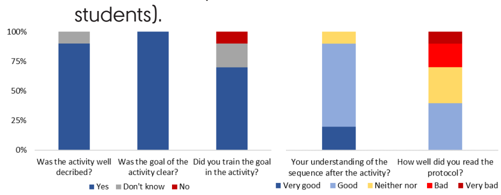


Figure 2 Answers from Ticket-Out-Of-The-Door (10 students).

4. Looking forward

Overall, the teaching activity promoted planning and organizing of the sampling activities before conducting the fieldwork, and the students increased their understanding of the sampling sequence during the activity. A future improvement could be to supply the students with a hard surface when arranging the sequence, because they lacked this in the field. An outside-class improvement could be a restructuring of the field protocol, thus improving the student's understanding of the sampling sequence before arriving in the field.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Solvei Mundbjerg Jensen
Aquatic biology
Department of Bioscience

What about the first weeks?

- Rediscovering the meaning of previous topics in your course!

Learning Lab

Abstract: Often a course will focus its time on learning new topics and getting new knowledge. Yet, some times looking back is an important part of learning as well. This teaching activity will take time to revisit old topics that have been covered previously in the course, allowing the student to reconsider the meaning of these. The activity will use a flash review showing central equations of different topics followed by active problem solving, allowing the students in groups to discuss the meaning of it and sharing knowledge with each other. The method proved very successful, where the students felt like they have learnt a lot from the activity! For future use it could be used 3 or 4 times per course with covering different parts/chapters.

COURSE FACTS

- Course name: Mechanics and thermodynamics
- Level: 1st semester
- ECTS credits : 10
- Language: Danish
- Number of students: 15
- Your role: TA in problem solving

TEACHING IN PRACTICE

1. Identifying a problem

Often a course will focus all of its energy of delivering new knowledge towards the students, which is also the case in this course. However, sometimes we will need to take a step back and acknowledge that it can be very difficult to remember things that have been covered in the first weeks. It can be a good idea to revisit old topics and discuss these again to rediscover new meanings and understanding. By acquiring a better and deeper understanding of a topic, one will also be able to explain and identify the key parts of the physics covered, which is at the core of the learning outcomes for the course.

2. Planning a teaching activity

As time is limited in a course, we will be utilizing, that students may have learnt different key concepts from the covered topics and thus they are able share this with each other.
In this activity we will be discussing previously covered topics in groups. As repetition often will strengthen the understanding – the activity will help them to rethink how these topics work with knowledge and skills they have acquired later.
In the second part of the activity they will solve a problem, combining different topics that we covered in the first part.
All of the abovementioned parts will aid their ability to identify and relate different topics as well as written problem solving. All of which are very important

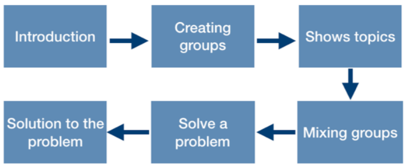


Figure 1: **Teaching activity program**
Flowchart of the program for the day! This was also shown to the students to give them an idea of the program for the activity.

3. Trying it out in practice

In the activity the students will be split into small groups for a flash review of 4 topics. Here they will discuss the meaning of the topics presented. They will only have 1 minute to discuss each topic, hence forcing them to get the main point across the table quickly.
Following the review the groups are mixed using the matrix concept, where they will solve the problem as described previously.
Finally, we have a follow-up where their result to the problem is discussed and how they used the topics covered. Finally, a online "one-minute-paper" is filled out by the students to evaluate the activity. A sketch of the plan is shown in Fig. 1.

The four topics that were covered were

- constant velocity and acceleration
- Newtons Laws
- impulse and Momentum
- collisions

All of which had to be combined to solve the following problem.

Overall, the activity went really well. In the evaluations the students felt like they learnt especially a lot on impulse and collisions. They also mentioned they had learnt a lot on how they can relate the topics.

MAIN POINTS

1. **Main problem/challenge:** Remembering old topics that have been covered multiple weeks ago
2. **Teaching activity**: Flash Review combined with group based problem solving
3. **How did it go?** The students were very pleased with the activity and felt they learnt a lot form covering old topics again
4. **What to do next?** A similar activity later in the course could be beneficial. We will also talk more about some of the topics they found the most difficult.

The scores from the students also reflect a high satisfaction with the activity as seen in Figure 2. Not only did they feel like they learnt something by covering old topics, but also felt that it could be useful to have a similar activity later, to reflect on new topics.

Figure 2: **Activity evaluation**
Evaluation of the activity. The scale is from left to right in "very little" and right "a lot". The questions were: Top meter "to what degree did you feel like you learnt something from todays activity", middle "Has it been a good activity". Lower "Should we have more of these activities?"

4. Looking forward

First of all, as the students were very satisfied with the physics covered, they also realized how useful the groupwork can be. This has led to that the students are working more in groups than previously. This is of course something that I, as a TA, will focus on later.
As for the activity, most of it worked really well, although having some hints to the problem ready could be useful.
As a final note, not only did the activity help the students in learning more about the topics, but I have also identified (through the evaluation) some topics that we need to talk more about in the class. This will allow for more strategic teaching, only spending more time where it may be required.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Henrik Jeppesen
iNANO

2-experiment strip sequence

Encouraging active learning in the laboratory

Learning Lab

Abstract: When performing laboratory experiments, students must to follow the protocol rigidly in order to achieve success. However, they tend to focus solely on doing as the protocol says, without thinking about what they are actually doing, and why they are taking the specific steps the protocol outlines, what happens in each, etc. This strip sequence teaching activity aims to force the students to think about the purpose of their actions by making them order individual steps of two concurrent experiments they are performing. To do this correctly, they must understand what happens during at each step of the protocol. Overall, the teaching activity was well received and the majority of the students felt that they understood their protocol and their

COURSE FACTS

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

TEACHING IN PRACTICE

1. Identifying a problem

When doing experiments during laboratory courses, students must rigidly follow a protocol to achieve good results. This often leads to students following the protocol without understanding what they are actually doing, and the science behind the methods they are employing.

This presents a problem as the students must be able to describe and analyze their experiments, and results, in their reports and at the examination. They will not be able to do this without understanding their protocol and experimental process. This activity aims to address this problem by teaching the students to analyze and understand their protocol.

2. Planning a teaching activity

To address the previously described problem, a teaching activity consisting of a strip sequence has been developed. During this activity the students will try to list in the correct order the individual steps of two different experiments they are performing at the same time.

The activity aims to make the students consciously think about what they are doing during the individual steps of the protocol and understand the experiments they are performing.

The aim of this exercise is to teach the students to analyze their experiments and describe them in detail, including what the purpose of the experiment is and what happens during each individual step.

These skills will help the students to achieve the learning outcomes of the course, which include being able to describe and analyze experimental methods, perform experiments, and analyze and conclude based on experimental results.

3. Trying it out in practice

The strip sequence is applied to a point in the protocol where the students have to perform two different experiments at the same time, each using different methods on different kinds of samples.

At the start of the laboratory lesson, the students are divided into 2-person groups and given the strip sequences to solve, along with an explanation of how.

The strip sequence is laid out as two sequences side by side, with a heading for each experiment, and each strip bearing the name of a step during each experiment, which the students then have to assign to the correct experiment and in the correct order (figure 1).

The students are given 10 minutes to solve the strip sequence, after which the TA's talk to each group to ensure that the strip sequences have been solved correctly.

The students are then instructed to carry out their experiments as usual, but keep the strip sequence in mind and use it to keep track of their experiments and understand what they are doing. During this time the TA's will go around the lab asking questions to ensure that the students are able to describe the experiments and the

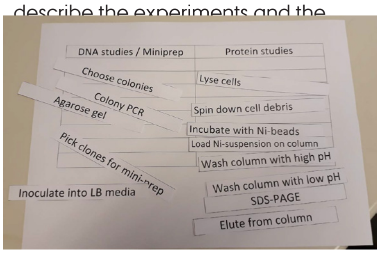


Figure 1. The strip sequence the students had to perform.

MAIN POINTS

1. **Main problem/challenge:** Students follow protocol without understanding it
2. **Teaching activity**: Strip sequence
3. **How did it go?** Very well, according to feedback
4. **What to do next?** Make the teaching activity part of the course

At the end of the lesson, the activity was assessed by asking the students to answer 3 questions about the strip sequence, to evaluate its usefulness and whether they felt they learnt from it (Figure 2).

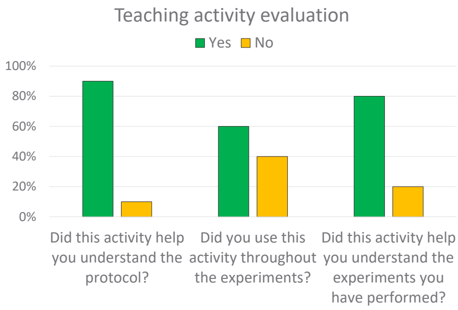


Figure 2. Evaluation of the teaching activity

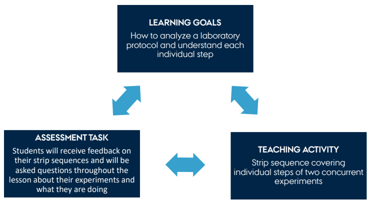


Figure 3. Constructive alignment

4. Looking forward

The teaching activity proved its usefulness as very few groups were able to solve it correctly without any help. In receiving help to solve the activity the students were thus able to understand their experiments better. Introducing the teaching activity right before the relevant experiments helped keep it fresh in the memory of the students, however, actions could be taken to help the students use the strip sequence actively while performing the experiments, such as having them draw arrows between the strips at points where they have to jump between experiments. As the activity proved highly useful it could be implemented as a standard part of the course.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Torben Heick Jensen Group
Department of Molecular Biology and Genetics

Motivating a small group of students to participate in plenum discussions

Abstract: As part of an elective course on organic livestock farming, students should in one, out of numerous lectures, be presented to constraints and possibilities in the organic pig production sector. Based on previous teachers' experiences, the level of participation among students was low. Consequently, lectures had become one-way communication from teacher to students. This does not facilitate a debating environment for students, that could otherwise support students in their overall learning goals. Based on these experiences, the teaching activity for the present lecture was intended to make all students communicate through presentation and discussion of one of two specific research cases. The goal was to engage all students and motivate them to describe and reflect on a specific issue.

COURSE FACTS

- Course name: Organic livestock farming
- Level: Master
- ECTS credits : 10
- Language: English
- Number of students: 6
- Your role: Give an 80-minute lecture on "Organic pig production – research perspectives"

TEACHING IN PRACTICE

1. Identifying a problem

The course Organic livestock farming consist of a number of lectures with different themes (e.g. dairy production, poultry production and pig production) and many different lecturers. Thus, the present lecture was a single acquaintance with these students.
The main challenge for the lecture was the varying level of participation reported by previous teachers. Often lectures had become one-way communications from the teachers to the students. An explanation could be that the students had specific interests and therefore were less motivated to engage in other subjects. Further, the exam will primarily be based on a report were content is chosen by the students. The lack of student's oral input, discussion and reflections during lectures prevent the students from practicing important explanation and discussion skills.

2. Planning a teaching activity

By the end of the course, students should be able to describe, discuss and reflect on various constraints and possibilities in relation to organic livestock farming systems. The teaching activity was carried out with the purpose of engaging the students in description and discussion of specific research cases by oral presentation of the cases to the other group. The presentation was followed by a plenum discussion based on their own questions.

3. Trying it out in practice

Prior to the activity, the two research cases were presented to all six students. The students were then divided into two groups of three. Each group received a folder with one file where the activity was thoroughly described, and four files related to their specific case. These consisted of a scientific article, two videos and a master thesis as background material. Students were given 45 minutes to prepare a presentation no longer than 10 minutes. They were supervised throughout preparation time if needed. After presentations and plenum discussion of their own questions, the activity was evaluated. The relationship between the learning goal, the teaching activity and assessment (constructive alignment) is presented in figure 1.

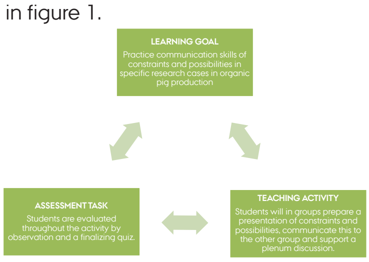


Figure 1: Constructive alignment

4. Assessing the teaching activity

The teaching activity was assessed partly by observing the ongoing discussions in the group and partly by a quiz. Observations were an important tool for assessment because the learning goal was related to communication skills rather than acquiring specific knowledge and memorization.

MAIN POINTS

Main problem/challenge: The participation of students is reportedly low.
Teaching activity: Presentation of a specific research case to practice communication skills of constraints and possibilities in a specific type of farming system.
How did it go? Evaluation indicated both strengths and potentials for improvement of the teaching activity.
What to do next? Instead of using research case examples, the students should present basic knowledge on organic pig production. Assignments should be given prior to the lecture to reduce time spend on the activity preparation in class.

The final quiz was a recall test of a quiz presented at the beginning of the lecture, where some specific issues related to the two research cases were presented.
Figure 2 shows a quiz question example. Results from observations as well as the test indicated an increased insight into the cases as well as a useful practice in communicative skills. However, cases seemed to complex and many important aspects where missed. Finally, the activity was too time consuming.

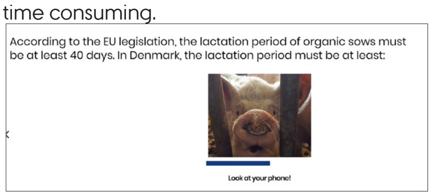


Figure 2: A quiz question example used in the recall test

5. Looking forward

Students were active throughout the activity, but the research cases seemed to complex. The presentation and the following discussions missed key issues. Two students became very active, while the rest were less participative. If the teaching activity were to be implemented in the future, students should be responsible for more introductory issues of organic pig production, while the teacher should present and support discussion of more complex dilemmas. Also students should prepare at home to make a better use of face-to-face teaching.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Lone Juul
Agricultural Systems and Sustainability
Agroecology

Isotopic spin
- A known problem in an unknown form

Learning Lab

Abstract:

The students generally struggle with two things in this course: 1. understanding isospin and 2. relating concepts and methods used in previous courses to the ones used in this course. To deal with this I held a lecture about isospin, with problems after each central concept, where most of the focus was on the similarities between spin and isospin. The lecture was well-received albeit some of the students felt that we spent too much time on the problem sessions. This could potentially be solved using the think-pair-share method.

COURSE FACTS

- Course name: Nuclear and Particle physics
- Level: Bachelors
- ECTS credits : 5
- Language: English
- Number of students: 42
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

A general problem for students is how to understand and work with Isotopic spin (Isospin); Despite the fact that most students are comfortable working with regular spin. This feeds back into another problem the students have: Using knowledge from previous courses to help understand the material presented in this course. As both of these are part of the learning outcome of the course, it is of great importance to solve them

2. Planning a teaching activity

The teaching activity is divided in to two parts. 1. A classical lecture format to introduce the concept of Isospin and 2. Intermezzo problem sessions to link the newly established concepts to material from previous courses.

The lecture allows me to introduce and explain isospin, and, more importantly, link it to regular spin. This on its own should solve the first part of the problem, however, to ensure this is indeed the case the students were also given classic spin problems to be solved using the isospin formalism.

And herein lies the solution to the second part of the problem. By forcing the students to work with previous concepts and problems they will either remember or be reminded of said concepts.

The learning goals for this teaching activity is therefore: To link isospin to regular spin and be able to use the spin formalism to solve Isospin problems

3. Trying it out in practice

Originally the teaching activity was supposed to be given to my own students in a small class problem session, but because the course responsible had to be away for a lecture and because my material was well-suited for small classes as well as large lectures, I was asked to do the teaching activity as a lecture. This meant that I couldn't guide them as I normally do, so they had to work together. Although it was not initially planned this way, it worked out very well and when faced with a problem the students eagerly discussed with each other.

Before the lecture I asked the students how they felt about spin/isospin. And while most students believed that they could understand spin well enough to be able to work with it, none of the students understood isospin.

At the following problem sessions after the lecture I asked the same questions and there was a huge shift in the opinion on Isospin. As can be seen on the figures below almost all of the asked students now feel like they can work with Isospin at the same level that they can with spin.

One of the students commented on this:

"In regards to Isospin I feel that after your lecture I can solve isospin

MAIN POINTS

1. **Main problem/challenge:** Understanding Isospin.
2. **Teaching activity**: A combined lecture and problem session.
3. **How did it go?:** The lecture was well received and most students felt like they better understand isospin.
4. **What to do next?** Use think-pair-share to help the students reflect on the given problems.

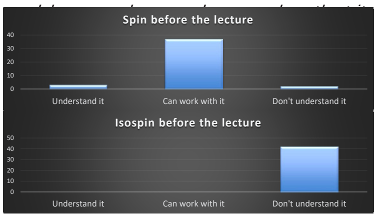
While the lecture was mostly positively received some of the students had comments on how to improve the session:

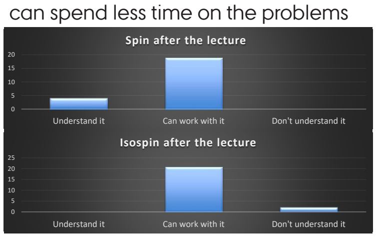
"When we have gone through an exercise, you should consider giving us 5 min to talk it over with our neighbor. This way we can look at the exercise again and reflect on the solution." – anonymous student 2#

and

"Perhaps a bit too much time was spent discussing the problems…" – anonymous student 3#

In my personal experience I agree with the final comment as we did spend a lot of time on the problems. Something I will consider for similar sessions is doing what student 2# suggested. This way I can spend less time on the problems





4. Looking forward

The main problem was the time spent on the problems. While the students in the middle felt it was perfect, both the top and bottom students felt that the problem sessions lasted too long, albeit for different reasons.

To deal with this I intend to give the students less time trying to solve the problems before discussing them, but rather give the students a little time to discuss the result and the used methods using think-pair-share after going through the answer on the blackboard.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Nikolaj Jørgensen
maQma
Department of physics and astronomy

Blackboard Presentation in Mathematics

Using jigsaw-group to encourage participation

Learning Lab

Abstract: Jigsaw group technique was implemented as a teaching activity in a 1st year bachelor course to encourage students' participation. It was anticipated a smaller group will be a "safer" environment for the students to practice their presentation skills. The activity achieved the intended goals, even though some students were frustrated by the decreased amount of direct supervision by TA. The problem may be mitigated either by mixing the jigsaw-group format with the traditional format, or by reassuring students by positive feedback.

COURSE FACTS

- Course name: Mathematical Analysis 1
- Level: 1st year Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 20
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

One of the recurring problems in mathematics TØ is that the majority of students do not dare present their solutions at the blackboard in front of the class. This represents a significant missed opportunity for students' learning, as blackboard presentation is an effective way to practice presenting a mathematical arguments, which is also an important aspect of the learning outcomes for this course.

2. Planning a teaching activity

The teaching activity is designed to provide students with a safer environment to practice their argumentation skills by limiting the size of the audience, and by removing the constant supervision by TA during the presentation. It is intended that every student will present a solution during a session.
The learning goal for the activity is to improve the mathematical argumentation skills for all students, both by getting them to present solutions and by encouraging them to actively participate in the discussion during/after the presentation.

3. Trying it out in practice

About 1.5 week before the TØ session an exercise sheet with problems was posted on the Blackboard. The students worked through them at home, but not necessarily solved them. In the class the students were divided into groups (4-5 per group) and each group was assigned a problem. They then spent 20 minutes to discuss the assigned problem within the group and prepare a presentation of the solution. During this time TA walked around the classroom to check their progress and answer any questions they had. After the discussion the groups were reorganised so that each group now consisted of students who had worked on different problems. Each student in a group then took turns to present the problem they had worked on to the rest of the group, using the "magic-chart" whiteboard papers. Each presentation was followed by questions/comments from the group.

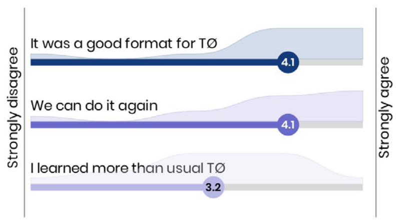


Figure 1: **Feedback for the teaching activity**
Feedback was generally positive.

MAIN POINTS

1. **Main problem/challenge:** Some students do not present at the blackboard
2. **Teaching activity**: Jigsaw group
3. **How did it go?** Increased participation, though some frustration
4. **What to do next?** Alternate with the "traditional" TØ format

There was a good level of student activity and engagement throughout the session. This impression was supported by the generally positive feedback from the students about the teaching activity. The feedback also showed some frustration about less supervision by the TA compared to the usual TØ format, even though most presentations were of good quality.

It was easier to present in front of a small group.

Everyone presents.

It is good to learn to present. But it would be nice to know if you are doing it right.

Not nice that you only study one problem properly.

You get a chance to say something, (even) if you don't think it is easy to go up to the blackboard and present.

Figure 2: **Selected comments for the teaching activity.** The comments show the activity mostly worked as intended, but there were also some critical remarks.

4. Looking ahead

Overall the teaching activity worked well and addressed the problems as intended. There were some frustrations caused by not being sure whether one's presentation is correct. This could be addressed by mixing jigsaw-group presentation with the traditional TØ format, or by more positive feedback from TA to reassure them of the quality of presentations.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Yuki Koyanagi
Centre for Quantum Geometry of Moluli Spaces
Department of Mathematics

Hands-on applied mechanics

- Developing intuition for mechanics of materials

Learning Lab

Abstract:

Students showed difficulties in fully understanding the mechanical behavior of materials and the response of connected systems. For this, a hands-on experiment was developed using a custom made tensile test machine which was utilized by the students to characterize the mechanical (force-deformation) response of a rubber band. Students found the application of theory from class refreshing, but improvements are to be made to properly determine the academic gain from the activity.

COURSE FACTS

- Course name: Mekanik og Termodynamik
- Level: 1st year, Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 10
- Your role: TA/Instructor

TEACHING IN PRACTICE

1. Identifying a problem

Students in highly theoretical classes have a difficult time connecting theory and equations to real problems. This can inhibit the depth of their understanding of the theory and reduce motivation due to not seeing the usefulness of what they learn.

This activity aims to induce motivation and increased learning on the subject by giving hands-on experience to help illustrate the usefulness and importance of the subject content.

Concretely the students characterize the mechanical properties of an elastic material by applying the theory from class on a hands-on activity.

2. Planning a teaching activity

The activity have students do experimental measurements and then by using theory and equations from the course, they will derive the mechanical response of a rubber band. The activity and course learning outcomes are:

• Explain and apply important concepts and results in mechanics.

• Analyze a simple physical problem using concepts and results in mechanics.

Where the concepts here are: displacement, force, stress, strain, elasticity, hysteresis and equilibrium.

To bridge theory and the experiment (activity), the structure given in "3." was planned with a theory recap.

3. Trying it out in practice

The structure of the teaching activity was as follows:

1. Present the purpose for the activity.
2. Introduce the activity.
3. Recap the necessary theory and equations.
4. Carrying out the activity.
5. Recap the activity
6. Evaluate and assess the activity.

Step 2 and 3 included questions to students, ensuring active engagement.

The activity consisted of students measuring the length of a spring and a rubber band as they were deformed. Custom made tensile test machines were used for this and illustrated in figure 1. Students measured the initial geometries, then pulled the white thread, in figure 1, and then measured the deformed lengths. They did this in about 7 steps until they had reach the max length of the tensile test machines.

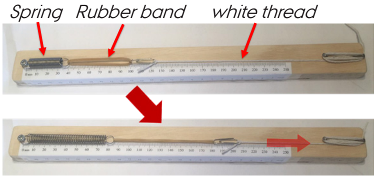


Figure 1: Custom made tensile test machine

The spring-constant and rubber band geometry were known, so they could use the course theory to calculate the stress-strain response of the material.

They were given an excel sheet that would plot the measured data.

When they were done, all data was combined and plotted using Matlab, and shown in plenum.

The evaluation and assessment were printed on two sides of the same paper to be able to compare what students thought about the activity and what they actually got out of the activity with respect to the learning outcome. For 4 agreeing partly and 5 agreeing completely, the average values for what the students thought about the activity was:

Remained interested throughout: **4.0**
Felt an improved understanding: **4.1**
Found it easy to follow: **4.8**
Found it clearly communicated: **4.8**

Several students commented that it was refreshing/nice to apply the theory on a practical problem and seeing Matlab applied. All but one found the level suitable. Overall they appeared to have a better understanding in accordance with the learning outcomes, however, lack of pre-assessment makes it difficult to properly quantify the real gain.

MAIN POINTS

1. **Main problem/challenge:** Applying theory to real world problem and realizing its usefulness.
2. **Teaching activity**: Problem based learning / experiment.
3. **How did it go?** Students were satisfied and learned by doing.
4. **What to do next?** Improve assessment and evaluation.

4. Looking forward

The structure and activity worked quite well, but took more time than expected. The assessment could be improved to reflect more conceptual understanding of material response, e.g. how the behavior of the system would change if a different spring was utilized. Furthermore the evaluation should have asked about how their perception of the subject changed after applying the theory to a practical problem. Lastly, better integration in the timeline of the course would improve time consumed and provide preparation possibilities for the students.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Johannes
Computational Mechanics
Department of Engineering

Isolation and characterization

How to find the correct experimental approach with strip sequences

Learning Lab

Abstract:

Microorganisms can be found in any type of environment. The question is, who is where and what are they doing? Understanding metabolic and physiological diversity among prokaryotes is fundamental for microbiology. Therefore, choosing the right media and understanding your toolbox to isolate microbes that perform a specific metabolic trait, is key. This could be guided through the help of self-invented strip sequences and peer advise. Students learn from each other about which approaches you can use for what purpose, and they can use this later on during their internships/speciale's.

COURSE FACTS

- Course name: MPI
- Level: BSc 2nd year
- ECTS credits : 10
- Language: English
- Number of students: 20
- Your role: Lab TA

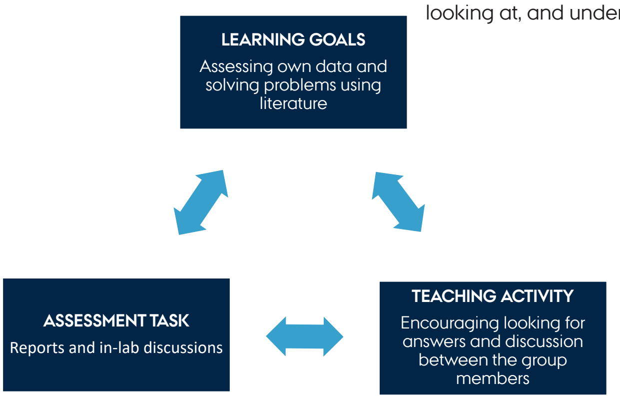


Figure 1: **Constructive alignment**
Schematic overview of the activities during the course

TEACHING IN PRACTICE

1. Identifying a problem

Students sometimes tend to ask very quickly for the right answer. It can be a challenge to make sure that the student in question goes through all the necessary steps of learning before arriving at the answer. In case of laboratory work, the steps in between are just as important as the results. So the problem is how to guide a student through the steps without showing the answer. The students learn a different way of looking at, and understanding experiments.

MAIN POINTS

1. **Main problem/challenge:** Guidance in thinking
2. **Teaching activity**: Strip sequences and discussions
3. **How did it go?** Students respond very well to this way of guidance, due to the freedom.
4. **What to do next?** Start with this from the beginning of the course

2. Planning a teaching activity

The theoretical solution used here is to identify what a student is missing in his/her starting knowledge, followed by a discussion about how to use this to move forward with their experiments and planning. Or even in the final stages of their laboratory work, having the results and moving to a conclusion. This may also lead to a more structured report and presentation at the end.

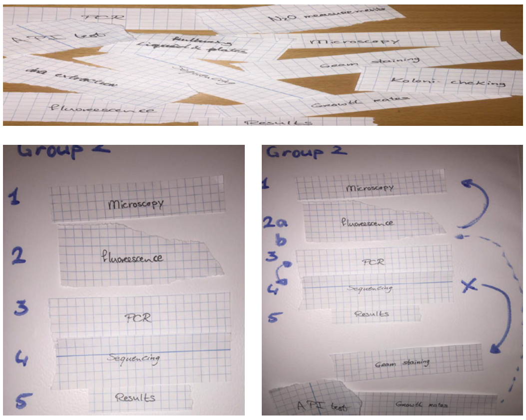


Figure 2: Some of the strip sequences that students have created. And what changed in the sequence after the discussions.

3. Trying it out in practice

The students create their own strip sequences with a bit of start up help, i.e. 4 strip sequences are presented to them. Then, they discuss the right order amongst their groups, and what they do or do not use for their experiments. When they are done two groups provide peer feedback to each other and I assess together with them afterwards. It revolves around this: "Does this answer the question you have for your experiment and which results will it provide you with?" From this, students create a good structure for their experiments and a solid understanding of the toolbox available. In addition, many students are happy to know what they are supposed to do, and proud to be able to figure it out on their own basically.

4. Looking forward

In class discussions are a good way to assess understanding of results and provide an opportunity for students to show their planning and investigative skills. Additionally, this also induces discussions and results in peer feedback. However, next time a little more guidance at the start would be nice for the students.
The future perspective would be better understanding of the equipment and techniques so they can more easily design an experiment in the rest of their bachelor/master (internships).

References

Kursus catalog:

https://kursuskatalog.au.dk/en/course/82700/Microbiology-Microbial-Physiology-and-Identification

Biological Control of Insect Pests

Strong theoretical base : A key to achieve learning outcomes

Abstract: Based on the previous year teaching, it came to know me that student don't have basic concepts of biological control enough to fulfill course outcomes. I planned my teaching activity as lecturer to build the students' theoretical background about necessary concepts. Students were forced to read the latest material provided before start of course by uploading answer sheet of list of questions provided covering the entire material. During first day students discussed the answered questions in small group with teaching assistants and instructor in the class. The students attempted the graded quiz as part of the overall grade. The activity resulted in successful achievement of course outcomes with constructive contribution of students. So it was decided to continue the activity next year with useful addition.

COURSE FACTS

- Course name: Biological control of insect pests
- Level: Master
- ECTS credits : 5 ECTS
- Language: English
- Number of students: 20
- Your role: Lecturer

TEACHING IN PRACTICE

1. Identifying a problem

During last year, when I was running the course, I observed that students lack **background** about the biological control. This problem leads to failure of achieving 100 percent course **learning outcomes**. Most of the discussion during the course showed that student need to strengthen the basic concepts of biological control. So instead of volunteer reading of the material provided before the start of course, it will be **made sure** that all the student have the necessary theoretical background to understand the advanced techniques and concepts related to biological control of insect pests.

2. Planning a teaching activity

It was planned to provide the latest background knowledge well before the start of the course. There will be provide a list of questions to be answered before the start of course and first day of the was fully dedicated to discuss different aspects relevant to the course along with assessment of the students so student will be graded as a part of final grade.

Learning outcomes of teaching activity:

- To build the **conceptual background** of biological control.
- To **make sure** every student learn the basic concepts.
- To inititiate the discussion in the class with **participation** from every student.
- To **assess** the **level** of basic knowledge of each student.

3. Trying it out in practice

Four weeks before the start of the course latest research papers, book chapters and a list of question was provided. Students were asked to **read** the material provided , to answer the provided questions, and the **answer sheet** was uploaded on the blackboard.
The first day of the course was fully dedicated to **discuss the concepts in small group** with the help of teaching assistants (TAs).
Students were asked to discuss each others and TAs, the questions provided and answers what they have written in the answer sheets.
Then the whole class was involved in **discussion** with the instructor to clarify the question posted by student they don't understand.

Learning Assessment:
Students were provided with the following **graded questions** to be answered;

1. What is biological control?
2. How biological control can be a part of IPM?
3. What are the possible controlling agents of an insect pest?
4. How abiotic factors can influence the efficacy of an biological control insect pest?
5. How much important is government regulations regarding biological control?

Student were graded as **5%** of marks of their **final grade.**

MAIN POINTS

1. **Main problem/challenge:** Students lack theoretical background.
2. **Teaching activity**: I used 'class teaching' with 'small group teaching' to make sure students build the necessary background knowledge by understanding the material provided.
3. **How did it go?** Activity worked very well and resulted in 100% success of the whole course.
4. **What to do next?** The activity will be continued with some useful addition.

Based on my assessment, all the students leaned the necessary basic theoretical knowledge related to the biological control. Students participated actively in the discussions.
They were confident enough to carry out complex and advanced theoretical and practical activities of the course.

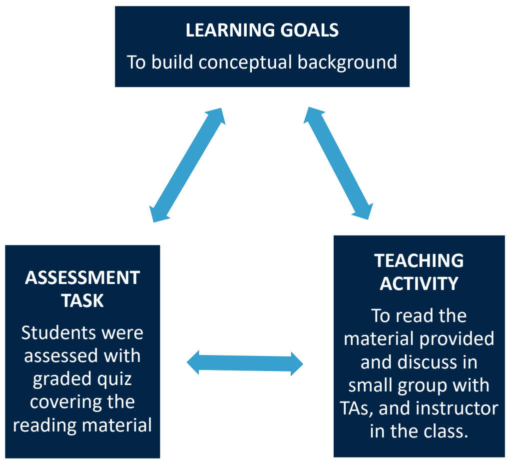


Figure 1. Constructive alignment

4. Looking forward

The teaching activity resulted in **100 percent** achievements of learning outcomes of the whole course. Students were **active in the class** as compared to the previous years. Discussions were more productive and students generated the **innovative ideas**. Lectures and TAs were also more productive and motivated to learn from the students as well.
I am looking forward **to continue** this activity and addition of planning a **case study** by students to work upon during the course.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Zahid Mahmood
Entomology and Plant Pathology
Department of Agroecology

Agro-Greenhouse gases abatement

Learning Lab

Group think, share and pair exercise

Abstract:

Students coming from different backgrounds find it difficult sometimes to fully understand basic economic concepts and frameworks. The course focus on environmental policies and decision-making specially on abating greenhouse gas emissions from agriculture. Students need to practice how to decide on the most feasible abatement measures and calculating cost effectiveness using marginal abatement cost curves. Group think, pair and share is assigned to the students after the lecture to help those who were not able to fully understand the method through knowledge exchange.

COURSE FACTS

- Course name: Agriculture policy and regulations
- Level: Master's
- ECTS credits : 5
- Language: English
- Number of students: 20
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

Students have different level of understanding how to construct marginal abatement cost curves and calculate the cost and benefits of greenhouse gas emissions abatement measures. After the lecture and the readings, some of the students still get confused when doing the calculations on their own specially if it is the first time to use cost effeteness as a tools for decision making. This can affect their level of interaction in the class and during the exercise.

2. Planning a teaching activity

Group think, pair, share and discussion exercise is planned to:

- help improve students interaction in the classroom
- gain more confidence to share their reflection of what they read.

The students are required to work in group of 3 members and discuss for 10 minutes: in reflection of your reading and the last lecture, discuss

- Why using marginal abatement cost curves (MACC) is important and to which extent
- Which type of data is needed, how it can be collected
- What are the steps followed to construct the MACC

After the discussion of these questions, each group will have 5 minutes to share their ideas with another group, followed by couple of questions asked for all the groups to evaluate the activity.

3. Trying it out in practice

The activity is planned but not yet implemented.

1.The exercise will start by an introduction on the activity and group organization (each group will consist of 3 students).
2. Within each group, students will be given 5-7 minutes to answer the above mentioned questions.
3. After the discussion within each groups, two groups will discuss for four minutes their answers of the questions they were provided and decide on major keywords as an answer for each of the questions. The results from the groups (6 members) will then be placed on blackboard.
4. A wrap up of the group's answer within the class to make sure that the students totally understood the use of the tool in decision making.
After the exercise, two questions will be asked to the whole class to evaluate the student's understanding and to challenge their (time assigned is 5 minutes).

With your group members, based on the previous lectures and the readings outcome in 5-7 minutes the following questions:

- **Why using marginal abatement cost is important, in which means**
- **Which type of data is needed, how it can be collected**
- **To which extent the data can be accurate**

Later, your group will have 4 minutes to discuss the answers of the above mentioned questions with another group and agree on main answers keyword for each question
Write these keywords on the post notes and then put it on the blackboard after finishing your discussion

Figure 1: Instructions and the list of questions to be distributed on each group.

MAIN POINTS

1. **Main problem/challenge:** different understanding level of tools
2. **Teaching activity**: Group think, pair and share followed by discussion
3. **How did it go?** Expected to have an impact in improving the student's understanding and help them to gain more confidence in discussing their results
4. **What to do next?** Implement the activity and modify it if needed.

The student will be assessed during their discussion through observation, the group answers (monitor the pattern of the keywords used to answer the questions on blackboard). After the exercise, two questions will be asked to the whole class to evaluate the student's understanding and to challenge their (time assigned is 5 minutes): a)Do you think MACC is the only tool for integrated decision-making; b) How to incentivise the farmers to implement the measures.

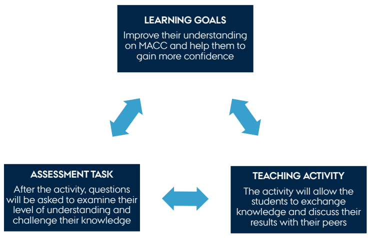


Figure 2: Constructive alignment between 1) Learning goals2) teaching activity 3) assessment task

4. Looking forward

The teachig activity is expected to be successful. In order to improve the activity, the students will be asked to fill in a questionnaire (anonymous) 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

Your name
Research group
Department

Methods in Food Microbiology

- Enhancing student learning

Abstract: Learning and understanding the methods used for the detection, isolation and identification of microorganisms in food microbiology theoretically without practical work in a laboratory could be challenging for students. A teaching activity is designed using strip sequences to help the students understand common terminologies used and the principle behind common methods used in the detection, isolation and identification of microorganisms in food. The activity should give a good overview of the students' understanding of key concepts and provide an overview of areas that are not well understood.

Learning Lab

COURSE FACTS

- Course name: Food Microbiology
- Level: Bachelors
- ECTS credits : 5 ECTS
- Language: Danish (This lecture in English)
- Number of students: 29
- Your role: Lecturer

TEACHING IN PRACTICE

1. Identifying a problem

In this lecture, laboratory methods used in the detection, isolation and identification of microorganisms in food are explained theoretically in the classroom. As the students do not get to practice these methods in the laboratory, the concepts could be difficult to understand. A teaching activity is therefore designed with the aim of helping the students to learn the different methods and understand the principle behind each method.

2. Planning a teaching activity

To help the students understand the methods, a teaching activity based on a strip-sequence is developed. The students will be divided into six groups and they will be tasked with assembling a set of strip sequences by matching the methods to the description of their respective principles. The students will have 15 minutes to complete the exercise. During the exercise, I will walk among the groups, listening to their discussions but still giving them space to do it on their own. Each group will then write down on the blackboard their agreed-upon sequence. From the discussion and answers given by each group, I will then be able to identify which topic/methods that the class is struggling with. I will then give a review of these topics in the next lecture and give a recommendation for specific literature for further reading.

Learning goals

- **Identify** and **describe** common food microbiology methods used in the detection, isolation and identification of foodborne pathogens
- **Explain** the principle behind each method

3. Trying it out in practice

The teaching activity will be carried out towards the end of a lecture introducing common food microbiology methods. This will be before a more advanced lecture where it is important that they understand the principle of these methods and common terminologies used.

Method/Terminology	Description/Principle
A. Selective media	4. Contain compounds that are inhibitory to many other microorganisms but less so to the species
B. Differential media	7. Contain reagents that provide visual responses to the presence of a specific metabolic product/enzyme
C. Major Groove	2. Binding point of most DNA binding proteins
D. Primers	3. Starting point for DNA synthesis
E. Digital PCR	8. Quantitates the expression of genes and does not rely on calibration curves for the detection of sample targets
F. qPCR	1. Monitors and quantitates the expression of genes in real time using non-specific fluorescent dyes or sequence-specific DNA probes
G. PCR	6. Amplification of particular sections of the DNA for detecting the presence/absence of a gene and identification of organisms
F. rep-PCR	5. Generates 'DNA fingerprints' by the use of oligonucleotide primers that anneal to repetitive DNA elements present in eukaryotic and prokaryotic DNA

Figure 1: **Teaching Activity – strip sequence**
The left column contains the methods/terminology that the students should match correctly with the description/principle in the right column

MAIN POINTS

1. **Main problem/challenge:** Understanding principles of food microbiology methods in a theoretical lecture
2. **Teaching activity**: Strip-sequence
3. **What to do next?** Implement the teaching activity in the lecture introducing the methods and principle

4. Assessment of teaching activity: 'Muddiest-point'

Assessment will be done by observing the ease with which the activity is done e.g. how long it takes for each group to complete the activity and the answers/sequences generated by each group. Additionally, at the end of the lecture, students will be asked the 'muddiest point' in the lecture and each student will write their answer on a piece of paper that they will give me as they leave the classroom.
Feedback will be given by sending out relevant literature given the responses and in the next lecture by clarifying the points of confusion.

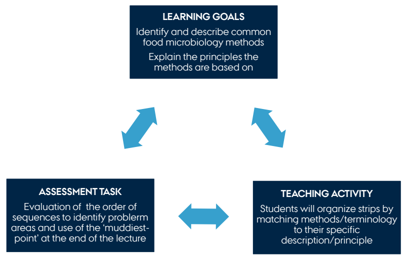


Figure 2: **Constructive alignment**

4. Looking forward

The teaching activity will be implemented in spring 2019 when the course starts. Using strip sequences can be quite useful to gauge the level of understanding of a class. In the next lecture, I will consider feedback from the evaluation of the teaching activity by the students to improve.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Doreen J. Metto
Food Chemistry & Technology
Department of Food Science

Mix and match sequence

- Helping students understand the theory of their lab exercises

Abstract:
Students often underestimate the value of understanding why they are doing the specific steps in a laboratory exercises. The students are therefore to perform a teaching activity. In the teaching activity they need to understand why they are doing each step in the laboratory exercise. This will allow the students to better understand the theory behind the exercise, making it easier for them to perform the exercise, and write the report afterward. The small amount of students that it was tried on, found the exercise helpful.

COURSE FACTS

- Course name: Inorganic chemistry I
- Level: First year students
- ECTS credits : 10
- Language: Danish
- Number of students: 21
- Your role: Lab instructor

1. Identifying a problem

Most of the students, use the laboratory journal as a cookbook. Meaning that they just mix the chemicals that it says, without questioning why they are doing it. If the students are to improve on their laboratory technique it is vital, that they understand what they are doing, such that they can e.g. identify when something is wrong. The aim of this activity is to help the students understand the theory behind the laboratory exercise, and to understand the value of this.

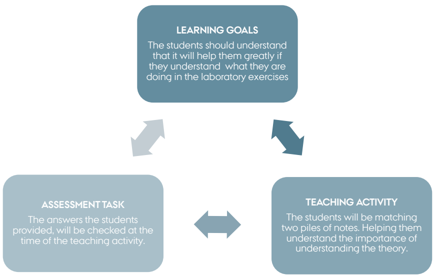
2. Planning a teaching activity

The teaching activity is planed such that the students will have to discuss why exactly chosen steps in the protocol are performed. This will allow the students to match the correct theory with the given step in the protocol. The students are going to discuss why they chose the solutions that they did, making them discuss both the theory and the protocol steps. The hope is that this will allow the students to get an increased understanding of why they are actually doing, what they are doing.

Trying it out in practice

The teaching activity was comprised of five steps:

1. The students are introduced to the teaching activity and why they are doing it.
2. The students are divided into groups of two, and set to start.
3. When the groups finish, they match up with another group and discuss their results. They need to reach a common agreement.
4. When they reach a common agreement, they shortly present their answers and reasoning to the TA. This should preferably be a discussion between all students and the TA.
5. At the next laboratory exercise the students are asked if they thought the teaching activity helped them when writing the report, and if they would do it again if it was voluntarily.



MAIN POINTS

1. **Main problem/challenge:** Students are following the laboratory journal as a cook book, and do generally not understand why they are doing things.
2. **Teaching activity**: The students need to mix and match strips in two piles. One pile will have a step in the journal, another will have the reason they are performing that step.
3. **How did it go?** The teaching activity went well and most students found it helpful.

Assessment

Because of time pressure the teaching activity was only tried out on four students.
A week after the teaching activity was performed, the students were asked the following questions:

- Did the teaching activity help you better understand why you are doing the different steps?
- If yes to (1), did this help you finish the exercise faster?
- If yes to (1), did this help you in writing the laboratory report?

Students were asked separately, and answered yes to all questions asked.

Looking forward

The teaching activity went well. All though a small samples size (4 students), all students agreed that it would definitely be worth it to prepare better. They agreed to this as this would allow them to better understand why the different steps in the laboratory exercise are performed. This allowed them to finish the exercise faster, and have an easier time writing the report of the given exercise.

Anders Märcher
Gothelf Lab
Interdisciplinary Nanoscience Center

Flow chart

- An attempt to promote active learning of students in the lab

Learning Lab

Abstract: The teaching activity presented on the poster focuses on encouraging active learning of students participating in laboratory exercises of the Biomolecular Structure and Function course. The students got a flow chart in the beginning of the exercises that they could use as a help to perform important calculations that they in many cases were not able to solve on their own. The 'ticket out of the door' evaluation showed that many students

COURSE FACTS

- Course name: Biomolecular Structure and function
- Level: Bachelor (2. year students)
- ECTS credits : 10
- Language: Danish
- Number of students: 120
- Your role: TA at laboratory and theoretical exercises

TEACHING IN PRACTICE

1. Identifying a problem

The Biomolecular Structure and Function course introduces 2. year students to the world of biological macromolecules, like proteins, nucleic acids, carbohydrates and lipids.
The laboratory part of the course focuses on kinetics of enzymes. The students have to determine the basic kinetic parameters of the beta-galactosidase enzyme and see, how these change, when inhibitors are added.
When teaching the course last year, I have observed, that many students had problems with performing important calculations needed for the experiments. Because of time pressure, TAs often ended up showing the students, how to perform these calculations.
This challenges students' learning as the learning is only passive and in the long run, they will probably forget, how to perform such calculations.

2. Planning a teaching activity

This teaching activity aims to promote the active learning of students participating in the laboratory exercises. It was planned and carried out by three TAs: Cathrine Kiel Skovbjerg, Simon Boje Hansen and me. We designed flow charts (Fig. 1) that would help the students to perform the needed calculations on their own. The flow charts did not contain detailed instructions on how the calculations should be done, but rather subtle hints that help the students to do the calculations.

3. Trying it out in practice

The teaching activity was performed in week 42. During the introduction to the laboratory exercises, the students got a flow chart per group and they were told that it could be used as a help to perform the calculations, do the experiments or write the report. The students were free to decide, if they need the extra help or not.
The activity was evaluated by an anonymous 'ticket out of the door' questionnaire, where students got an opportunity to express their opinion about the usefulness of the flow chart. They got three questions, shown on Fig. 2A, where they had to mark a number from 1 to 10. Additionally, they had the opportunity to write a comment.
In order to validate the evaluation, another group of students performing the same exercises in the neighboring laboratory did not get the flow charts. In the end of their exercises, they also got a 'ticket out of the door' questionnaire, where they needed to answer three questions (Fig.2B).

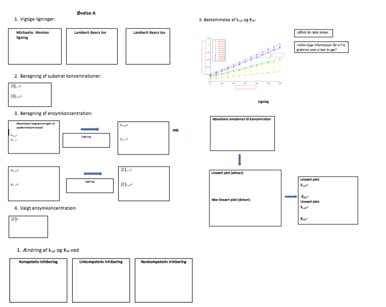


Figure 1: Flow- charts that were handed out to the students in order to help them with calculations and performing the experiments.

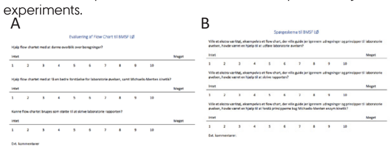


Figure 2: Flow- charts that were handed out to the students in order to help them with calculations and performing the experiments.

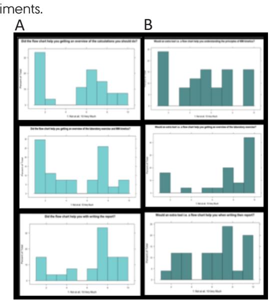


Figure 3: Results of the 'ticket out of the door'. A) Students that got the flow chart, B) Students that did not get the flow chart.

3. Conclusion

The results of the questionnaires show clearly that the flow charts were helpful for many of the students both for performing the experiments and to write the report. There was a group of students that did not use the flow chart at all as they knew exactly, what to do.
Similar results were observed in the group of students that did not get the flow charts. Some students marked that they do not need any extra help for performing the experiments or to write the report, but the rest of the students expressed a wish for some additional help (Fig. 3 A and B).
Concluding, it seems that the flow chart fulfilled its function and promoted active learning in many of the students. We got significantly less questions when compared with the last year exercises and there was no case, where the TAs needed to perform the calculations for the students, because of the time pressure.

MAIN POINTS

1. **Main problem/challenge:**
Problems with performing calculations both under the laboratory exercises and later, when writing the report.
2. **Teaching activity:**
Flow chart with subtle hints that help the students to perform needed calculations on their own.
3. **How did it go?**
The evaluation showed that many students appreciated the additional help.
4. **What to do next?**
The flow chart could be improved for the next year course.

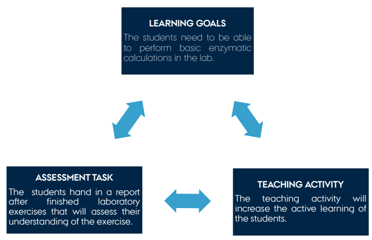


Figure 4: Constructive alignment
Constructive alignment between the learning goals, teaching activity and assessment of the task.

4. Looking forward

Observation of the students working in the lab and the results of the evaluation, clearly show, that the flow chart worked well. The next reasonable step would be to analyze the reports handed in by the students and to expand the flow chart with the most commonly made mistakes. This improved flow chart could be used in the course next year.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Caroline Neumann
Poul Nissen's lab
Department of Molecular Biology and Genetics

Think pair share

- Student activation and learning assessment.

Learning Lab

Abstract: The challenge I am trying to handle is activation of students during the lecture and assessing if the students learn what I intend to teach them. The chosen method is Think-Pair-Share with a small change so instead of only having 2 in each group I will have 3-4. For this exercise the students is asked to reflect on two things from the lecture discuss it in the small groups and finally share it with the class so we can have a short concise plenum discussion. The result of the activity were very positive. The students was activated and both the discussions in groups and the presentations and plenum discussions enabled the assessment of their learning. The final evaluation of pros and cons after the lecture confirmed that student valued the exercise.

COURSE FACTS

- Course name: lean, lean design and lean construction
- Level: Master
- ECTS credits : 5
- Language: English
- Number of students: 14
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

The students in my course is being taught by me in one lecture. The problem is that the students until now have been very inactive in regards of asking questions and participating in discussions. This causes the students to have little reflection during the lecture and disables me of assessing their learning during the lecture.
In order to accommodate the problem the teaching activity: Think-Pair- Share has been chosen.

2. Planning a teaching activity

The activity: Think-Pair Share will have the ability to solve the described problem in by firstly activating the students in four steps: 1. reflection, 2. group discussion, 3. presentation and 4. plenum discussion and secondly, the activation of the students involve discussing and presenting the key elements from the lecture which enables me to asses whether they have understood what I intended to learn them.

The overall learning goals for my teaching activity is to make the students reflect and understand the overall concept being taught but also understand each of its individual elements and how these contribute to the whole.

The concept taught is a project delivery system for construction called Integrated project Delivery which consists of the 5 main elements: Contract, Lean, Culture, Simulation, and ICT.

3. Trying it out in practice

The teaching activity: Think- Pair-Share was structured according to the concept being taught. The Lecture was also structured according to the elements. The teaching activity was used after each element had been presented which meant that the lecture was stopped 5 times. The class was divided into 5 groups who each presented a element. This presentation was then used as a stepping stone for the plenum discussion.

Figure 1: Students discussing a element from the concept

The teaching activity worked really well and it was both a god way of activating the students and assessing their learning during the lecture.

To improve the activity, time used on the activities should be management tighter (I forgot to time it) and the teaching should only be used 2 or 3 times during the lecture (see 4. looking forward, for elaboration)

MAIN POINTS

1. **Main problem/challenge:** Student are passive and I need a way to asses learning.
2. **Teaching activity**: Think pair Share.
3. **How did it go?** Very good – the students engaged actively in the activity which enabled the assessment of their learning
4. **What to do next?** This teaching activity will definitely be an integrated part of future lectures

The final evaluation of this teaching activity in relation to constructive alignment shown in figure 2 is that it was a success. The learning goals (concept and 5 elements) was well supported by the activity and enabled me to asses the student learning during the class. In all the activity supported a well balanced constructive alignment for the lecture.

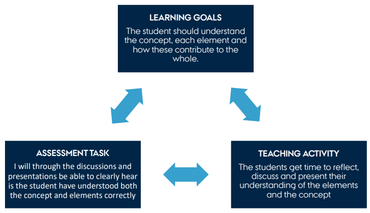


Figure 2: **Constructive alignment**

4. Looking forward

The teaching activity worked really well and it was both a god way of activating the students and assessing their learning during the lecture. The students were very engaged in both group discussions, presentations and plenum discussions

To Improve the exercise in the future two things should be changed: firstly, a strict time scheme for the different parts of the activity would be a improvement. I realized that time flies when a really good discussion is going on and even though the output from the discussions were good, time is taken away from just as important parts of the lecture and secondly, instead of using the teaching activity 5 times in one lecture this could easily be reduced to two or three. This would also reduce the time consumption and probably provide the same output.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Hasse H. Neve
Construction Management
Department of Engineering

Muddiest point with group discussion

- Identifying, clarifying and summarizing

Learning Lab

Abstract: The teaching activity "Muddiest point", where questions are collected from the students, were combined with group discussion and presentation for the class. The problem was dual: to address was lack of repetition in the course and passive students. The activity was positively evaluated and will be repeated in a slightly modified form at the end of the semester. In conclusion the activity helped solve the addressed problem.

COURSE FACTS

- Course name: Inorganic Chemistry I: General Chemistry
- Level: First year BA
- ECTS credits : 10
- Language: Danish
- Number of students: 20
- Your role: TA at TØ

TEACHING IN PRACTICE

1. Identifying a problem

In Inorganic Chemistry I: General Chemistry the TØ sessions mainly consists of students going through exercises with one student at a time presenting these at the board and the rest of the class asking questions. Not all students participate in the class, i.e. go to the board or ask questions – especially the weak and/or shy students are passive. Furthermore not much time is generally spend on reviewing the topics from previous classes. Thus it could be beneficial to address the parts of the curriculum which the students find difficult again by summarizing and clarifying the topics to make sure the students have obtain understanding of the topics. This should be done in a way that activates all the students.

2. Planning a teaching activity

I want to collect questions from all of the students to reveal the hard parts of the curriculum. This can be done by "muddiest point", where all students hand in a question at the end of a session. I would like the students themselves to the answer for the questions they have posed. This way they will train their abilities to talk about and explain chemical concepts to their peers as well as gain a better understanding of the discussed topics. I will do this by having the students in small groups in class, where they will discuss some of the questions in each group and then explain these answers to the class. This way hopefully all students will participate and gain from the teaching activity.

3. Trying it out in practice

The activity was initiated by collecting questions from all the students in the end of a TØ class. The students were asked to write a question to a part of the curriculum which they don't understand or find difficult. The question should be as precise as possible. I then reviewed and sorted the questions. Some of the questions regarded a part of the curriculum which so far have only been address in the lectures, and not in TØ, so these I saved for a later session (and told the students we will address these again later).
The rest of the questions were grouped in two types: pH/equilibrium calculations and general questions. I wrote the questions into a padlet.

Figure 1: QR code for the padlet
Have a look at the padlet used for the teaching activity by scanning the QR code. Here both the students questions and the groups answers can be seen.

In class the students were put into 5 groups of 4 students, and each group were given two questions; one from each of the question types.
The group were then given 15 min to discuss and answer their two questions in the padlet. During the discussion time I went around the class to help and guide in answering the questions and obsvered that most students were active. Afterwards the groups' answers were presented for the whole class, which took approx. 20 min in total.

4. Looking forward

I will repeat the activity with small alternations at the end of the semester. I will aim at giving the students a bit more time for the activity the next time, as they asked in the evaluation. But it might not be possible because of the time pressure of the course. I think this activity helped my students learning.

MAIN POINTS

1. **Main problem/challenge:** Identifying, clarifying and summarizing difficult parts of the curriculum and activating the passive students
2. **Teaching activity**: Muddiest point combined with group discussion and presentation
3. **How did it go?** The students liked and learned from the activity
4. **What to do next?** I will repeat the activity in a slightly modified form at the end of the semester

> I liked to get explanations from my peers
>
> -Student

At the end of the class, the activity was evaluated by a questionnaire, where the students answered the questions: "Did you benefit form the teaching activity?", "Which topics do you understand better now?" and "What could have been done differently to maximize your benefit from the activity?". The evaluation of the activity showed that most of the students feel they benefitted from the activity (Figure 2). The questionnaire also showed that most students got a better understanding of pH/equilibrium calculations or all of the addressed topics. So the activity must be considered a success. The students generally proposed that more time should be spend on the activity the get more in depth with the answers.

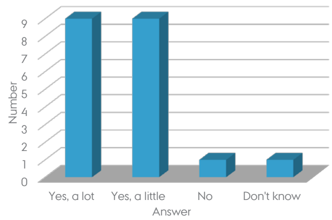


Figure 2: Evaluation of the teaching activity.
Answers to the question "Did you benefit form the teaching activity?", show that most students felt they benefitted from the activity.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Department of Chemistry

Kodo-Python Lab

- A real world introduction to Random Linear Network Coding

Learning Lab

Abstract: Students tend to become inactive when presented with concepts that are hard to understand. In the topic of RLNC, this is a common observation. To counter the problem, a set of exercises, giving a practical perspective on RLNC used in distributed data storage, will be presented. A graphical method is used for self-assessment, namely encoding and decoding of a picture of Pikachu. This is expected to activate the students and give them a better understanding of how RLNC can be applied in distributed data storage. The implementation of the teaching activity resulted in a higher activity among the students and an increase in the students' insight in RLNC applied to distributed data storage. However, due to technical problems with the computer setup, some students could not finish the exercises within the allocated time. Therefore, an extension for hand-in deadline was needed. From the hand-ins it was apparent that a few students had not put enough effort into the assignment.

COURSE FACTS

- Course name: Distributed Storage
- Level: Master
- ECTS credits : 5
- Language: English
- Number of students: 9
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

In lectures and TØ, we see that students are inactive. According to the students, this is due to the complexity of the subject (RLNC) taught. Therefore, it is crucial to make the subject easier to understand and engage the students to get a better understanding of the concepts of RLNC.

2. Planning a teaching activity

To ensure that the students are properly prepared for the task at hand, a lecture about the general topic and setup for the exercise is to be given. Being prepared is expected to motivate the students to be more active.
During the exercise, the TA should be present and ready to answer questions so that students does not get stuck.
The students are supposed to do self-assessment by reflecting on the assignments and by reaching the goal of decoding the picture they have encoded.

3. Trying it out in practice

At the beginning of the lecture, the students were informed about the purpose of the lecture, namely that it was to aid them in conducting the exercises. Then, the setup of Kodo-Python was explained, and a practical example was given. This resulted in a visible increase in both focus and activity from the students.
Then the students were given the exercise, and again they seemed motivated and engaged. Some students had trouble with the technical setup, which clearly made them frustrated. However, they seemed eager to solve their problems and get on with their assignments.
After the exercise session, we expected the students to finish the exercises at home and produce a hand-in which the TA would assess.
Between the exercise session and the hand-in deadline, multiple students had question with regards to RLNC and distributed data storage, which reflected good understanding of RLNC.
All students handed-in the assignments and, in general, showed a good understanding of RLNC, though with room for improvement. Most students saw the benefits, however had trouble identifying the limitations of RLNC.
It is our impression that the students achieved a better understanding of RLNC a higher activity level compared to previous students. This was also reflected in the assessment from the students of the learning activity.

MAIN POINTS

1. **Main problem/challenge:** The students does not participate actively in the TØ.
2. **Teaching activity**: Classroom lecture and exercise session with self-assessment.
3. **How did it go?** Students showed an increase in activity and a better understanding of the subject.
4. **What to do next?** Make sure that the exercise setup works as intended.

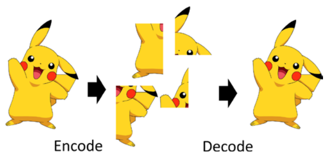


Figure 1: Illustration of how encoding divide data into multiple pieces and decoding construct the original data from these pieces.

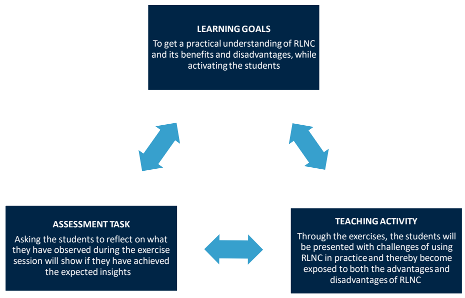


Figure 2: Constructive alignment

4. Looking forward

A lot of the students had issues with the technical setup. Therefore, future preparations should include making a more error proof setup.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

René Arendt Sørensen & Lars Nielsen
Beumer Group & Communication Systems
Department of Engineering

Laboratory exercise in general chemistry

- Helping students to improve their skills in the lab

Learning Lab

Abstract:

Learning how to plan and execute an experiment in the inorganic chemistry lab is an essential part of this cause. It is therefore important that the students learn good laboratory practice. However, it can be difficult for the students to know how they perform the exercise in the most efficient manner, and to realise where they can improve. Encouraging the students to focus on how to optimise their own routines and helping each other by sharing experiences can hopefully help them overcome this challenge.

COURSE FACTS

- Course name: Inorganic chemistry 1: General chemistry
- Level: First year bachelors
- ECTS credits : 10
- Language: Danish
- Number of students: 24
- Your role: Lab instructor

TEACHING IN PRACTICE

Identifying a problem

When students starts working in the lab they often lack the overview of how to best preform a given analysis. Therefore bad habits and poor practice might occur without the student realizing it. This will affect their results and cause large derivations. Furthermore, the students are often unable to identify where the error occurred causing great frustration. This teaching activity aims to help the students overcome these issues.

Planning a teaching activity

As the students are not all performing the same exercise at the same time, it can be difficult to plan a common teaching activity. However, this teaching activity is designed to utilize this obstacle as an advantage. The students are asked to pay attention to different things during the exercise. At the beginning of the next exercise they will share their observations with their peers, and chare tips and trikes on how to improve the execution of the exercise with another group.

In the activity, the students will be developing their skills in the lab. They will focus on how to improve the execution of the exercise. Furthermore, they will practise how to plan an exercise, and communicate in a precise manner how to execute the analytical methods. In this way, the teaching activity is design to help the students fulfill the learning goals.

Execution in practice

The teaching activity is conducted over two course days.

Cause day 1:
Students are introduced to the teaching activity, and asked to focus on the following during the exercise:

1. Where did we make mistakes and how could they be avoided?
2. Did we perform the exercise in the most efficient manner (order of the different steps) or where could it be changed?
3. Could we have done anything to obtain higher precision of the analysis?
4. Other tips and tricks to perform the exercise in the most efficient and precise manner.

They will receive a piece of paper with the questions given above and room to answer them. This paper must be included in their report for asessment.

Couse day 2
Before they begin performing the exercise, half of the students will go to the exercise they performed on cause day 1. Here they will provide their answers the to the students who are performing this exercise on cause day 2. (they are given 4 min to talk)
Afterwards the groups switch so the first half will receive answers they can use during the exercise on day 2. In the report they will include the answers they received, and state if/how they felt that they the exercise was helpful.

MAIN POINTS

1. **Main problem/challenge:** Students lack overview and basic skills in the lab
2. **Teaching activity:** The students will evaluate their own laboratory work, and share experiences of how to improve the execution of the exercises and good laboratory practice.
3. **How did it go?** The teaching acivity have not yet been performed in practice
4. **What to do next?** For future lessons the students are encouraged to continue focusing on improving their skills, and to learn from each other

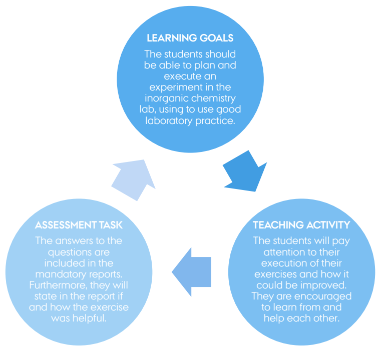


Figure 1: **Constructive alignment**

Looking forward

As it has not ben possible to try the teaching activity in practice, it is difficult to say if it will be successful. It is important to evaluate if it is helpful for the students. This will be done by observing the students in the lab, talking with them during the exercises to help them reflect on the work process, and considering the answers they state in their reports. The questions can be altered if it is found no be necessary.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Nanna Louise Nielsen
Gothelf Lab
Interdisciplinary Nanoscience Center

Comprehending DNA origami and lab procedures

- What, why, and how?

Learning Lab

Abstract: For untrained High School students in particular, laboratory protocols and the theory behind are often found difficult to grasp as they lack the necessary experience and theoretical understanding. Therefore, a teaching activity with the design of a strip sequence was used to provide the students with a broader understanding of the theoretical background, each step in the protocol while also working as a tool to help them solve the necessary calculations during the experiment. This should ensure the same fundamental basis for all students. The teaching activity was evaluated by the students as a good and valuable tool and should be implemented as a standard assignment.

COURSE FACTS

- Course name: DNA origami visiting service
- Level: 3rd year High School students
- ECTS credits : 0
- Language: Danish
- Number of students: 4
- Your role: Instructor

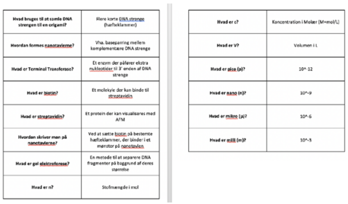
TEACHING IN PRACTICE

1. Identifying a problem

The students participating in visiting service have very different background, as they come from different High Schools, and have different study programs. Furthermore, they haven't had any teaching in the subject before or experience with the laboratory procedures. They tend to follow their protocol without thinking about what they actually are doing and why.

2. Planning a teaching activity

The teaching activity is designed to help the students obtain a better and broader understanding of the theory behind each step in the protocol and a better overview of the protocol. Furthermore, it will help them solve the calculations that are needed in order to complete the experiments. To accomplish this, the teaching activity will be a strip sequence where the students need to combine the questions with the right answers.



Hvad bruges til at samle DNA strengen til en origami?	Flere korte DNA strenge (hæfteklammer)
Hvordan formes nanotavlerne?	Vha. baseparring mellem komplementære DNA strenge
Hvad er Terminal Transferase?	Et enzym der påfører ekstra nukleotider til 3' enden af DNA strenge
Hvad er biotin?	Et molekyle der kan binde til streptavidin
Hvad er streptavidin?	Et protein der kan visualiseres med AFM
Hvordan skriver man på nanotavlerne?	Ved at sætte biotin på bestemte hæfteklammer, der binder i et mønster på nanotavlen
Hvad er gel elektroforese?	En metode til at separere DNA fragmenter på baggrund af deres størrelse
Hvad er n?	Stofmængde i mol

Hvad er c?	Koncentration i Molær (M=mol/L)
Hvad er V?	Volumen i L
Hvad er pico (p)?	10^-12
Hvad er nano (n)?	10^-9
Hvad er mikro (µ)?	10^-6
Hvad er milli (m)?	10^-3

Figure 1. Example of the teaching activity. The left columns represents the questions, and the right columns represents the answers they need to combine with the right questions.

3. Trying it out in practice

The teaching activity is carried out during High School SRP visit. We will start by giving them a short introduction to the experiment, laboratory safety rules and how to pipet. After that, they will start the first step of the experiment, followed by a more thorough introduction while the samples are incubating. After the introduction, the students will work individually on the teaching activity and then discuss their results in pairs before discussing it in plenum. The instructor will ask relevant and engaging questions to make the students think rather than guess and give hints or feedback if necessary. They will continue on to calculating the volumes they need to use during the experiments with their new knowledge from the teaching activity.

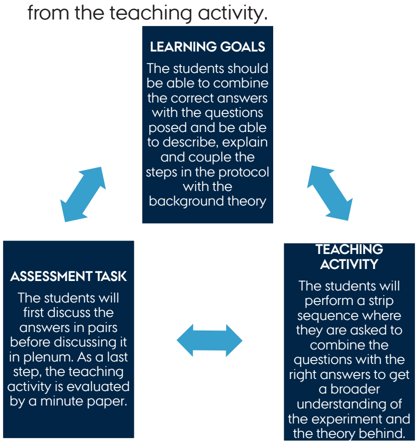


Figure 2: Constructive alignment

MAIN POINTS

1. **Main problem/challenge:** Lack of theoretical background for. understanding the experiment and the calculations.
2. **Teaching activity**: Strip sequence to help them understand the experiment and each step in the protocol as well as the calculations needed during the experiment.
3. **How did it go?** Overall a successful teaching activity fulfilling the aims.
4. **What to do next?** Implement the teaching activity at every

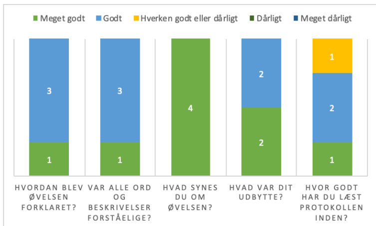


Figure 3: Evaluation of Teaching Activity. The students evaluated the teaching activity as a good and valuable tool to give a broader understanding of the experiment and to help them solve the calculations during the exercise.

The students responded well towards the teaching activity and the majority found it helpful to obtain a broader understanding of the experiment, each step and the calculations during the experiment.

4. Looking forward

The teaching activity worked as planned by providing the students with a good and valuable tool to gain a broader understanding of the experiment, the protocol and to help them solve the calculations during the experiment. This allowed the students to execute each step during the experiment as best as possible while learning about DNA origami and laboratory procedures at the University. The teaching activity should be implemented as a standard step during the laboratory exercise due to the positive evaluations.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Sarah Kroer
Jørgen Kjems Group
iNANO

Active learning

- Increasing the activity of every student in the classroom

Learning Lab

Abstract: Active learning strives to involve students more directly during the teaching process. Active learning can enhance the learning outcomes of the students. An issue with regular TØ session is that only a few students are involved directly. I have implemented jigsaw based teaching to increase the activity of every student in class.

COURSE FACTS

- Course name: Calculus Beta
- Level: 1st year bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 10-18
- Your role: TA in TØ sessions

TEACHING IN PRACTICE

1. Identifying a problem

In Calculus the TØ sessions are normally based on teaching on the blackboard, where a few students usually presents their problem solutions. This means that most of the students are inactive for a long period of time. Increased activity is something that can help each student in their learning process. The problems is how to activate an entire classroom of students to enhance everyone's learning outcome.

2. Planning a teaching activity

In order to try and make activate every student in the classroom I have implemented a Jigsaw/matrix exercise (fig 3).

Every week the students are asked to solve a number of problems on their weekly agenda. I made up 4 groups of students with 4 members in each (if 16 in total). Each group was assigned specific problems from the weekly agenda. These groups were called 'expert groups' as they were given 45 minutes to become 'experts' in these problems. They did that by going through and discussing the problems. After 45 minutes the groups were reshuffled into 4 new groups with one member from each of the 'expert groups' in every group. During the last 45 minutes every group member presented their expert solution for the other 3 members. This exercise makes sure that every students gets to discuss and present some problems. The small groups could also make it easier for the students to engage in discussions.

3. Trying it out in practice

For evaluating the effect on students activity I made an evaluation before and after the activity with the same questions (see fig 1). In the evaluation they were told to rate their own activity and how many times they present a problem, etc. Before the activity they were ask to base their evaluation on regular TØ and after the activity the evaluation was based on the activity itself.

In order to help the student to engage in discussions and presenting the problems, I used additional, mobile whiteboards in the classroom so that each group had a whiteboard to use.

Hvor ofte præsenterer du et problem ved tavlen foran én eller flere af dine medstuderende?

0 (aldrig)	1-2 gange	3-4 gange	5 eller derover

I hvor stor del al TØ timen kigger du på andre studerende præsentere deres løsninger?

Mindre end 1/4	Mellem ¼ og ½	Mellem ½ og ¾	Mere end ¾

Hvor ofte engagere du dig i en diskussion, eller stiller spørgsmål, til dine medstuderende der præsenterer?

Aldrig	Sjældent	Ofte	Hele tiden

Vurdér dit eget aktivitets niveau

Meget lidt aktiv	Lidt aktiv	Aktiv	Meget aktiv

Fig. 1 student evaluation

In order to align the general learning outcomes, from the weekly agenda, I made sure that every expert group had at least one problem from every topic on the weekly agenda.

In order to asses the learning outcome I made a simple two question quiz related to the weekly topic. The students were asked to answer the quiz with 2 minutes for both questions.

12 out of 16 students were able to get the questions right, which is a pleasing result. The assessment was fairly easy and short, so I do not state that it is a complete assessment, but it was a good indication on the learning outcomes.

MAIN POINTS

1. **Main problem/challenge:** Raising the activity level
2. **Teaching activity**: jigsaw
3. **How did it go?** Success
4. **What to do next?** Try and use it more

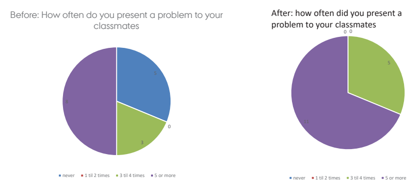


Fig 2: Evaluation question 1 before (left) after (right) teaching activity.

The evaluation, fig 2, showed that the activity helped some of the students that never present problems to be more active in this regard.

One difficulty with this activity is that it can become very chaotic to organize, as students have to group and regroup and all be at whiteboards etc.

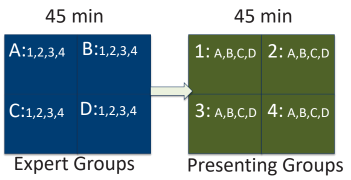


Figure 3: **Jigsaw groups**
On the left: expert groups, with members (1,2,3,4) in each. On the right are the presenting groups where all members assigned 1 group and 2 group and so on.

4. Looking forward

Based on the evaluation, I find that the group of students that never presented their solution to other students, were at least presenting 3-4 times during a session, which is a successful effect. I think that the students were pushed to engage in more discussions than usual, which is also positive. In the future I would like to work on the organization of the activity, as it can easily become chaotic to a point where it is distracting. To have better organization with the groups, whiteboards, etc. would make it less chaotic.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

How many moles?

- Practice makes perfect

Learning Lab

Abstract: In Nanoscience studies we work with particles within the nanoscale range. It is known that DNA can be programmed to self-assemble into various structures. This is referred to as DNA origami. For this to occur, only the right stoichiometry of DNA strands will give the correct nanostructure. To perform laboratory experiments, it is essential that high school students participating in Visiting service at iNANO have basic understanding of what "amount of substance" is and how to calculate volumes, concentrations etc. within the nanoscopic scale. In this teaching activity, students will be introduced to the concept of "amount of substance" and trained to solve problems regarding calculation of volumes and concentrations using very small numbers.

COURSE FACTS

- **Course name:** Visiting service - Origami exercise
- **Level:** 3rd year high school students
- **ECTS credits :** None
- **Language:** Danish
- **Number of students:** 4
- **Your role:** Organizer and lab instructor

TEACHING IN PRACTICE

1. Identifying a problem

Students participating in Visiting service events are mainly from high school and thus have different theoretical background in basic mathematics and chemistry. Based on previous evaluations and former TAs, the students are highly challenged when it comes to understanding the concepts of "amount of substance" and "mols" as well as converting between mol to nmol or pmol. The ability to understand these concepts and applying them to calculate different parameters is essential to execute the lab exercise.

2. Planning a teaching activity

The teaching activity aims to improve the students' understanding of the concepts of "amount of substance" and to help them get more familiarized with the formula: c=n/V, which is vital in almost any laboratory working with chemicals or other solutions. Since the students are at a Nanoscience Center, obviously, we work within the nanoscale range, thus this teaching activity also focus on explaining the students how to perform mol unit conversion.

This will prime the students for calculating volumes for their lab exercise where the precise stoichiometry of DNA oligonucleotides is essential to obtain correct origami structures.

3. Trying it out in practice

Initially, the agenda of the day was presented and so was the first step of the protocol which was carried out immediately due to time restrain.

During the waiting time, students were introduced to the concepts of "amount of substance" and "moles" and the formula c=n/V. Students were working in pairs of two to solve the exercises dealing with real-life lab problems suchs as calculation of volumes or concentrations in submolar range (micro, nano, and pico). The last three exercises were relevant for the subsequent experiments they had to execute.

$1\ nmol = 1 * 10^{-3} \mu mol$

$1\ nmol = 1 * 10^{-9}\ mol$

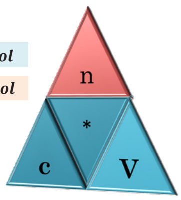


Figure 1: Useful formula for calculation of concentration in molars. The amount of substance is given by the concentration in mol/L multiplied with the volume in L.

The correct answers to the TA exercises were discussed in class. Evaluation of the TA was done by using a one-minute paper (Fig. 3). The response on the exercise from the students was positive and the majority of them found it useful to do the exercises.

Based on the assessment and evaluation, the activity can be improved by incorporating some more difficult questions/exercises for the well-prepared students.

MAIN POINTS

1. **Main problem/challenge:** Lack of understanding of the concepts of "amount of substance" and the ability to convert between mols to nmol/pmol.
2. **Teaching activity**: A piece of paper containing different exercises that must be solved by using the formula: c=n*V.
3. **How did it go?** Good. Students found the TA useful.
4. **What to do next?** Implement the TA in future Visiting service – origami exercise and make some more difficult exercises.

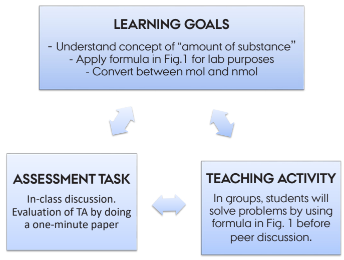


Figure 2: Constructive alignment.

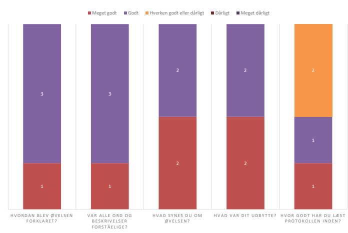


Figure 3: TA evaluation by students. The students overall evaluated the TA as a good and useful exercise.

4. Looking forward

The execution of the TA went good with positive feedback from the students. Student learning was improved by initially being presented to some formulas and performing some exercises before calculating volumes/concentrations for their actual lab exercise. Students that were prepared found the TA performed the exercises with no difficulties in contrast to those who were less prepared.

I hope this could be implemented in each Origami exercise to aid future students in having a better understanding of amount of substance and why it is essential for making DNA origami structures. For the future, there could be more complicated exercises for those students who need more challenge.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Marjan Omer
Group of nucleic acid technology
Interdisciplinary Nanoscience Center (iNANO)

Activity clock

a comprehensive time list for organizing field teaching activities

Learning Lab

Abstract:

Field activities integrating different tasks and procedures can be confusing. This affects both the achievement of learning outcomes as well as the development of subsequent activities. The coordination between the different protocols and the organization of the times assigned to the work of the groups is fundamental for a good realization of the teaching in the field. To achieve this goal, an activity clock is proposed: a comprehensive list with times assigned to the field activities that must be organized by the students. This practice tend to improve the organization of multiple activities in teaching activities in field, by promoting a greater autonomy and awareness on the active teaching process.

COURSE FACTS

- Course name: Flora and Fauna Identification in Freshwater
- Level: MsC PhD
- ECTS credits : 5
- Language: Eng - Dan
- Number of students: 20
- Your role: TA in sampling methods and lab activities

TEACHING IN PRACTICE

1. Identifying a problem

During field activities of the course, students have to carry out multiple sampling in an organized manner. Until now, students received different protocols for each sampling and a previous talk explaining the order and duration of activities. The problem that was evidenced is that the students generally mixed the activities or did not assign the correct time to each one, making it difficult for them to maintain the general vision of the process. Consequently, teachers had to continually review the development of activities of student groups, and indicating the changes and the order of activities each time.

Figure 1: Biology students during field, clearly confused, trying to remember the order of different sampling activities in a lake

This limited the focus of the students on the activities, and did not involve them in the development and temporality of the activities, restricting them to a passive role in the teaching activity.
The challenge is that students are able to develop field activities in a conscious and autonomous way, being able to follow the order and extension of them easily.

2. Planning the teaching activity

The activity aims to engage students in the organization of the sampling process, fostering on each activity, its order and timing. Try to make easier for the student to keep the focus on the activities and reduce the mental load about order of activities. On the other hand, it is expected to increase the teaching capacity to interact with groups besides the organization of activities.

3. Trying it out in practice

In a comprehensive list of activities with a clock format, students must organize the logical sequence based on sampling protocols and previous talk.

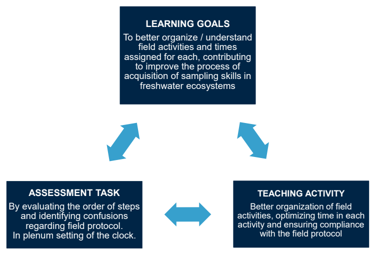
Each activity is organized in a starting at 0 0'clock, and have a size associated with its duration. This allows the student to know in addition to the order of the activities, how much time must assign to each one. This activity will reduce the idle time of the student favouring their concentration and mind (and not just hands) in the process.

In the initial talk, the groups are instructed to order the clock based on the protocols and the explanation of the different samples. After a set time, the clock is corrected in general and sampling begins.

MAIN POINTS

1. **Main problem/challenge:** Sampling activities organization and time
2. **Teaching activity:** Activity clock list
3. **How did it go?** To be implemented in the next edition of the course (Aug 2019)
4. **What to do next?**

+ Try to practice it with a small group of student volunteers.
+ Evaluate the contribution of the activity with respect to the previous edition of the course



Future assessment:
at the end of the field practice, by general discussion, asking the groups about how the clock was used to organize the activities. Any suggestions about how to improve the practice will also be asked.

4. Looking forward

In the previous edition of the course, the existing problem in the field activities was recognized. In the future edition (Aug 2019) this activity will be applied and evaluated. Feedback from students and teachers will be used to improve the activity.
It is planned to practice the activity with a group of student volunteers before its implementation in the course.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Juan Pablo Pacheco
Lake Ecology Group
Bioscience

Extended strip sequence

Preparing students for laboratory work and teach them to think about underlying mechanisms of protocol steps

Learning Lab

Abstract

Laboratory exercises is a great way to encourage student learning and understanding of molecular and biophysical mechanisms observed in e.g. different food matrices. Student learning is enhanced if students are prepared for the laboratory exercise, so they do not just focus on the practical matter of the exercise, but have the surplus energy to think and discuss the theoretical background. With the extended strip sequence activity, before starting the laboratory exercise, students will get an overview of the practical work in the laboratory and discuss molecular mechanisms underlying the main steps of the protocol, giving the students an improved basis for comparing observed results with theory. The activity has not yet been implemented.

COURSE FACTS

- Course name: Fødevarer på Molekylært Niveau
- Level: Bachelor's degree
- ECTS credits : 10
- Language: Danish
- Number of students: 8
- Your role: TA during laboratory exercises

TEACHING IN PRACTICE

1. Identifying a problem

Unprepared students for laboratory work is not uncommon, as students tend to think they have time in the laboratory to read and understand the protocol. The problem with this, is that students then only focus on the practical work they have to do, and therefore do not have the time or surplus energy to correlate the exercise with the theory from the lectures. The aim is therefore to get prepared students, which will get much more out of the laboratory exercise and be able to discuss the observed molecular mechanisms lying behind, being one of the main learning outcomes.

2. Planning a teaching activity

During the activity "extended strip sequence", the students have study the protocol, if they have not read it already. They do not only get an overview of the work they are going to do, but also *why* (which is the extended part) they are doing the different things, as well as they have to correlate it to theory from the lectures. The learning goal is therefore for the students to reflect about steps in the protocol, preparing them for doing the laboratory work with the theoretical background in mind.

3. Trying it out in practice

At the beginning of the laboratory exercise the students are asked to pair up and do the teaching activity "extended strip sequence". All pairs get two set of strips, one set numbered 1-5 and the other A-E. The set numbered 1-5 includes five main steps from the protocol, which the students should order in the way the steps should be carried out in the laboratory. The strips A-E are statements about what happens in a protocol step or why the step should be done. Now statements A-E are paired up with the strip sequence 1-5.
The students get 5-10 minutes to discuss the right sequence and answers. 5 minutes should be enough, if students are well-prepared for the laboratory exercise.

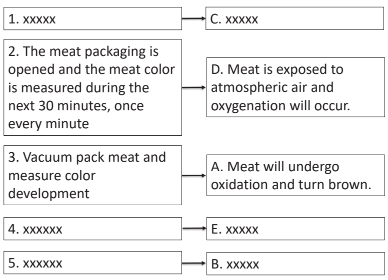


Figure 1: Extended strip sequence
Example of strips, regarding a lab exercise in meat science.

The teaching activity is assessed by a small classroom discussion, where all groups should tip in, which should be possible, as the total number of students in this class is 8.

MAIN POINTS

1. **Main problem/challenge:** Unprepared students for laboratory work
2. **Teaching activity**: Extended strip sequence
3. **How did it go?** Not yet implemented
4. **What to do next?** Implement teaching activity

After the laboratory exercise, an oral recap of the day is performed in class. Here, students will be asked whether the teaching activity in the beginning of the lesson helped them during the day to both know what they should do and why. This is done by a "ticket-out-the-door"-evaluation, asking the two following questions:
- "Did the activity help you understand how the laboratory work should be carried out?"
- "Did the activity help you understand why different protocol steps was performed?"

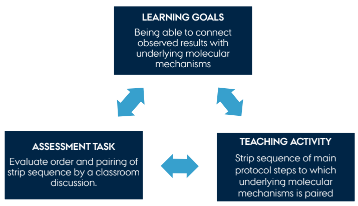


Figure 2: Constructive alignment
Illustration of the interplay between teaching activity, learning goals and assessment task.

4. Looking forward

As I did not have the chance to implement the teaching activity yet, this will be the forthcoming goal. I am especially eager to see whether the activity will help the students get better through the laboratory work and if it will support them in theoretical discussion during the work, preparing them better for the report writing.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Your name
Research group
Department

Filtering Information from Spectra

- What are the most important signals?

Learning Lab

Abstract:

Learning to solve spectra in the structural chemistry I course is also the main learning goal of the course. In these spectra the students find a some times overwhelming amount of signals to interpret, and this can be challenging for many. Learning to filter the less important from the important signals is the goal of this teaching activity. The students will match paper scraps consisting of central questions to the course and answers to these, in order to know what to look for first when solving spectra. The students were positive about the activity, saying that it was a great way to start class. Future improvements would include a better assessment option than the oral assessment presented here.

COURSE FACTS

- Course name: Structural Chemistry I
- Level: Bachelor
- ECTS credits : 5
- Language: Danish
- Number of students: 22
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

In the course, Structural Chemistry I, it is evident that new students solve their spectra either very slowly or incorrectly, which could be due to the amount of spectral information they receive, which perhaps is too much. If they instead learned what are the most important signals and what to look for first, I believe time usage per spectrum would be significantly reduced as well as an increase in the amount of correct solutions.

Furthermore implementation of "quick thinking" is also desirable as they should get used to quickly link signals to answers.

The students would learn quick thinking and to filter the unnecessary information.

2. Planning a teaching activity

The teaching activity consists of 20 paper scraps of central questions that one must ask oneself during spectra-solving. Another bunch of 20 paper scraps hold the answers to these central questions, and the students are set to pair these answers with the correct questions in groups of 3-4. In addition a time limit of 10 min is set, so the students would have to think quickly. This activity will introduce a new guideline for thinking when solving spectra, as they from now on can ask themselves these questions when solving spectra. Furthermore the time limit of 10 min will make them improve their "quick thinking".

3. Trying it out in practice

The teaching activity was conducted in groups of 3-4 persons. In the start of class the activity was explained along with its purpose. Every groups was handed a bunch of paper scraps like shown in figure 1 below, and the 10 min time was begun. During the exercise helping was provided for anyone who did not understand the question or answer, but there was no help provided for solving the pairing of questions with answers. It seemed as all students were heavily focused and involved in group discussion regarding the exercise. After the 10 min had run out, each group was checked for correct answers, and an explanation

Figure 1: The paper scraps used for the exercise consisting of 20 answers and 20 questions.

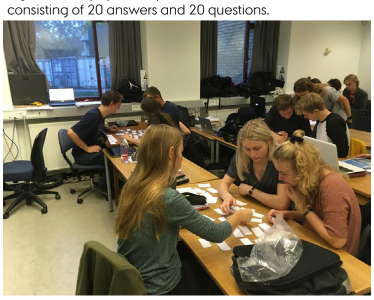


Figure 2: Structural Chemistry I students during the teaching activity.

MAIN POINTS

1. **Main problem/challenge:** Filtering information from spectra, what to look for.
2. **Teaching activity**: Matching paper scraps.
3. **How did it go?** The students understood the task and had fun while carrying out the exercise.
4. **What to do next?** Implement the exercise as a start-up activity to prepare the students for actual spectra

The 5 different groups scored between 16 to 4 correct pairs of paper scraps, and assessment was carried out orally. The feedback was surprisingly positive even for the lowest-scoring team. They found it "hyggeligt" and explained that it was a nice start of the class to prepare them for the actual class exercises. They found the time limit a bit stressing, so maybe this could be increased. Lastly the students received my questions and answers for their own use in future.

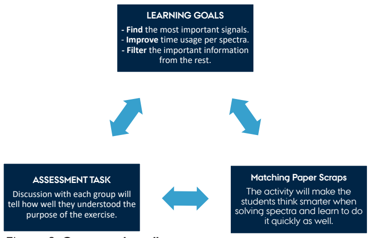


Figure 3: **Constructive alignment**
The connection between learning goals, assessment task and the teaching exercise.

4. Looking forward

The exercise worked very well based on the oral feedback from the students. In future this exercise could be implemented as a start-up activity to ready the students for the actual spectra solving and to give them a broader idea of what are the most important signals and what they mean.

Future improvements could be to make an online assessment option, in order to get a better feedback also from the students who could be afraid to openly criticize the activity. In addition the time limit could be increased, so the students having difficulties with the course would have more time to think.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Simon Steffen Pedersen
Group 107 / Troels Skrydstrup
iNANO

Using a fish-bowl-like activity to engage discussions among students

Learning Lab

Abstract: It has been noticed that students do not often engage discussion about unclear concepts during exercises. This fish-bowl-like activity involves the students in discussing topics considered unclear. This seems to help the students to not only identify the not-understood concepts, but also to engage discussions that help to

COURSE FACTS

- Course name: Fysisk Kemi I
- Level: Bachelor
- ECTS credits : 10
- Language: Danish/English
- Number of students: 15
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

As teaching assistant, I realized that during the theoretical exercises many doubts were not openly shared: this precludes the possibility of open discussions, which are very useful in answering unclear questions and doubts. The aim is therefore to help the students to firstly identify these doubts and secondly to engage discussions among peers that aim to solve the before mentioned doubts.

2. Planning a teaching activity

The planned teaching activity is a Fish-bowl-like activity where students write concepts that are not completely understood in pieces of paper that are later inserted into the bowl. The TA makes sure to also insert some concepts that he/she believe to be important: this gives more control to the activity. The students are then divided into groups that will extract a piece of paper from the bowl. Each group will then discuss and try to explain the fished concept in the best way possible, including all the believed-essential points. While a group is explaining, the TA writes on the blackboard a list of keyword/keyconcepts identified by the group. If some of the important keyconcepts are missing, the TA will try to initiate a guided inter-group discussion which aim is to find the missing points. This activity will hopefully help the students in identifying what is not clear as well as in discussing and sharing ideas with pairs: this in principle allows not only to clarify ideas and concepts but also to see problems from a different point of view.

3. Trying it out in practice

The students have individually written on one of more pieces of paper unclear concepts encountered during the lectures that were then gathered into a jar. The students then were divided into five members groups and one student in each group extracted a piece of paper from the jar. The groups had 10 minutes to discuss and explain the concept written in the fished piece of paper. A group was then randomly chosen to explain to the rest of the class the fished concept in approximately 5 minutes while the TA took notes on the blackboard. As this activity does not incluse right/wrong answers, the assessment is uniquely based on participation. Having students deeply involved in discussions as foud for this activity is to be considered a success of the activity itself.

MAIN POINTS

1. **Main problem/challenge: Make the students more open to share doubts**
2. **Teaching activity**: fish-bowl-like
3. **How did it go? The group-environment helped the students to feel more confident and kean of sharing ideas and doubts**
4. **What to do next?** It would be nice to try the activity on regular basis, as the students have "fresh" doubts from exercises or main lectures

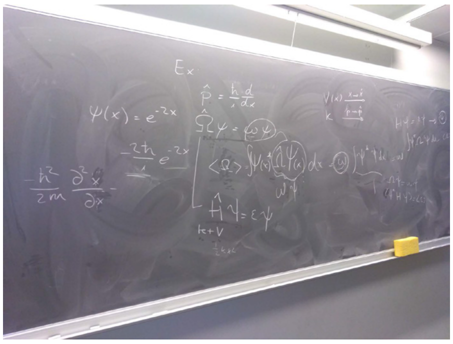


Figure 1: Example of notes taken by the TA during the group's explanation of the topic "Eigenvalues and Eigenvectors". Some of the notes have been added during the open discussion.

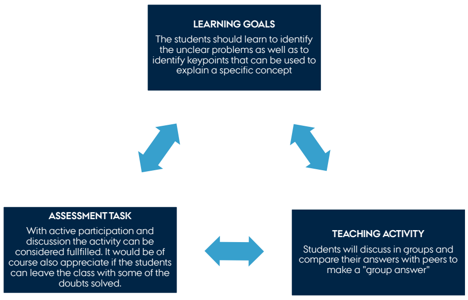


Figure 2: **Constructive alignment**
You can modify this figure and use it to illustrate how the connection/alignment between 1) what you intend students to learn 2) how you teach and 3) how you will evaluate whether your students learn what you intend

4. Looking forward

The use of groups seemed to help the students to discuss and share openly as the communication among peers is probably easier.
As the activity is a bit time consuming it would be nice to dedicate to the activity two full TØ, one in the middle of the course and one at the end, so that the students have a possibility of a recap along the course. The latter could be eventually coupled with the usual "spørge time".

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Pier Paolo Poier
Biomodelling group
Institut for Kemi

From discussion to presentation

- Turning a small group work into a presentation

Learning Lab

Abstract: Students need to be good at making presentations and explain topics in an informative way throughout the University. This learning activity was based on class discussion, group discussion and presentations. The students worked in four smaller groups and made group presentations in front of their other groups. To improve their awareness of the presentations the student groups had to give another group feedback on their presentation. The result was four group presentations, where all of the students were engaged, and a majority of the students had a positive outcome from the learning activity.

COURSE FACTS

- Course name: Introduction to Chemistry
- Level: Bachelor
- ECTS credits : 5
- Language: Danish
- Number of students: 20
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

Classroom discussions and group work discussions are a great way for students to be familiar with addressing academic problems. In addition a presentation gives the students insight about their understanding of the given topic.

It is a problem for students to do presentations in front of each other and for students to stand in front of the black board explaining problems. Therefore, in this class the students will engage this problem in groups, which would give a safer environment for the students to practice presenting.

2. Planning a teaching activity

The learning goal of the course for the students were to understand and differentiate between the different sub-divisions in Chemistry. During the theoretical exercises they learned about the divisions through different questions asked by the lecturer. Each question asked would lead to a group presentation at a later lecture.

Figure 1: The students are giving each other feedback on their presentations.

2. Planning a teaching activity

The learning activity was discussion based and all the student groups were helping with all the questions. My hope was, that this would give a shared feeling of responsibility resulting in a safer environment for the students to work and make the presentations.

To improve the trial presentations in the class I had made a feedback activity. The groups would pair-up and give each other feedback on four different focus points, which I had made.

Focus points:
- Structure of presentation
- Is the topic communicated clearly
- Is the topic put in a context
- Is the academic content correct

To estimate if the students learned something from the activity, I made an evaluation scheme for the feedback activity.

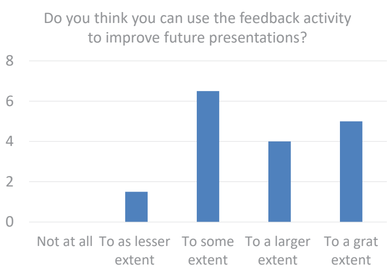


Figure 2: Question from the evaluation scheme illustrating that the students had a positive outcome from the activity.

3. Trying it out in practice

The different topics were discussed first in the class discussion, where all the students could share their imputs. Afterwards the students divided into their respective four group, where they worked with their given topic and using the feedback from the class discussion and making a presentation.

I mainly guided the students in the group discussion, if they had any problems or ran into any misunderstandings.

MAIN POINTS

1. **Main problem/challenge:** Creating a safe environment to practice giving a presentation
2. **Teaching activity**: Group work discussion and presentation
3. **How did it go?** It went really well. The students were engaged in all the different activities.
4. **What to do next?** Next time I would like for the students to make the own focus points for the feedback.

3. Trying it out in practice

After the group work the four groups made their presentations in front of the class. The feedback session is seen in *Figure 1*, where a feedback group is working. After the feedback activity, I handed out an evaluation scheme for each student asking them if they got more aware about how to make a presentation. The evaluation scheme included structure, communication and context.

"It has been a pleasant and instructive way of getting feedback. Nice to have someone from our own level giving advise on how they would understand it better."- Student

The last question and answer is shown on *Figure 2*, where most of the students did learn about giving presentations and can use this in the future. Therefore, I concluded that the learning activity went well, all the students were engaged and a majority of the students had a positive outcome from the activity.

4. Looking forward

I would improve the feedback focus points, as it should be the students, who are doing the presentation, who should choose the focus for their feedback.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Mette Heidemann Rasmussen
Physical Chemistry
Department of Chemistry

Making your first script

- Making a map using digital soil mapping techniques

Learning Lab

Abstract:

Developing your first script is challenging since you need to think about the flow of data from beginning to end. To overcome this difficulty, it is helpful for students to draw out the steps required in making a successful script before ever touching a computer. This exercise will require students to draw out a script on paper and use digital soil mapping techniques to make a map. The exercise will require students to think through the steps required to make a map; thus, strengthening what the students will learn in the course entire course. Asking a colleague to try the exercise, I learned that she thought the exercise is challenging but more rewarding since she had to develop her own script. In the future, this exercise will be implemented in all Agroecology scripting courses in Foulum.

COURSE FACTS

- Course name: Workshop in Digital Soil Mapping
- Level: Masters/PhD
- ECTS credits : 3
- Language: English
- Number of students: 12
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

Problem solving and thinking through the proper steps in creating a code is difficult, especially since most students have a tendency to jump straight to the computer before stopping and thinking about what is required. Digital soil mapping requires complicated scripts to make reliable maps and it is beneficial for scripts to be planned ahead to save time and energy. Using digital soil mapping is a perfect case to practice thinking through a script before touching a computer. This is because students need to be aware of how to select the correct data for mapping, handle and prepare the data, analyze the data, and produce a final map. By practicing how to think through a script, the students will develop a true understanding of problem solving while creating a map.

2. Planning a teaching activity

The reason for creating a map from scratch is to show students the necessary steps and that there is not one correct method when creating a script. The learning outcome is for the students to **learn how to visualize a script before actually coding and than implement their ideas**. The teaching activity is two fold with the goal of recreating Figure 2 using the data from Figure 1. First the students will draw out the steps required to make the map with detailed information on what functions to use for each step. The important tasks and associated functions can be seen in Table 1 and will be presented to the students half way through the coding portion of the activity, in case students need some guidance. Second the students will take the drawn schematic of the script and create an actual script. This teaching activity will be accomplished in a 3 hour session between pairs of students and will be evaluated with a rubric in three ways: from the drawn schematic, code execution with final map, and presentation of reasoning behind process (being most important).

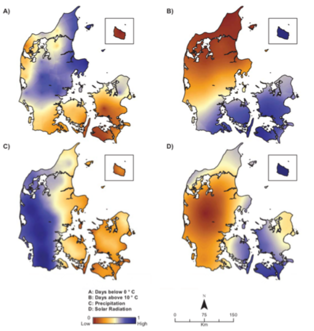


Figure 1: Data needed to create final map.

Table 1: Important tasks and functions within the script.

Task	Functions
Load Libraries	raster cluster
Read Data	raster
Convert Data	rasterToPoints
Extract Data	extract
Clean Data	remove.na
Cluster Data	kmeans
Make Map	rasterize writeRaster

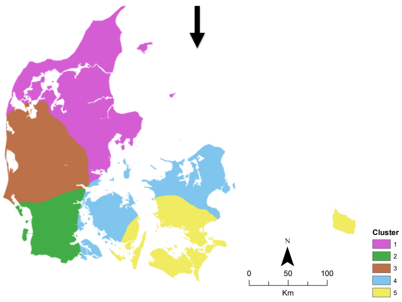


Figure 2: Final map using data provided and the functions provided.

3. Trying it out in practice

A colleague was asked to participate in this teaching activity to evaluate the activity before trying with actual students in 2020. After giving a short introduction on the real-world application of this task, she began to make a schematic. Once the schematic was made and approved, the coding began. She was struggling with a few lines of code after she cleaned the data so I presented Table 1 and some simple tricks to working with spatial data. After this bump in the road, she worked efficiently and completed the task, resulting in the same map. After comparing the "correct" code with hers, there were slight differences. I explained the pros and cons of each method but in the end, she realized that there are many ways to accomplish the same task. She was excited to finish the task and now has a script for the future.

Looking forward

The best part of the activity is for the students to compare their results and see that creating a script is easy and requires creativity. The feeling of accomplishing this challenging task is rewarding for students. Now that they have a script, this can be customized and repeated. The next step would be to execute the activity in the workshop with more complicated techniques to further develop these critical thinking skills while having more hands-on experience with digital soil mapping.

4. Assessment of task

The three assessments will occur at two different times. The first will be direct feedback once the students present their reasoning behind the scripts. The second will be after class when I evaluate the schematic and script with map output using the rubric. A follow-up on the assessment will occur during the next workshop day. A short presentation will be given to summarize all of the results and give constructive feedback to the class.

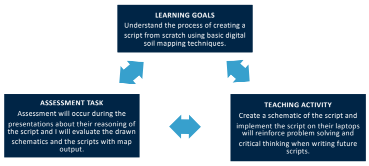


Figure 3: Constructive alignment with connections between learning goals, assessment task, and teaching activity.

MAIN POINTS

1. **Main challenge:** Create a map from scratch using coding.
2. **Teaching activity**: Develop a schematic of a script and implement the schematic to reproduce the TA's results.
3. **How did it go?** Test run went well with minor troubles dealing with unfamiliar data types but final goal was accomplished.
4. **What to do next?** The workshop will include a lot of coding; thus, this activity needs to be utilized early in the workshop after the basics of coding is taught. Follow-up with the students is needed after benchmarks are run on the scripts to determine which code was the fastest.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Yannik Roell
Soil Physics
Department of Agroecology

Strip-sequencing microbial metabolism

- Essential steps to quantify metabolic rates

Learning Lab

Abstract:

Microbial metabolisms influence global biogeochemical cycles. Metabolic rates are measured to understand how and to what extent. Rate measurements are thus a fundamental toolset in microbiology, taught in practical exercises. In practical exercises, students often come unprepared and do not know the procedure. Therefore, students will use strip-sequence to (1) split up the procedure into its essential steps and (2) produce the correct order before starting the practical exercise. Once implemented, strip-sequence will free up time to reflect on the procedure and allow questions beforehand. Feedback can ensure that students are confident to work in the laboratory.

COURSE FACTS

- Course name: Microbial Ecology
- Level: Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 20
- Your role: Laboratory assistant

TEACHING IN PRACTICE

1. Identifying a problem

Microbial Ecology relies heavily on practical exercises. Students attending lab exercises often have not read the protocol in advance. The essential steps and the order of the protocol are unclear. As a consequence of missing understanding, lab assistants have to help students by reciting the protocol. Students lack time to ask questions, can not work independently and do not understand the method. But one of the goals of the course is that students should be able to explain how rate measurements work. Splitting up the protocol in its steps and asking the students to arrange the steps correctly will help them reach this goal.

2. Planning a teaching activity

The teaching activity 'strip-sequence' will help students to think the laboratory exercise through before starting it. Students will get the chance to organize the workflow sequentially in the teams that they later work with in the lab. Reflecting on the workflow and discussing it in their groups and the whole class later results in a better understanding what is going to happen in the lab exercise. General and more conceptual questions can be asked up front and there is time for clarification. In this way students will more easily understand and remember the lab exercise which will help them to explain the method correctly.

References

https://kursuskatalog.au.dk/en/course/85905/Microbial-Ecology - as of 12.11.2018

3. Trying it out in practice

In this activity students align a strip sequence. All important steps of a protocol are presented as key notes. Each group will get these key notes and a worksheet to assemble the strips onto. Students are asked to think about it in silence for 3 minutes before discussing the strip sequence in their group. The groups get 10 minutes to assemble the sequence. Afterwards one group member presents the result to the whole class with magnets on the white board. The other groups can add, rearrange and comment the strip-sequence.
Students are asked to evaluate by dot query. Before the teaching activity students will get two different colored strips of tape. One of the colored strips to answer whether or not they feel able to do the lab work right now and the other colored strip to answer the same question after the teaching activity (Fig. 1).

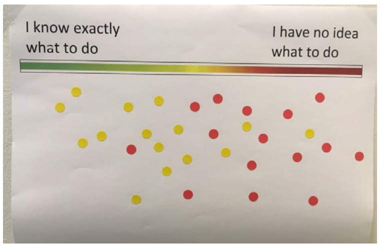


Figure 1: Evaluation with dot query: red dots were added before and yellow dots after the teaching activity

For the first lab exercise the strip-sequence includes images (Fig. 2 left panel) to ensure that students know what to look for when starting to work in the lab. In later lab exercises only key notes will be used (Fig. 2 right panel).

MAIN POINTS

1. **Main problem/challenge:** Students don't know and/or understand procedures before lab exercises
2. **Teaching activity**: Strip-Sequence
3. **How did it go?** Not implemented
4. **What to do next?** Implement teaching activity and broaden

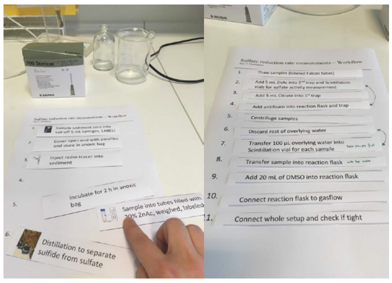


Figure 2: Aligning a strip-sequence with (left) and without images (right)

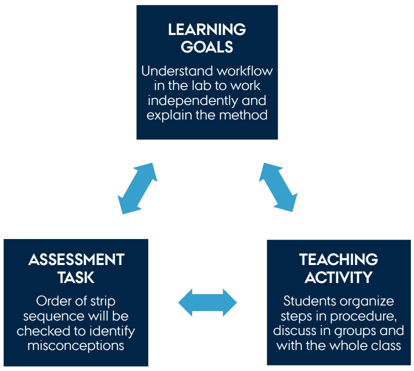


Figure 4: Constructive alignment for rate measurements TA

4. Looking forward

The teaching activity is still to be implemented, but additionally there should be time to discuss what the correct sequence is and why. For this purpose students can be asked to pose questions to the plenum that the peers need to answer. This can encourage further discussion about the meaning of the different steps and help the students to train to explain the method.

Terrain Modelling Exercise

Python scripting for terrain modelling

Learning Lab

Abstract: This hands-on computer laboratory teaching activity is meant to inspire students to learn how to use scripting to model and map the terrain. It was successfully tried out on a colleague and is to be further tested in a classroom situation. It gets students to think in terms of a workflow in creating scripts whereby an example is given as a baseline. Students are to then plan their script and work on an assignment problem to create their own map. Feedback is to be given directly to students during creation of their scripts so as to improve their understanding and challenge them further. Assessment includes handing in the assignment as part of a final report that includes all the exercises within the course.

COURSE FACTS

- Course name: Digital Soil Mapping Workshop (DSM)
- Level: PhD, MSc
- ECTS credits : 3
- Language: English
- Number of students: 10 - 20
- Your role: Tutorial Assistant

TEACHING IN PRACTICE

1. Identifying a problem

Terrain modelling is an important part of Digital Soil Mapping (DSM). Digital soil mappers mostly use Geographical Information Systems (GIS) tools to perform this task. GIS Software provides in-built processing tools that enable users to carry out different spatial analysis tasks within their interface. However, execution of complex tasks such as those required in terrain modelling can better be achieved by creating custom scripts. The challenge in this exercise is to inspire DSM students with capabilities that can be achieved through the use of custom scripts to model and map the terrain digitally.

2. Planning a teaching activity

This is a computer based laboratory activity and will therefore make use of computers, datasets and an execution workflow for students to follow and get an idea of the execution steps. Students are to learn by following a hands-on example that I will walk through with them before working on an assignment with an exercise dataset individually. The activity will give students the opportunity to put into practice knowledge gained from hands-on learning by working on assignments that are to be submitted as part of an overall course final report.

Learning Goals:

- **Inspire** students to learn through a hands-on example
- **Create an environment for students to leverage** knowledge gained through the hands-on to work on the exercise assignment

3. Trying it out in practice

I tried out the activity on a colleague who wanted to learn the routine for her own work as prelude to using it on actual students in the course. I walked her through a hands-on example where she quickly came up to speed on how she should go about creating her own script. Table 1 presents the scripting workflow that was followed to get to the final map.
Figures 1 and 2 show the input data and final map respectively.

Table 1: General workflow used for the exercise

1	**Import modules** (arcpy, numpy, scipy, os, etc)
2	**Set workspace** (arcpy.env.workspace)
3	**Read in data** (arcpy.raster)
4	**Carry out analysis** (numpy, scipy, etc)
5	**Export** (arcpy.NumpyArrayToRaster())
6	**Create map** (arcpy.mp)

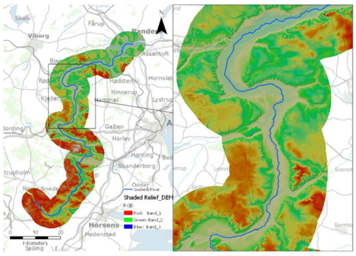


Figure 1: Input data used to create map

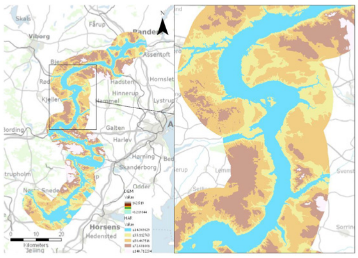


Figure 2: Final developed map

MAIN POINTS

1. **Main problem/challenge:** Inspire DSM students with capabilities of scripting to create custom scripts for terrain modelling.
2. **Teaching activity**: Computer laboratory based
3. **How did it go?** Activity was tried out on a colleague who quickly came up to speed, and will be further implemented in a classroom session of DSM workshop course. Students will work on an exercise assignment in class and take it home for compilation into a final course report.
4. **What to do next?** After testing the activity in a classroom situation, based on student feedback and assessment, I will continue to improve and make it better for future students.

I will continuously provide feedback to students in class during creation of their scripts. There will also be a final report that the students have to hand in as assessment, where my task will be among those presented.

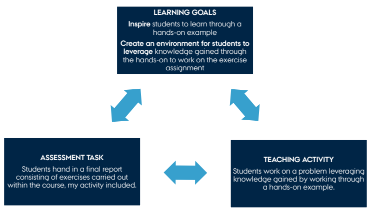


Figure 2: **Constructive alignment**
Alignment between learning goals, teaching activity, and assessment improves learning outcomes.

4. Looking forward

When preparing this activity, I had it in mind to get students to see the potential of scripting for terrain modelling and consequently apply it in their own work. I hope to gain more insight on what works and what doesn't when I implement it with more students during the actual course offering. I will also use student feedback and assessment for continual improvement of the activity for future students.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Department of Agroecology

A “tragedy” of errors

- Teaching uncertainty analysis in a consistent framework

Learning Lab

Abstract:

First-year university students are, often, ill-equipped to work with uncertainties/errors in experimental analysis and current teaching methods completely ignore this knowledge gap while stressing on their utilization in the experimental report![1] A modular teaching activity is proposed to inform students about uncertainty analysis in the logically consistent ISO:GUM framework.[2] Using interactive classroom & online modules, students will learn to analyze uncertainties in their lab exercises. The activity is expected to benefit students transitioning from high school/gymnasium-level science to undergraduate-level science. It is planned for implementation.

COURSE FACTS

- Course name: Inorganic Chemistry 1 (Lab)
- Level: 1st year Bachelors
- ECTS credits : 10
- Language: English
- Number of students: 18
- Role: Laboratory instructor

TEACHING IN PRACTICE

1. Identifying a problem

- Analysis of uncertainties or “errors” is an important part of any scientific experiment.
- But, uncertainty analysis is *“(often) the most abused and neglected part”* of many university courses in experimental science.[1]

Educators acknowledge this problem...

“In experimental courses, error analysis is taught by handing out a couple of pages of notes containing a few formulas, and the student is expected to get on with the job solo...”
- John R. Taylor[1]

Error analysis added at the end of the lab report because “the instructor said so...”?!!

Students repeatedly state it!

*“...calculations with uncertainties and understanding the theory while working can sometimes seems difficult.” **

*“The calculations with error are a bit difficult, and very time consuming. Especially considering that we haven’t had a course that goes into it in depth!” **

* Actual student comments sampled from mid-term survey: Inorganic Chemistry 1 LØ – Autumn 2018

How can we fix this problem???

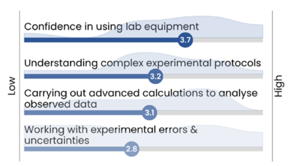
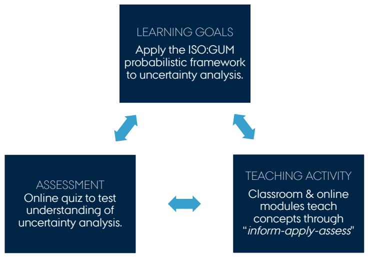


Figure 1: Student opinion poll. They rated themselves on a 5-point scale when asked the question: “How proficient do you feel in the following lab skills?”
Uncertainty analysis scored lower than all others!

(1 = Low proficiency, 5 = High proficiency. Actual results from mid-term survey in Inorganic Chemistry 1 LØ – Autumn 2018)

Students are unable to relate how uncertainties from a single measurement and uncertainties from repeated measurements affect the uncertainties on the final value measured in an experiment ⟶ implies a logical gap between the treatments of a single reading and ensembles of dispersed data. ⟶ need to learn a consistent framework. [3]



2. Planning a teaching activity

Aim: **Students learn how to correctly analyze uncertainties in a consistent framework.**

The teaching activity would be implemented in modules aimed to *“Inform” – “Apply” – “Assess”.* It will be an in-class activity and will be carried out in the beginning and end of each lab session.

- **Intro presentation *(Inform)* :** PowerPoint presentation (delivered by the instructor) outlining the core concepts & formulae. Done before exercise – 15 min.
- **Group module *(Apply)* :** Online module to guide the students (working in groups) through the various steps of carrying out an uncertainty calculation (beginner level). Done before the exercise – 15 min.
- **Individual module *(Assess)* :** Online quiz module on Menti to guide the students (working individually) through the various steps of carrying out an uncertainty calculation (moderate level). Performed at the end of the lab exercise – 30 to 45 min.

The activity will introduce students to the ISO:GUM framework and give them opportunities to work first with a simple case and later with a more complicated case. **In this way, the activity aims to teach uncertainty analysis within a single framework.**

3. Trying it out in practice

Teaching would be performed as described in previous section. Teaching material would be based on references 2 & 3. The activity has not been implemented yet.

Assessment of the student learning would be delivered in two ways:

1. **Continuous formative assessment :** Performed during group modules & lab exercise session. Feedback from instructor & peers.
2. **Summative assessment :** Performed in the individual module. Feedback from instructor & online quiz.

MAIN POINTS

1. **Main problem/challenge:** Teaching uncertainty analysis in a consistent framework.
2. **Teaching activity:** Instruction through interactive classroom & online modules.
3. **How did it go?** Yet to be implemented.
4. **What to do next?** Develop & deploy planned modules in future laboratory sessions.

Before the lab session, the students would be introduced to the relevant ideas and formulae through a PowerPoint presentation. ***(Inform)***

After the presentation, the students would work in groups and solve a simple uncertainty analysis problem online. The online module would present a step-by-step analysis for the solution. ***(Apply)***

After completing their assigned lab exercise, the students will receive an online exit quiz. This online module would require solution of a moderately complicated question. ***(Apply-Assess)***

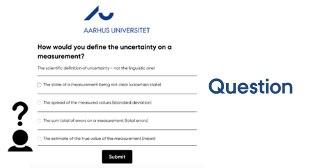


Figure 2: Exemplar snapshot of assessment module showing the question seen by the student in the online module.

This module would provide feedback to the students and assess their progress. Students would also be able to evaluate the success of this activity. ***(Assess)***

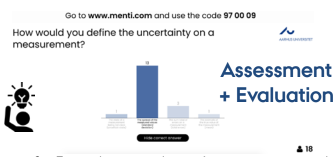


Figure 3: Exemplar snapshot of assessment module showing assessment & evaluation results (delivered after the online quiz module’s completion).

4. Looking forward

As the activity has yet to be implemented, the first step would be to test it in an upcoming laboratory session. The initial tests would help provide student feedback on the activity. Using that, the activity can then be refined and adapted for next year’s laboratory exercises.

References

1. Taylor, J. R. Introduction To Error Analysis: The Study of Uncertainties in Physical Measurements, 2nd ed.; University Science Books (1997).
2. International Organization for Standardization (ISO), Guide to the expression of uncertainty in measurement (GUM) (1995).
3. Allie, S. et. al., Teaching Measurement in the Introductory Physics Laboratory. Phys. Teach., 41, 394 (2003).

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Priyank Shyam
Nanomagnetic Materials Group
Interdisciplinary Nanoscience Center (iNANO)

Diagnosis of plant virus

-Laboratory protocol

Learning Lab

Abstract: Diagnosis of plant virus is often difficult and tricky in which student needs necessary study background on theoretical and practical aspects of plant virology and biochemistry. This is a challenge for student who lacks as mentioned educational background. Therefore, a teaching activity (TA) with design of flowchart was used to provide the student with general overview of each steps in the protocol with some level of theoretical aspects. Student worked in a small group with two available quick methods of the plant viral disease diagnosis. Results came from their laboratory exercise were showed on board and discussed with students and necessary feedback was given to student. Overall, TA was evaluated by student as very good to grasp the idea behind practical outcomes.

COURSE FACTS

- Course name: Diagnosis of plant disease
- Level: Masters
- ECTS credits : 5 ECTs
- Language: English
- Number of students: 20
- Your role: Instructor

TEACHING IN PRACTICE

1. Identifying a problem

Student participating the course come from different study background from Denmark and others part of the world; all of the student are not familiar with diagnosis of plant virus. They also lack background on practical molecular biology. Based on experience as student and recently taught this course, I choose to give them overview using pictorial flowchart with some theoretical aspects behind the mechanism which improve the understanding of the protocol.

2. Planning a teaching activity

To give student a visual overview, a number of pictorial flowchart were introduced to connect the steps to follow during practical experiment. Pictorial flow chart has an advantages to go inside of the mechanism how it operate in the system. In addition, student can observe the change of different steps in their own eyes which is not possible through theoretical lesson. Moreover, this flowchart tells the story itself which is easily conceivable in the long-term memory of the student.

3. Trying it out in practice

TA is carried out on second week of the course after theoretical lesson and field visit on viral plant disease on week-1 which gave broad overview on the subject matter. This help to organize and planning of the laboratory works in the following week. Student works in a small group (3-4 person) during practical. Necessary protocol with pictorial description was given in advanced. Demonstration was provided to student with safety measure and how to handle necessary equipment. Student works step by step and each step TA was following each group of student; and asked them whether they have anything unclear or not. After finishing the experiment, results were present on the screen by student and necessary feedback was given to all student.

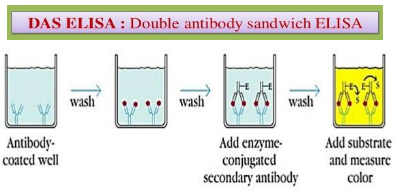


Figure 1: **DAS ELISA technique to diagnosis of the plant virus**

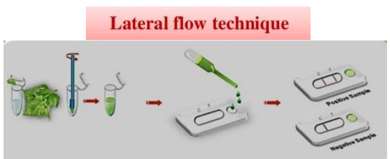


Figure 2: **Lateral flow technique to quick diagnosis of the plant virus**

MAIN POINTS

1. **Main problem/challenge:** Lack of overview of the protocol
2. **Teaching activity**: Mini experiment in which pictorial flowchart with combining main steps of the technique
3. **How did it go?** I am convinced that student perform their task nicely
4. **What to do next?** Include bioinformatics to detect unknown plant virus

We evaluate the teaching activity at the end of the experiment in the classroom discussion. All of the student was agreed that pictorial flowchart was very nice to conceive the idea behind mechanism. Sharing the results of the other group on screen was helpful for them to write up nice report on this experiment. Student got feedback on their report before oral exam which help them enormously.

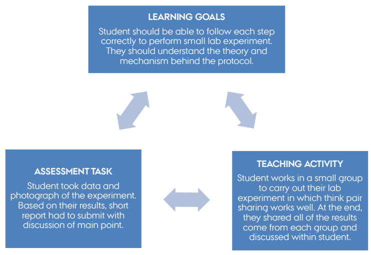


Figure 3: **Constructive alignment**

4. Looking forward

Students were activated throughout the teaching activity which explained the theory behind the protocol and discussed the potential link between theory and practice. By doing the small quick experiment, the students got impression and knowledge that how to diagnose the known plant virus. The next step could be to include some bioinformatics tools to identify unknown plant virus and their functionality study using software.

References

- Matthews, R. E. F. 2017. Diagnosis of Plant Virus Diseases. 1st Edition. CRC Press-Taylor & Francis.
- Yadav N., Khurana S.M.P. 2016. Plant Virus Detection and Diagnosis: Progress and Challenges. In: Shukla P. (eds) Frontier Discoveries and Innovations in Interdisciplinary Microbiology. Springer.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Md Maniruzzaman Sikder
Entomology and Plant Pathology
Agroecology Department

The unfinished flowchart

- A tool to guide students through calculations

Learning Lab

Abstract: **When in a laboratory one needs to be able to maintain an overview of how to get from raw data to interpretable results. Sometimes this is a rather comprehensive process, including several calculation steps where students can get lost or give up along the way. In order to help the students maintain an overview, we have developed an unfisnished flowchart which serves as a guide and a way of stimulating students to get from one piece of data to another. Most students found the flowchart really helpful when writing the report. For future improvement the flowchart will be modified to look more manageable.**

COURSE FACTS

- Course name: **Biomolecular Structure and Function**
- Level: **2nd year BA students**
- ECTS credits : **10**
- Language: **Danish**
- Number of students: **30 pr. lab**
- Your role: **Laboratory assistant**

TEACHING IN PRACTICE

1. Identifying a problem

It is my experience that students often have a hard time figuring out how to arrive at a desired result if it involves several calculation steps. They tend to get lost along the way and rarely have an overview of where they are going. We wish to fix this problem since maintaining an overview is an absolutely necessary skill to obtain if one wants to become a good scientist.

2. Planning a teaching activity

In the laboratory one collects raw data which needs to be analyzed and interpreted. Especially, when it comes to enzyme kinetics getting presentable results often involves one calculation followed by another. One of the learning goals in this course is for students to be able to perform enzyme kinetics calculations. To help students acquire the skill of converting raw enzyme data into interpretable enzyme kinetic parameters, this teaching activity introduces an unfinished flowchart of calculations. The chart is meant to stimulate students to think themselves but still guide them so that they will not feel they are totally lost from the start. In addition, students will eventually end up with a "guide" sheet of paper they can use when writing the report.

3. Trying it out in practice

In the beginning of the laboratory exercise students will receive a sheet of paper with a unfinished flow of the calculations they need to perform. This includes important formulas, graphs etc. Most important is that essential information will be missing (see Fig.1). During the exercises the students fill in the blanks, discuss and get an overview of how they get from one piece of information to another. It is up to each group how much they want to use the sheet.

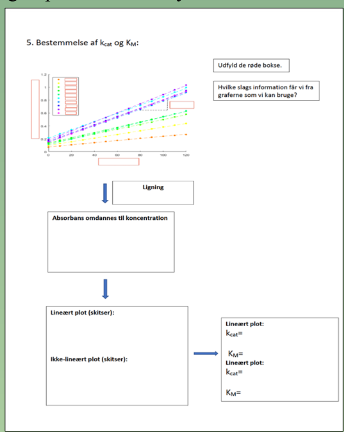


Figure 1: A overview of page 2/2 in the unfinished flowchart.

The flowcharts were only provided to groups in laboratory U, whereas the groups in laboratory A did not get anything (control group). The students in laboratory U was given a small paper slip with three feedback questions asking how much (scale 1 to 10) the flowchart helped them in different contexts. The control group received feedback slips with three questions as well mainly trying to figure out if they think they would have benefitted from a flowchart. The feedback was anonymous. Fig. 2 shows the feedback results.

The groups used the flowchart to a very different extent and some found it very helpful when others did not. The flowchart seemed to be most helpful when writing the report and most students that did not get the flowchart would have preferred similar help to get an overview of the laboratory exercise and when writing the report.

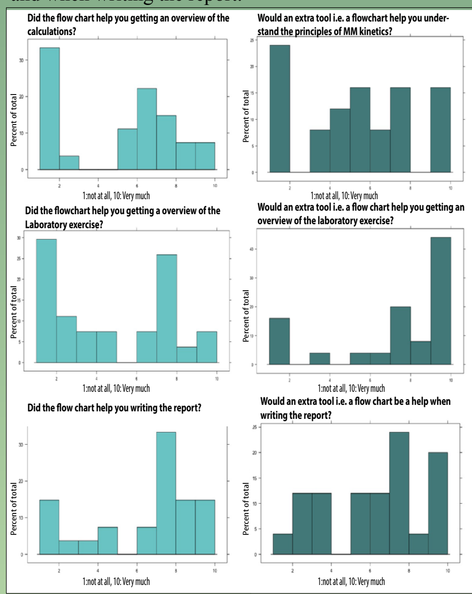


Figure 2: Histograms showing the results of feedback

4. Looking forward

More of the students suggested that it would have been nice to receive the flowchart before the exercise. This could certainly be considered the next time the activity is implemented. In addition, it is desirable to modify and reduce the context of the unfinished flowchart so that it will be able to fit on one A4 page and thus be more manageable and nicer to look at.

MAIN POINTS

1. **Main problem/challenge:** Students lack overview when processing raw data to interpretable results includes too many calculation steps.
2. **Teaching activity**: Unfinished flowchart
3. **How did it go?** To some groups the flowchart was a big help, mostly when writing the report
4. **What to do next?** Modify and reduce the context of the unfinished flowchart

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Cathrine Kiel Skovbjerg
Plant Molecular Biology
Department of Molecular Biology and Genetics

Molecular Processes in the Cell

- An intense lab course

Learning Lab

Abstract

The lab exercises in the course "Molecular Processes in the Cell" are quite intense and so a teaching activity could give the possibility for the students to better understand the scientific principles that are performed during the course. Because of the long days and a lot experiments performed, the students tend to just mindlessly follow the protocol without understanding the actual science and this is of course a real shame and could perhaps be remedied by a teaching activity. The teaching activity in mind here is combined strip sequence and matching.

COURSE FACTS

- Course name: Molecular Processes in the Cell
- Level: 3rd year Bachelor
- ECTS credits : 10
- Language: Danish/English
- Number of students: 100-120
- Your role: TA in lab exercise

TEACHING IN PRACTICE

1. Identifying a problem

The lab exercise in this course is really intense, as the students are performing 5 different experiments during only 5 days. The students are working all days, until 6-7 PM, and therefore the level of comprehension during the long days are perhaps not that great. Especially the understanding of the individual steps done in the protocol are not great and the students can often just follow the protocol mindlessly without thinking about the actual science that are being performed.

2. Planning a teaching activity

Using a strip sequence method, the students are asked to first sequence several pieces of paper strips which contains a step in the protocol used. In this way we can first see how well-prepared the students are concerning the different steps and through group discussion, they can enhance their overview of the experiments performed. The students are then given more paper strips with an explanation or a scientific principle which they should match with their initial protocol strips. In this way, the students will then through group discussion better understand the theory behind the individual steps performed in the protocol.

3. Trying it out in practice

Describe the teaching activity and how the teaching was performed. Include examples or summaries of "data" (see STEP C) e.g. pictures, quiz results or evaluations. How did you assess you learning goal and did the students learn?

I have not tried it out in practice and sadly it is highly unlikely that I will have time for it in this intense lab course.

MAIN POINTS

1. **Main problem/challenge:** Students not understanding the science behind the individual protocol steps
2. **Teaching activity**: Strip sequences and matching strips
3. **How did it go?** Not performed.
4. **What to do next?** Improving concept or material that would have been used

4. Looking forward

The exercise have not been performed. However, if I had performed it, I would listened to the discussions and a possible feedback to know whether the sequence strips were helpful or not. Also, the difficulty of the sequencing and matching of strips could be assessed to optimize them for the next time.

Hopefully, in the future a teaching activity like this one could be implemented during the lab course to improve the students understanding of the material.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Stig Skrivergaard
NanoPharmaceutical Lab
iNANO

In-Class Design Simulation

- From mechanical application of design procedures to understanding of the rationale behind each step

Learning Lab

Abstract: **On successful completion of *Analog and Radio-Frequency Integrated Circuits*, students should be able to design the main building blocks of modern radio-frequency integrated systems. Some students memorise design formulas and apply them mechanically, with the result that they cannot adjust design procedures to different circuits, when needed. Students should be able to explain the rationale behind each step of a design procedure, in order to be able to adapt it to different circuits. An in-class design simulation activity involving in-plenum discussion of the rationale behind each step of a design procedure is proposed.**

COURSE FACTS

- Course name: Analog and Radio-Frequency Integrated Circuits
- Level: Master's Degree
- ECTS credits : 10 ECTS
- Language: English
- Number of students: around 20
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

As a course learning outcome, on successful completion of the course, students should be able to design the main building blocks (i.e., circuits) of modern radio-frequency integrated systems.

Previous exams and assignments have shown that some students apply design formulas mechanically, with the result that they cannot design a circuit that is not exactly the same as one that they have already encountered in class.

To sort this problem out, students should also understand the rationale behind each step in a design procedure, so that they can adjust the procedure to adapt it to different circuits.

2. Planning a teaching activity

To tackle the above-mentioned challenge, an in-class design simulation activity is proposed.

The activity focuses on the design of a low-noise amplifier, which is one of the main building blocks of radio-frequency transceivers. This is aligned with the above-mentioned course learning outcome.

The activity will engage students in an in-plenum discussion on the rationale behind each step of a design procedure. After the activity, the students will be able to **design** a low-noise amplifier and **explain** the rationale behind each design step. This will allow them to **generalise** the procedure, adapting it to different circuits.

3. Trying it out in practice

The teaching activity is an in-class design simulation. The activity is as follows.

PowerPoint slides are prepared by the TA. Each slide reports either a question about a design step or the answer along with plots exemplifying the design step. Every slide asking a question is followed by one or more slides reporting the correct answer. An example is shown in Figure 1.

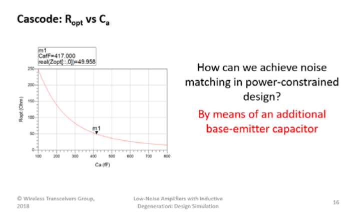


Figure 1: An example of a slide providing the answer to a question posed in a previous slide.

The questions are posed so as to engage all class in an in-plenum discussion. Even participation of all students is ensured as follows. For each question, the TA initially asks if there are any students who wish to attempt an answer. Then, other students, randomly picked, are asked to give their opinion. Since the activity is carried out in a small class, all students can be asked to answer at least one question.

Assessment of learning outcomes

The **in-plenum discussion** is a chance to assess student understanding. Also, an **out-of-class assignment** is given to

MAIN POINTS

1. **Main problem/challenge:** Students apply design formulas mechanically, without understanding the rationale behind each step in a design procedure.
2. **Teaching activity**: In-class design simulation.
3. **How did it go?** The activity will be proposed to the course coordinator. If approved, it will be implemented in the Spring Semester. The TA has already prepared the slides.
4. **What to do next?** Similar activities focusing on other building blocks will be considered.

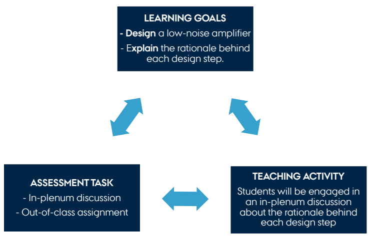


Figure 2: **Constructive alignment**

Student evaluation of the teaching activity

Ticket out the door/muddiest point. At the end of the session, the students are asked to hand in a piece of paper upon which they answer the following question: "What was the muddiest point in the amplifier design procedure?"

4. Looking forward

Other implementations of the activity can be explored. For example, the design procedure could also be implemented by the students in class on their laptop, in an eltronic design automation software available to them. Also, similar activities focusing on design procedures for other building blocks of radio-frequency transceivers can be planned.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Department of Engineering

Inactive Students? Present in Groups

Learning Lab

Abstract: To avoid lot of inactive students and a lack of eager to present exercises, I have created an alternative to the classical blackboard presentation set-up for mathematic courses. Focusing on a more group-based set-up the number of active students is greatly increased, and more students get to present exercises. This is essential to the desired learning outcome of being able to present clear and precise mathematical arguments orally and in writing. According to the students' evaluations and my own impression, the activity worked very well, and I will implement it next semester.

COURSE FACTS

- Course name: Introduction to Probability Theory and Statistics
- Level: Bachelor, 1st semester
- ECTS credits : 10
- Language: Danish
- Number of students: 22
- Your role: Teaching Assistant

MAIN POINTS

1. **Main problem/challenge:** Inactive students & same students presenting exercises
2. **Teaching activity**: Group-based problem solving and solution presentation
3. **How did it go?** Very well, both based on my impression and student evaluation.
4. **What to do next?** Implement it next semester, and find optimal way to make initial groups.

TEACHING IN PRACTICE

1. Identifying a problem

Blackboard centered exercise presentations is the usual set-up in mathematics and statistics classes. The problem is a low activity rate due to the mostly one-way communication, and also it is usually the same students presenting, with the rest of the class inactive. The challenge is to engage more students in the learning while keeping a presentation based set-up, and hence to create an atmosphere where students are comfortable presenting.
It is important to stick to a presentation set-up, as clear and formal mathematical arguments (both orally and written) are essential learning outcomes of the mathematics degree, in particular in this course

2. Planning a teaching activity

The idea behind the activity is to keep the presentation an essential part of the class, however, by doing it in smaller groups and thus creating a more comfortable environment. Also, by having a group set-up, more students get to present their solutions. Furthermore, the students have time before presentations to discuss a particular assigned exercises with another group of students. Ideally this discussion in a relaxed atmosphere increases the eager to present and ultimately the quality of the students' exercise solutions and mathematical arguments.

Also, by reorganizing the groups halfway, the students are activated by the simple fact that they have to move around in the classroom

3. Trying it out in practice

The class is divided into groups, and each group is assigned one or two primary exercises (depending on the number of exercises and the number of students present). After some initial welcoming, questions and discussion of weekly assignments, the groups discuss all exercises but focus mainly on their primary ones; appr. 30 minutes. Throughout all 30 minutes I, as a TA, will visit groups and ask/answer questions. For the last 45 minutes of class, new groups are created such that each new group has one or two members from each of the previous groups (again, depending on number of exercises/students). The students now present their assigned primary exercises somewhere in class using blackboards and magic-paper etc, and hence, more students get to present their solutions. If there are exercises remaining, which are not presented in the group set-up, we have regular blackboard presentation at the end of class.

When tried out in practice, there were 8 students present for 7 intended exercises. We divided the class in two groups of 4 people and assigned 2 exercises to each group. For the next 30 minutes the groups discussed all exercises, but focused on the two assigned to their group. At the same time I visited the groups, clarified general and specific questions, and had them present parts of the exercises to me.

In the last 45 minutes, two members from each group changed places, and the exercises were presented in these new groups at separate blackboards, while I visited both groups and asked clarifying questions. This took appr. 30 minutes, and the last 15 minutes was then spent on classical blackboard presentation for the 3 remaining exercises.

In my opinion, the activity worked very well, as all students presented an exercise each, which was exactly the point of this set-up, and all students were active in the majority of time. Also, the students were much more critically aware of the solutions compared to usual blackboard presentations. The students were asked to consider pros and cons (at least 2 of each) with this new presentation set-up, and this also indicated that students in general were very fond of this model.

4. Looking forward

The group-based solution worked very well, however, due to the low number of students compared to the number of exercises, there was some initial time-delay. This will be avoided when tried multiple times. As the activity was very well received by the students, I will most likely implement it next semester, although, I will probably implement it as an activity occurring every 2 or 3 weeks.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Dept. of Mathematics

Draft – Discuss - Refine

- Peer reviewing of fellow students

Learning Lab

Abstract

In the Experimental Organic Synthesis course the students must learn how to report and write about synthetic organic chemistry. This is the first time the students are facing this. The report has to include a correctly written procedure and reporting of data. To solidify the concepts we introduced a peer-review exercise to the students. The students were generally positive about the exercise, and felt they benefitted. In the future the activity should be optimized to make the task less daunting for the students, by splitting the process into pieces.

COURSE FACTS

- Course name: Organic Chemistry IIIa: Experimental Organic Synthesis
- Level: 3rd year (5th semester)
- ECTS credits : 10 ECTS
- Language: Danish (English)
- Number of students: 35
- Your role: Laboratory instructor

TEACHING IN PRACTICE

1. Identifying a problem

As part of the course in Organic Synthesis the students must learn to write organic chemistry in a proper format and manner. This includes reporting experimental data and discussing it in the right fashion. This is the first time students encounter this challenge. There is a quite steep learning curve, and the students tend to keep making the same mistakes even though they have been corrected multiple times. This also gives a heavy workload for the instructors correcting the reports.

2. Planning a teaching activity

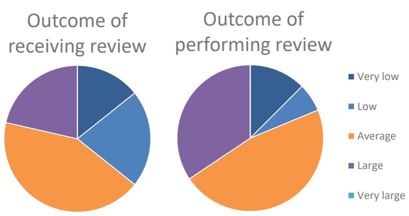
By having the students peer-reviewing each others reports we believe that the basic concepts of writing organic chemistry (e.g. reporting data, writing references) should get more 'under their skin'.
The peer-reviewing starts after the students have received a number of reports back from the instructors so they know what the report should look like. Thus they will have exemplars to use when correcting their fellow students' reports.

Furthermore, correcting other peoples mistakes hopefully makes them more aware of their own writing, and how a good/bad report is structured and written.

3. Trying it out in practice

The students were given the task to correct one report of their fellow students. They were given one week to perform the task in the time outside the laboratory (or while waiting for a reaction). They then had to hand back the report to their fellow students who then had until the next laboratory session to make the suggested corrections.

Questionnaire results



- 63 % of students would prefer to continue with the activity
- 50 % of the students spend 16-30 minutes on peer-reviewing while 38 % spend 5-15 minutes

The final hand in of the report to the instructors then consisted of the original, non-peer reviewed report together with the peer-reviewed and correct report. This allowed the instructors to asses the ability and effort of the peer-reviewers. Furthermore, the students were asked to fill out a questionnaire to asses the teaching activity, and their own gain from it.

MAIN POINTS

1. **Main problem/challenge:** Increasing the writing capabilities of the students
2. **Teaching activity**: Peer reviewing
3. **How did it go?** Overall alright, but needs more repetitions
4. **What to do next?** Repeat the activity multiple times, with feedback to reviewers as well

The assessment by the instructors is that the effort from the students was too low to really impact the report. Many things still had to be corrected after the peer-review, and the revisions were mostly minor things.
To improve the outcome of the activity some time should be allocated in class for the reviewing process to take place.
Furthermore, the reviewers should receive the corrections made by the instructors, so they can see the things they have "missed".

Students also had the option to place a comment on the questionnaire. Many students would like a better exemplar for reviewing. Although students receive some exemplars in the form of literature and that their previously (instructor)-corrected reports should provide them with sufficient exemplars, it could be considerable to provide the students with additional material to facilitate the process.

4. Looking forward

Almost all students have finished handing in reports for this semester. If I am teaching the same course next year I would consider starting the peer-review process earlier, and also give the reviewers a copy of the corrections I make. This would help them realize which things they overlooked, and what I expect them to be able to correct.
Furthermore, several things could be done to improve the exercise. One thing could be to have the students focusing on one thing each time: Reporting data, the reaction mechanism, the description of the procedure and so on. This would allow the students to slowly build the tool-box to correct the full report in the end, and make the task less time-consuming and more manageable.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Esben Svenningsen
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Department of Chemistry

Quick Problem Overview

Problem knowledge from brief solution strategy presentations in small groups

Learning Lab

Abstract: First year students tend to be overloaded with mandatory homework to an extend that limits the preparation level for regular class sessions. This significantly lowers the learning outcome of a session with problem presentations on the blackboard. A teaching activity with quick 2-3 minute student presentations of solution strategies in small groups provides a good background knowledge of the problems presented on the blackboard. The solution strategy presentations will be based on problem solving work performed in initial small problem solving groups. Each initial group is assigned 1 problem, with 20-30 minutes to solve this problem before the quick presentations. The teaching activity provides, an initially unprepared student, time to solve 1 problem in a small group, present a brief walkthrough of the solution strategy and receive a similar walkthrough of 3-5 additional problems within a time span of 45-60 min.

COURSE FACTS

- Course name: Mechanics and Thermodynamics
- Level: First year
- ECTS credits : 10 ECTS
- Language: Danish
- Number of students: 18
- Your role: Teaching assistant in small class problem solving

TEACHING IN PRACTICE

1. Identifying a problem

The first year students taking this course have a very large amount of homework, where a rather large part is mandatory. This means that the students are generally very poorly prepared for these classes. The students are intended to have solved/almost solved 5 to 7 problems for each session. In reality, only very few students have accomplished this, while the rest have looked at 0-2 problems, see figure 1. With a very limited time in class, this is a big problem as students only learn by doing. However, the available time will only allow them to solve 2 or 3 tasks in class and leave no time to go through the remaining tasks on the blackboard. On the other hand, if time is used for presentations on the blackboard, the students will only have time to solve a single task on their own. Furthermore, the students will not benefit much from black-board presentations of a problem they have no

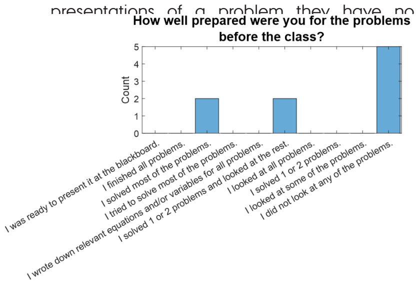


Figure 1: Students answers to the stated question at the end of the class session. The question addresses the preparation level of the attendant students. The session included 9 students, where more than half of them had not looked at a single problem in advance.

2. Planning a teaching activity

The problem addressed above does not have a simple solution, but must be handled by a good compromise between problem solving time and the overall understanding of every problem for the specific session. Here, this is faced by first creating small groups (2-3 students), one for each problem. Each student should preferably be assigned to a problem they have not yet prepared. In each group they will get 20-30 minutes to solve their problem, while the teaching assistant will guide all groups to solve the problems within this time frame. This part of the activity makes sure that everyone have looked intensely on at least one problem. The next step is to separate these groups into new groups. This step can either be repeated, or the new groups can be rather large depending on the number of students and problems available. Despite the format of this step, the intention of the newly formed groups is to provide each member of the group 2-3 minutes to present their solution strategy for the other members of their new group. This will improve their understanding of their own problem and improve their overall problem solving skills by being able to focus on the solution strategy rather than the actual solution due to the strict time constraint. Furthermore, this setup will in less than 15 minutes also be able to introduce all students to 3 problems on top of the one they solved them selves (provided that the groups are made properly). The time used for the activity can easily be adjusted, but with a 45 min. activity it seems realistic to let all students solve 1 problem in a small group and acquire a solution strategy to a total of four problems. This leaves a significant amount of time to present problems at the blackboard as well, which the students should be able to benefit from now since they are already familiar with almost all problems. In extension, all students have already made a brief presentation of their problem in the small groups, which makes the students more comfortable with presenting at the blackboard. This is also a bonus according to the time pressure in the session, as the students are able to present faster and more concise due to the practice from the small groups.

3. Trying it out in practice

The teaching activity has been carried out in a single class session at this point, where only 9 students were attending. As the session included 5 problems, the initial problem solving groups were 4 groups of 2 students and a single 1 student "group". 25 minutes was used in these groups before these 5 original groups was split up and used to create 3 new groups of 2 and 1 group of 3 students. After 5 minutes, 2 students from each group had explained the solution strategy to their problem to the other group members. At this point, 1 of the 2 person groups was split up and asked to explain their problem to the 2 other 2 student groups, while the last student of the 3 person group was explaining in that group. The concept of group splitting and matching is very hard to keep track of at this point, but another 2 group splits was performed in practice. However, these last splits did unfortunately contain some overlap

MAIN POINTS

1. **Main problem/challenge:** Unprepared students does not benefit from blackboard presentations.
2. **Teaching activity:** Problem knowledge from brief solution strategy presentations.
3. **How did it go?** High student activity, great increase in overall problem knowledge for the average student.

roughly 45 minutes including the introduction of the activity.

Immediately after the teaching activity, the full solution to the same problems were presented by the students on the blackboard. The students were able to do this significantly better than in any previous class sessions. It is reasonable to believe that this is caused by the teaching activity, where the students already presented their solution strategy very briefly 2-3 times. It appeared that they were both more secure and had a better understanding of their solution than normally.

The teaching activity was evaluated in a short questionnaire at the end of the class. The results from the questionnaire shown in figure 1 clearly shows that the addressed problem is relevant, while figure 2 indicates that the participating students also felt more comfortable with the problems of this session compared to a normal session. In fact, 8 out of 9 students rated their outcome of the session to be greater than usual and the activity to be good or very good.

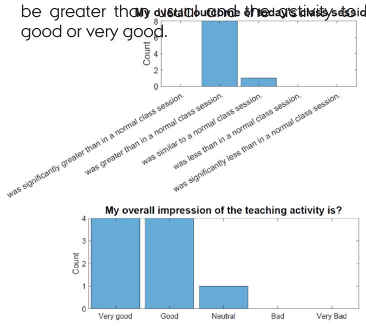


Figure 2: Student answers to the stated questions at the end of the class session. The two questions addresses the effect and the impression of the teaching activity respectively. The session included 9 students.

4. Reflection

The intend of the teaching activity appeared very efficient in the addressed class session. However, it should be used with great care, as it can introduce the unfortunate side effect of even less prepared students for future classes. This activity appeared to increase the problem solving skills of the students by focusing on the solution strategy of a problem in contrast to the full solution. This effect would be interesting to look in to and it could potentially be used as the main reason to use the activity.

To improve the activity, it would be nice to have a strict way to organize the splitting and matching of new groups to avoid overlap of the presented problems. Potentially this could be achieved by a small algorithm using the number of students and the amount of problems, or by

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Jacob Søgaard
Semiconductor Group
Physics and Astronomy

The gel-challenge
- Is it DNA or protein?

Learning Lab

Abstract:

When you are at the beginning of your molecular biology studies, distinguishing between DNA, RNA and protein can still be a challenge – especially when having to work with them in the laboratory. In the laboratory exercises of the analytical molecular biology course, a common confusion arises when the students have to run two types of gels to resolve either plasmid DNA or purified protein on the same day. To prevent this, the students were presented with a strip sequence activity designed to help them keep structured and understand how the methods for analyzing DNA and protein differ. Even though the teaching activity was generally evaluated as helpful by the students, it also appeared to need some improvements to be more challenging and further increase their learning outcome.

COURSE FACTS

- Course name: Analytical molecular biology
- Level: Bachelor 3.semester
- ECTS credits : 10
- Language: Danish with english protocol
- Number of students: Almost 100
- Your role: TA in laboratory exercises

TEACHING IN PRACTICE

1. Identifying a problem

From last year's laboratory exercises it is the experience that students become confused when having to visualize DNA and protein on gels in parallel experiments on the same day. This underlines the challenge for inexperienced students to actually understand and see the reasoning behind the steps, they are performing, which can compromise their learning outcome from the lab exercises. Therefore, a teaching activity is developed to address this particular confusion.

2. Planning a teaching activity

In order to succeed in their work and in the final report on the results from the lab exercises, the students should be able to clearly distinguish between DNA and protein and understand how and why these biomolecules are analyzed with different methods. In a strip sequence activity the students will sort out, order and discuss the steps in the two parallel experiments to provide them with additional structure to a confusing day and a possibility to clarify potential misconceptions, hopefully preventing them from getting DNA and protein mixed up.

3. Trying it out in practice

In extension to the regular introduction to the agenda of the day, the students are presented with the teaching activity and asked to carry it out in their groups before proceeding to the lab work. After five minutes of placing the strips in the right order (Figure 1), the groups go together two-and-two to compare their sequences and agree on the correct solution. As the TA, I walk around to check their answers and address any mistakes by asking them clarifying questions.

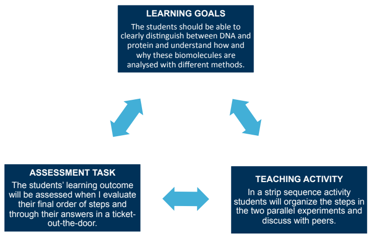


Figure 2: Constructive alignment

The benefit of the activity is evaluated by a ticket-out-the-door with one question testing the understanding gained by the students and the rest to cover their assessment of the activity. First of all it was satisfying to see that only 10% gave a wrong answer to the first question (Table 1). The fact that over 50% answered partly correct suggests, however, that the phrasing of the question could be improved to generate more detailed answers.

Table 1: Evaluation of the students' learning outcome

Question 1: What is the difference between agarose gels and SDS-PAGE gels? (Hint: When to use each type of gel, how to visualize it?)			
	Correct	Partly correct	Wrong
No. of answers (Total=96)	37	49	10
Percentage %	38.54	51.04	10.42

MAIN POINTS

1. **Main problem/challenge:** Distinguishing the analysis of DNA and protein on a gel from each other and staying structured
2. **Teaching activity:** Strip sequence
3. **How did it go?** Overall good, but might be more challenging
4. **What to do next?** Adjusting the level of complexity

When looking at how the students assessed the quality of the teaching activity, the general feedback was positive with an average score of 3.8 when asking them how helpful it was. In addition, the activity also appeared to make them feel more prepared to carry out the following lab work (Table 2+3). The majority, however, only felt such an improvement of one score, suggesting that the activity was not challenging enough and/or that they already found themselves relatively well prepared.

Table 2: Students' assessment of the activity

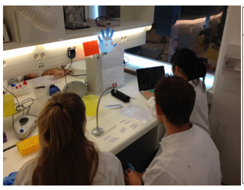
Question 2: Did you find the activity useful/helpful for understanding the flow of today's experiments? Please answer with a score from 1 to 5 – 5 corresponding to extremely helpful/useful					
Score	1	2	3	4	5
No. of answers (Total=96)	1	8	24	37	26
Percentage %	1.04	8.33	25.00	38.54	27.08

Table 3: Students' assessment of the activity

Question 3 and 4: How well prepared did you feel BEFORE and AFTER the activity? *			
	More prepared**	Equally prepared	Less prepared
No. of answers (Total=96)	76	18	2
Percentage %	79.17	18.75	2.08

*Students have answered with a score from 1-5 with 5 corresponding to extremely well prepared
**In this category 16/76 felt an improvement of two scores and 60/76 felt an improvement of one score

In conclusion, the teaching activity was executed rather successfully but could possibly be adjusted to challenge the students a bit more.



Identification of positive colonies	Purification and analysis of recombinant Sp1-DB protein
A - Colony PCR	A - Lysis of cells that express recombinant Sp1-DB
B - Run PCR products on an agarose gel	B - Purify recombinant Sp1-DB from the cell lysate
C - Visualize gel using UV-light	C - Run the eluted recombinant Sp1-DB on an SDS-PAGE gel
D - Identify positive colonies	D - Stain the gel using Instant Blue
E - Inoculation of positive colonies	

Figure 1: Students working with the strip sequence activity - the right panel shows the correct order of steps in the two parallel experiments, which the students have to sort out and distinguish from each other.

4. Looking forward

The strip sequence activity forced the students to reflect on the steps in the two parallel experiments. Only a few groups, however, did not get the order right during the assigned time. Combined with the results from the evaluation questions, this indicated that the activity might have been too easy or the students might have been better prepared this year than expected. Therefore, as an elaboration for next year the strip sequence could be combined with questions focusing on how and why DNA and protein are analyzed differently.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Enabling Students Teaching

- How students can teach students

Learning Lab

Abstract: Combinatorial Testing is a construct in the Overture tool for validating models expressed in the VDM++ language. Unfortunately, it is not being used by the students for cases where it could be beneficial due to lack of familiarity and understanding. To address this issue, the concept of student teaching, students teaching students, is used as a teaching activity. The exercises created and solved by the students demonstrate that they understood the construct. The evaluation of the activity by the students rated the activity 4.6 out of 5 on average and all students wrote that it improved their understanding. As such the activity is regarded useful and can be applied to other scenarios.

COURSE FACTS

- Course name: Modelling of Critical Systems
- Level: Master
- ECTS credits : 5
- Language: English
- Number of students: 16
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

A construct called Combinatorial Testing taught in the course is typically not used in the final mini-project that each student has to deliver. It is unfortunate as the construct exists for several programming languages and useful for testing and validating implementations. The reason for the lack of usage is due to the students feeling uncomfortable with the construct. The aim of this activity is to improve the understanding of the construct and thereby utilize it.

2. Planning a teaching activity

In order to improve the students' familiarity with the construct it is desirable to expose them to both applying the construct and to discover contexts for its application. The teaching activity is that each student creates an exercise for a peer, and solve an exercise created by the same peer. The exercises are to be "simple enough" to get experience with the construct should be solvable within 3 hours. The main effort should be spent on their final mini-project. The students must solve their own exercise, to ensure it is solvable. They must also present a context for their exercise to show relevance to a real-world case. After they have solved each other's exercises they discuss and compare them. Student learning during the teaching activity: Consider a problem on different levels of abstraction, Hands-on experience, Consider a challenge from different angles, give and receive feedback.

The teaching activity targets several of the learning goals of the course, including, but not limited to:

- Hands-on Experience
- Context of application of construct
- Work on different levels of abstraction

3. Trying it out in practice

To ensure successful completion of this activity it is essential that the students understand enough to experiment with and seek out knowledge related to the construct. They had a thorough introduction with a class-assisted live-coding session, where each student was asked to contribute. Furthermore, the TA was available for two hours in class to assist with creating the exercises. Afterwards, they had 3 days to create an exercise with skeleton code and 4 days to solve an exercise. Low attendance of only 7 students prevented the discussion and comparison part.

Example exercises:
A new game is being made on top of the famous Dungeons and Dragons franchise.
One of the features of the game is to be able to party up.
However the game creators doesn't want players to party up together with other players that have the same class and race, to ensure diversity.
T: Make a test that goes through all combinations of a two man party.

MAIN POINTS

1. **Main problem/challenge:** Lack of understanding a certain concept
2. **Teaching activity**: Students creating and solving exercises by other students
3. **How did it go?** Positive results, but lack of attendance
4. **What to do next?** Await mini-projects and exam results . Incorporate feedback and consider low-attendance

The final evaluation and assessment consisted of:
1) Examine the exercises and solutions created by the students. **TA assessment: The students understand it, albeit in a simple fashion**
2) Ticket Out the Door (TOD):

- Do you like the structure of the teaching activity? **6 of 7 students wrote Yes**
- Do you feel the activity improved your understanding of combinatorial testing? **All students wrote yes**
- Rate the activity (1 = good, 3 = neutral, 5 = very good) **Average: 4.6**
- Rate the assignment from your peer? (1-5) **Average: 4.2**
- Rate the discussion with your peer? (1-5) **Lack of attendance**
- Suggestions, comments and similar? **Available on request**

4. Looking forward

The activity was successful based on the evaluation, assessment and atmosphere in class.
The next step is to await the final mini-projects and oral exams to see, whether the usage of the construct has increased.
The execution and evaluation of the activity showed that some students spend a lot of effort on creating the perfect exercise, which was not the purpose originally. However, it showed to improve their understanding and learning of tremendously, since it required them to understand the construct in depth.
For introducing the construct, the class-assisted live-coding session worked very well, this was also reflected in the TOD, and will definitely be repeated.
The challenge going forward is the lack of attendance. An approach is to focus the activity on the exercise creation element, as it proved to be very rewarding.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Software and Computing Systems Group
Department of Engineering

Peer feedback

- Improving scientific writing skills

Learning Lab

Abstract:

In the course Organic Chemistry IIIa the focus is on laboratory work. Students are supposed to improve scientific writing skills. The expectation is that a teaching activity consisting of peer feedback will improve the understanding and skill level of the students. The teaching activity was implemented and students responded positively in a following questionnaire.

COURSE FACTS

- Course name: Organic Chemistry IIIa
- Level: Bachelor 3rd year
- ECTS credits : 10
- Language: Danish
- Number of students: 16
- Your role: Lab TA

TEACHING IN PRACTICE

1. Identifying a problem

One of the course goals is to improve the scientific writing skills of the students. The course provides no clear guidelines on how the reports should be made and often the assessment criteria are misunderstood by the students. This means that the correction of reports is very time consuming for both TA's and students. By activating the students in the correction process this can hopefully be reduced and improve their writing skills.

2. Planning a teaching activity

The teaching activity is meant to help the students improve their scientific writing skills which is one of the learning goals for this course.
By providing others with feedback students' ability to understand the assessment criteria increase. Also they will hopefully gain an understanding and opinion on how a report should be written and set up through discussion with the peer.

3. Trying it out in practice

Students hand in a draft report to another group and receive peer feedback the following lab session. These groups are matched up randomly. The students then correct their reports and hand in both the draft and corrected ones to the TA. This allows the TA to see the corrections from the peer and asses the teaching activity.

From the TA's point of view the outcome of the teaching activity has been smaller than expected. It has been very dependent on the students' writing skill level.

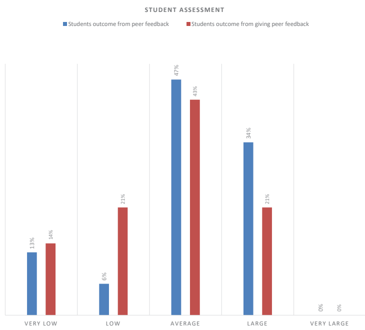

Figure 1: **Student assessment of the teaching activity**

The teaching activity was assessed by the students through a questionnaire. 34% gained a lot from reading other students' reports. 21% gained a lot from the peer feedback they received. 63% of the students would like to do this activity again.

MAIN POINTS

1. **Main problem/challenge:** Minimize the time spent on correction of reports, activate the students in the correction process and increase student understanding of assessment.
2. **Teaching activity**: Peer feedback for lab reports
3. **How did it go?** Students are mostly positive and feel that they have gained skills.
4. **What to do next?** Evaluate whether to make this activity a permanent part of the course. Students are mainly positive.

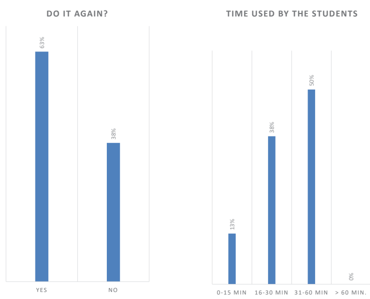

Figure 2: **Student answers on questionnaire**

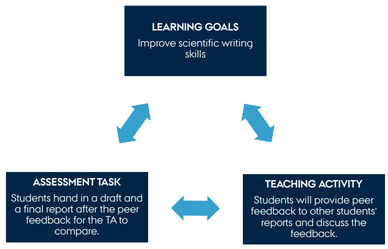

Figure 3: **Constructive alignment**

4. Looking forward

If the teaching activity should be done again the match-up of groups could be less random. This would maybe enhance the learning outcome for the students with a higher writing skill level but would possibly decrease the outcome for less skilled students.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Predicting Simulations
- Building Intuition of Wireless Networks

Learning Lab

Abstract:
Students may not be able to see how the many aspects of a wireless network comes together to form the final product. A simulator is used to solve this issue: Students are shown results of example configurations and asked to predict how new – related – configurations will behave using Think-Pair-Share. After a few repetitions, the students' understanding improved, and they saw the benefits of simulating to gain understanding.

TEACHING IN PRACTICE
1. Identifying a problem

After having studied all separate aspects of building a wireless network, students lack an overall overview of how the many aspects fit together.
When students are asked to predict the behavior of a given wireless network, they often lack the ability to answer meaningfully: This is understandable since the way the performance changes based on network-wide parameters is often non-intuitive, especially if they do not have a deep understanding of every small detail and procedure used in the network.

2. Planning a teaching activity

Typically such understanding is built through solo experiments with real hardware or simulators. An in-class activity is designed to give all students some experience and beginning intuition. The workings of a simple simulator is presented in detail, ensuring that the students understand what is happening at each step. Then students are shown the result for a chosen network configuration. They are then presented with a challenge: They are to predict how (some of) the key performance indicators change when one of the parameters is adjusted.
An example of results is seen on figure 1. The think-pair-share technique is used to let students come to their conclusions, and all students can then be engaged in the discussion of the answer.
The teaching activity aligns well with the course objective to "*model and design applications or simulations related to the course topics*". Achieving this objective is easier if students understand have seen several different network configurations and have compared their performance.

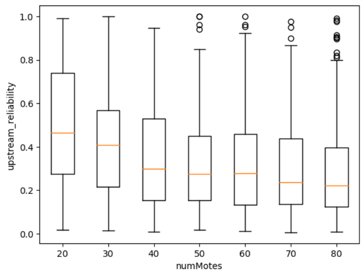

Figure 1: **Example results to predict**
The figure shows the results for networks of given sizes. The students were asked to predict how this figure would change if, for instance, more data was generated in the network.

COURSE FACTS

- Course name: Internet of Things Technology
- Level: Master's
- ECTS credits : 10
- Language: English
- Number of students: 12
- Your role: Guest lecturer

3. Trying it out in practice

The activity was used in the lecture on 29/10/18.
During the first part of the lecture many the students were difficult to engage and get involved: Only few would answer questions when prompted.
When the first challenge was presented, most of the students became involved. In the first iteration the majority did not get the right answer, as expected.
The result was then explained.
Two more challenges were issued, and each time the students became better at predicting the changes and considered a larger number of possibilities, assessed by listening to their internal discussions and the subsequent joint discussion.
The students did not immediately become experts with a solid intuition of how such networks work, but they did understand how a simulator can be extremely useful to argue about highly non-intuitive behavior.

MAIN POINTS

1. **Main challenge:** Wireless networks are non-intuitive, but students need a deep understanding
2. **Teaching activity**: Predicting how simulations change based on parameters changed.
3. **How did it go?** Students' understanding improved and they understand why it is important to simulate.
4. **What to do next?** Ensure that everyone understood, potentially through a small assignment.

4. Looking forward

In general, the teaching activity worked well. It engaged the students, and their understanding did improve. However, some students were less active during the activity. To solidify everyone's understanding, it could be a good idea to present the students with more challenges as a small take-home assignment. This would allow a much better assessment of their individual understanding and gain of the activity.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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STRIP SEQUENCE

- A way to give the student a better overview of the lab exercises

Learning Lab

Abstract: The teaching activity presented on this poster focuses on providing the students with a better overview and understanding of the laboratory exercises of the Molecular Biology II course. The students were given a puzzle composed of strips and a chart in the beginning of the exercises that they had to solve before starting the lab exercises. The students were really positive about the exercise, and they said it helped them a lot.

COURSE FACTS

- Course name: Molecular Biology II
- Level: Bachelor (2. year students)
- ECTS credits : 10
- Language: Danish
- Number of students: 92
- Your role: TA at laboratory

TEACHING IN PRACTICE

1. Identifying a problem

The Molecular Biology II introduces 2. year students to fundamental processes within the cell. The purpose of the course is to qualify the student to analyze and draw conclusions based on original experiments within molecular processes, such as DNA replication, transcription and translation as well as processes such as recombination and DNA repair. The course consists of lectures, theoretical exercises, and lab exercises.

In the lab the students are often confused about what the experiments are actually about – especially when their protocol asks them to do two distinct things on the same day. On one of the lab days they are purifying both Protein and RNA/DNA, and we noticed that the students find it really difficult to distinguish between the purification methods.

2. Planning a teaching activity

The teaching activity aims to provide the students with a better overview and understanding of the lab exercises. This will be done by promoting the active learning of students through puzzles followed by discussions related to the different purification methods. The activity was planned by two TAs: Dennis Johnsen and me, and carried out by all the TA's present in the lab.

3. Trying it out in practice

The teaching activity was performed in week 40. After the usual introduction to the lab exercises, each group (2 students) were handed a folder containing a sheet with two columns and some strips (Fig. 1). The students were asked to arrange the strips on the correct sequence and also on the correct column – one for Protein and one for DNA/RNA. When the students had arranged the strips, an instructor 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 purification protocol. After that the students were allowed to continue with the lab exercises.

In order to evaluate exercise the students were given a "ticket out the door" (Fig. 2) where they had to between 3 different statements, while we would ask them to explain their choice.

Figure 1: The sheet with a column for Protein and a coumn for DNA (A). Strips for the "strip sequence" (B)

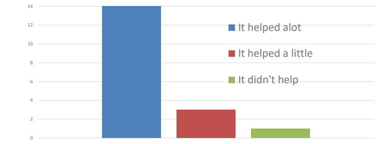
A

DNA studies / Miniprep	Protein studies

B

Choose colonies	Lyse cells
Colony PCR	Spin down cell debris
Agarose gel	Incubate with Ni-beads
Pick clones for mini-prep	Load Ni-suspension on column
Inoculate into LB media	Wash column with high pH
SDS-PAGE	Wash column with low pH
	Elute from column

Figure 2: Ticket out the door. Student answers from one of the labs



3. Conclusion

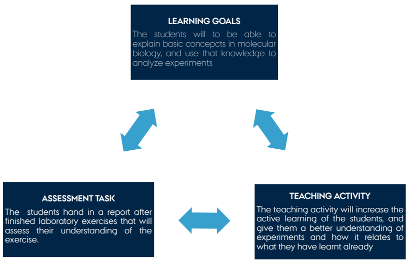
As observed by the TA's and from what the students told us during the "ticket out the door", the exercise helped giving them a better overview and understanding of the exercises. It was easy to see who had read the exercises and prepared properly.

Concluding, it looked like the teaching activity fulfilled its function and promoted active learning in many of the students. What is normally the most time consuming day during the course suddenly became a day where the students could leave before time while having the surplus energy to write the report in-between experiments. Furthermore we got significantly less questions than compared to the week before where we had not planned the activity yet.,

MAIN POINTS

1. **Main problem/challenge:** Problems with understanding and differentiating between methods in the lab.
2. **Teaching activity**: Strip sequence that the students had to solve, followed by a discussion with TA before doing the lab exercises
3. **How did it go?** The student were really positive about the exercise. They said it helped them to understand the exercises better.
4. **What to do next?** The strip sequence could be used for all the lab days, maybe at the next year course.

Figure 4: Constructive alignment
Constructive alignment between the learning goals, teaching activity and assessment of the task.



4. Looking forward

Given the students surplus of energy, fewer questions, less time consuming day in the lab and from the statements they gave afterwards, the activity worked quite well. The next step would be to expand this activity to cover all the lab days, and then implement it next year if possible.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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