PROCEEDINGS: TEACHING@ST SPRING 2018

12 JUNE 2018

AARHUS UNIVERSITY
SCIENCE AND TECHNOLOGY LEARNING LAB

SOLIDUM PETIT IN PROFUNDIS · UNIVERSITAS ARHUSIENSIS

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.

Visit: stll.au.dk

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CONFERENCE PROGRAMME

Time	Event
14:00-15:00	Professor Sue Bennet: **From initial to revisited Learning Design** This keynote presentation will explore how teaching can be considered a form of design, and how learning design is relevant to higher education. The implications for the effective design of teaching and learning (including technology integration), student engagement, learning outcomes, and decision-making will be discussed. This will include a particular focus on how to move from an initial learning design through an iterative process of continuous improvement over time, drawing on evidence. Illustrative examples will be used throughout to show how these ideas have been applied in practice. **Place**: The Aula
15:00-16:00	Poster presentation of participants' teaching experiments. The presentation will be done in parallel tracks. **Place**: The Vandrehal

KEYNOTE BY PROFESSOR SUE BENNETT

Professor Sue Bennett has more than 25 years' experience teaching in Australian universities. She began her career tutor-ing in physics and engineering, before moving on to a position as an academic instructional designer, working closely with teaching staff across disciplines to develop effective designs for face-to-face, online and distance learning. She graduated with a PhD in Education in 2002 and has been a full-time teaching and research academic since. Sue is an internationally-recognised researcher in the area of learning design, with a special interest in supporting university educators to improve their design practices and to integrate information and communication technologies effectively into their teaching.

TEACHER TRAINING POSTERS BY ASSISTANT PROFESSORS

Learning design \ theme	Lectures	Group work* ('theoretical exercises'/TØ)	Group work* (lab/LØ)	Supervision
Flipped classroom				Esben Lorentzen *Long Distance Supervision (LDS) at the Department of Molecular Biology and Genetics*, p. 14
STREAM	Thomas Tørring *Activating students in- and out-of-class using peer instruction and webcast at the Department of Engineering*, p. 17		Martin Ansbjerg Kjær *Accelerering af læring med løbende udprøvninger* at the Aarhus University School of Engineering, p. 11	
Just-in-time Teaching			Henrik Kirk *Just-in-Time Teaching Threads in C# at the Aarhus University School of Engineering*, p. 10	
Peer Instruction		Kasper Kristensen *Exam practice in terms of peer feedback for Chemistry C, Access Course at the Aarhus University School of Engineering*, p. 13	Finn Jensen *Experiment with peer feedback in small-class teaching at the Aarhus University School of Engineering*, p. 9	
Structured discussions				Carsten Eie Frigaard *Retrospective Meetings at the Aarhus University School of Engineering*, p. 7
Ad hoc	Mikkel Melters Pedersen *The Finite Element Method (FEM) at the Department of Engineering*, p. 16	Rikke B. Kjærup *Experiment with active learners in small group teaching at the Department of Animal Science*, p. 12 Mikkel Bo Nielsen *Peer feedback med Peergrade.io at the Aarhus University School of Engineering*, p 15		Thomas Birkballe Hansen *Scientific Project Reflections (sciPR) at the Department of Molecular Biology and Genetics*, p. 8

*Also referred to as 'small-class teaching'

Retrospective Meetings

Carsten Eie Frigaard

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KEYWORDS: Bachelor supervision, supervisor/group-meetings, metacommunication, augmented meetings.

Context/course facts

For 7.th semester Bachelor projects at the School of Engineering (ASE, Science and Technology, 20 ETCS) the groups mainly consists of only two students.

BA-group retrospective meetings are introduced by the supervisor, and held with a bi-weekly or monthly frequency. The retrospective meeting will take about 15 minutes.

Method

The retrospective meeting is a know concept from the SCRUM software process. Here it is meant as a mean for continuously changing and improving the way a staff of software engineers work in smaller teams.

Similar the process of construction systems and producing bachelor reports can be improved by leveraging on the same formal method.

For the retrospective part, a series of per-circulated questions are to be discussed (from spørgeciklen), all dealing with how the students are coping with the process. Its focus is on overall process-improvements: it's about the mindset in the group.

The Metacommunication part comes along as a natural extension of the retrospective-discussion: it is about how the group interplay work, why their process might be facing problems, etc.

Pedagogical Challenge/Purpose

Often small-group meetings can be hampered by ad-hoc planing and lack of structure. This can lead to inefficient meetings and laissez faire supervision due to miscommunication and abandoning of existing formal meeting procedures.

One way to combat this tendency of meeting-dilution is to (re-)introduce formal structure, say via the retrospective meetings.

Learning Outcomes

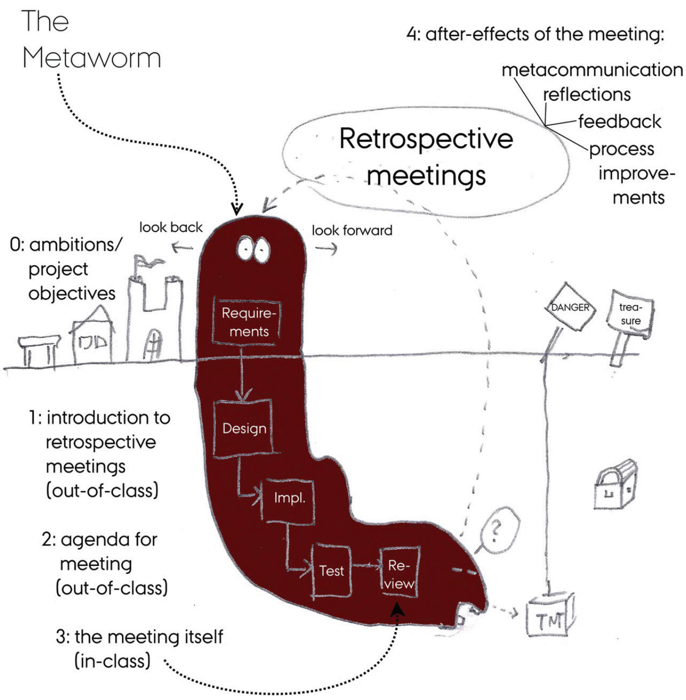
This experiment is focused at one particular Learning Outcome (LO) from the BA-project:

- Plan and execute a project in a project group in collaboration with internal and external partners.

The LO of this experiment: the students will be in a better position to fulfill the BA-learning objective. A secondary LO will be valuable feedback from both student/student and student/supervisor about the progression and potential problems in the project.

EDU-IT role and non-benefits

No students were harmed by dysfunctional websites in this experiment! It is primarily about strengthening human relations, empathy and trustworthiness—all issues that are hard to convey via IT; better to use 'em old analog methods!



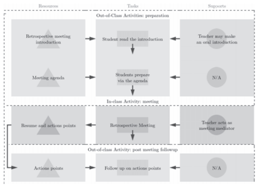


Figure 1: A conceptual drawing for the learning design. The Metaworm represents the process of digging deeper and deeper into an engineering subject—then stopping the worm to do a review trying to re-gain the overall picture. Insight can be collected looking both forward and backward in the review phase (the worm-end with eyes). [right: the corresponding LDTool design.]

Indicators of Impact

The retrospective meeting is a relative straightforward method to use, seen from the supervisor.

The students was generally well prepared for the meetings, and a valuable feedback circle was soon establish between both student/student and student/supervisor.

Objectively, nothing can be said about any evidence of impact: more observations and better qualitative methods are needed here to be able to express impacts with more confidence.

Lessons Learned

Subjectively, the method seems to work well with BA groups. Large groups (say eight students) could benefit from the method even more, since communication in big groups are more difficult.

References

The Scrum process (2018, May 29). The Sprint Retrospective Meeting. Retrieved from https://www.scrum.org/resources/what-is-a-sprint-retrospective.

Wichmann-Hansen, G., & Jensen, T.W.(2013). Processtyring og kommunikation i vejledning., I: Lotte Rienecker, Peter Stray Jørgensen, Jens Dolin og Gitte Holten Ingerslev (red.), Universitetspædagogik, Kbh: Forlaget Samfundslitteratur, pp. 329-50.

SciPR – Scientific Project reflections

Thomas Birkballe Hansen
Assistant Professor, MBG, ST

Scientific Project Reflections (sciPR) – a framework for supervisors to stimulate scientific thinking in students.

Context

The outlined learning design applies predominantly to bachelor and master students; however, for the time being it has only been conducted on one bachelor student, three PhD students and one Postdoc.

Aim

The aim of this learning design was to stimulate creative and scientific thinking by reflecting upon the project at hand – in terms of background knowledge, relevant methodology, major challenges and future directions - to establish in writing the aims and direction of a scientific project. Immediately, this would challenge the student's deeper understanding of the project and commit to a written proposal, ensuring consensus between student and supervisor, and thereby in part address some of the concerns outlined in the **Background/Challenge** rubric. Moreover, the product of the exercise would serve as a project repository covering the ongoing research in the lab to inspire and inform future lab-members.

Design

The methodology used was inspired by SCRIBO – The Research Question and Literature Search Tool for thesis project descriptions, however the specific questions and focus was found to be inadequate for life science research. Instead, questions more relevant for students with high laboratory workload was developed and coined, **SciPR – SCIentific Project Reflections:**

Context:
1. What is the title of your project? – phrase it like its a scientific paper
2. What inspired your choice of topic - what is you motivation?
3. What is the starting point and open question?
4. What is the relevance and perspectives?

Proposed methods / solution:
1. What is the novel hypothesis?
2. What are the most important experiments to answer your question (outline the methodology and the control experiments)?

Gains and obstacles:
1. What are the expected gains?
2. What are the possible obstacles?
3. What is your criteria for success?
4. What objections would you expect to meet from reviewers and how would you address them?
5. If successful, what could be the next steps?

Disposition:
1. Sketch out a disposition of your project – phrase it like subheadings in a result section.

The implementation was divided into four-steps (outlined in **Figure 1**): The **first step** of the experiment was an individual out-of-class activity, where each student should complete a SciPR on their ongoing projects. All the SciPRs were made available on **labbook.au.dk**, a wiki based online repository for laboratory protocols and research monitoring. **Then**, all the participants, i.e. students and the supervisor, provided feedback for at least two SciPRs, also using the online forum. **The third step** was a short in-class presentation of each individual SciPR followed by discussions in plenum, and **finally** the online SciPRs were revised to accommodate the feedback, resulting, hopefully, in a well-structured, concise and comprehensive SciPR for future use.

Results

Six SciPR project descriptions were uploaded to labbook.au.dk from five students and one supervisor (see **Figure 2**). Each SciPR received on average 3.3 **feedback commentaries**. At the following lab-meeting, all students provided a brief **presentation** of their ongoing scientific project based on the SciPR and the obtained peer-feedback. Here, the individual projects were **discussed in plenum** and potential misconceptions were clarified. The peer-review of uploaded SciPRs and the subsequent in-class discussions documented (and stimulated) the students ability to critically assess scientific proposals. Interestingly, although slightly preliminary, the experiment – in particular the peer-reviewing - supplied the students with increased motivation and confidence to engage actively in the scientific discourse, suggesting that the reflections upon the projects of others were perhaps the most rewarding part of the exercise. After the in-class activity, all the SciPRs were **revised** and modified to adhere with the obtained feedback, and consequently the project descriptions became slightly more elaborate and coherent.

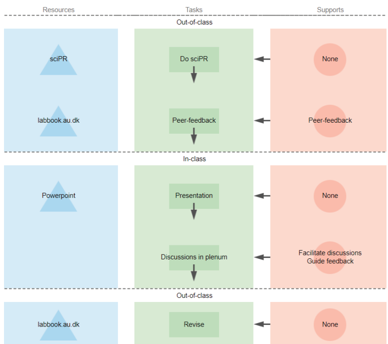


Figure 1. LDTool representation of learning design tasks (https://needle.uow.edu.au/ldt/ld/tY7uzYqA)

Labbook.au.dk

The design was implemented in Labbook.au.dk, which is wiki-based repository used by most student at ST to document their daily research. Here, the student fills in various types of information – both on a more confidential scale and in open or collaborative fora. Moreover, Labbook.au.dk is easy to maintain and searchable, and it provides all the necessary features, e.g. commentaries, editing, and sharing useful for creating SciPRs and for subsequent peer- feedback purposes. Now, apart from the day-to-day scientific progress, our labbook page holds the students reflections and the obtained peer-feedback. This will without doubt serve as a valuable resource in the years to come.

labbook

Background / Challenge

Scientific research is typically a dual operation, in part practical and in part theoretical. Acting as a daily supervisor, the vast majority of supervision covers the practical aspects of research, namely the experimental setup and the protocol details. Consequently, the theoretical aspects, i.e. the scientific context, the overall aims, the rationale and future prospects are often disregarded in the everyday supervision (personal experience, not necessarily a general theme). Thereby, the ability to think and write scientifically will be under-developed during a typical project course. This is problematic for several reasons: i) The student does not develop a scientific mindset capable of conceiving and designing research. ii) The students writing skills are not assessed continuously but only at the very end during thesis preparation. iii) The overall disposition and the narrative of a project, i.e. how to present data in an orderly fashion to convey the take-home message, is not being reflected upon by the student, and iv) The student and supervisor may not share the aim and direction of a project, i.e. no matching expectations.

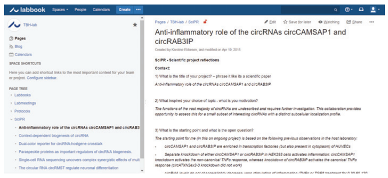


Figure 2. Screendump of SciPR-page on labbook.au.dk comprising the individual project titles and excerpts from one specific SciPR.

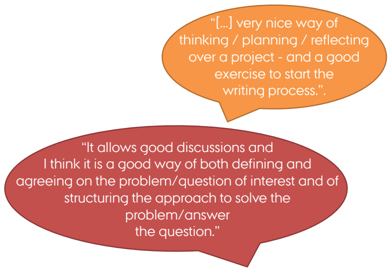


Figure 3. Feedback from students

Conclusion

Here, by answering a set of predefined questions customized to scientific project reflections, the so-called SciPR, students were forced to think and rethink their ongoing research projects. This made the students take a step back from the technical and lab-oriented concerns occupying their daily minds and instead phrase the scientific rationale behind their projects and reflect on the overall disposition in writing. The reflections and the mere written assignment aimed at stimulating and enhancing the scientific mindset in students. This is not quantifiable by any simple approach, and therefore whether the experiment had the intended outcome was difficult to determine, although the evaluation by the students were very positive (**Figure 3**). However, while the actual impact on student mindset by this rather short-term exercise was difficult to assess, the experiment is nonetheless considered successful for the following reasons: i) For the bachelor-student, the SciPR served as a valuable **tool to communicate** a scientific research project. Now, the student has a much more profound conception of the project and not just a simple understanding of the upcoming experiment at a practical level. ii) The SciPRs now serves as a valuable **resource for future lab-members** to rapidly gain knowledge on the ongoing research in the lab, and iii) unexpectedly, the exercise sparked an unprecedented **lust for scientific discussion** amongst the students. Here, the mandatory online peer-reviewing enforced the students to actively engage in the projects of their peers which resulted in many insightful suggestions and fruitful discussions.

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Experiment with peer feedback in Small Class Teaching

Finn Jensen
Assistant professsor, ASE

Keywords*: Lab exercises, Oral presentation, Small class teaching, Peer feedback.*

Pedagogical challenge/purpose

Deep learning by working in small groups combined with peer feedback on oral presentation. Effective feedback gives educational progress and is in this experiment interactive. Repletion of the presented exercises gives better learning

Context/course facts

The courser "Drive Systems for Electric Motors" (Elektriske Drivsystemer) is a newly started not obligatory course (5 ECTS point) on 6-7 Semester Bachelor's Degree Programme in Electrical Energy Technology. There is1 teacher and 21 students. The course is in drive system for electric motors, more specific working with modelling, measurement and control of brushless DC motors. The course consist of lectures mixed with exercises where the presented theory is used and practical experience is achieved for the students by working on own hand in the laboratory and building up simulation models.

Learning outcomes and purpose of learning design

The purpose of this experiment is:-

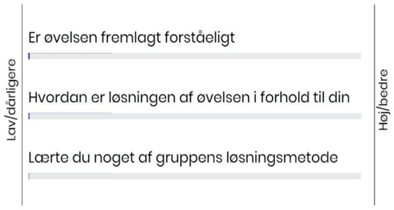
1. The students gives and gets (from each other) feedback on exercises made in the course.
2. The exercises and the results are repeated.
3. The students gets training in oral presentation.

The investigation is if the students have made and understood the exercises and the theory behind the exercises.

Learning design and Educational-IT

Over 2 * 2 hours, the groups alternately present the result of 1 exercise orally for the entire team and receive oral feedback from the teacher and the other students. All students have done all exercises so that what is been presented, has the audience also made. Feedback is from both the other students and the teacher just after a group's presentation. At the same time, an online feedback is made where the students who don't submit, evaluate the solution presented in relation to their own solution to things like methodology, validity of results, etc. Here, the Mentimeters "Scales" are used from 1-5 and an "Open Ended" to comments for each group.

Criterion-based feedback
2 lectures before the students present their exercises, they are presented to the criteria for feedback. These were also posted on Blackboard. This allows the students to organize their own presentation in relation to what they are being evaluated against



Mentimeter "Open Ended" is for comments about the group's presentation and what would you do differently in your practice after this presentation.
After all the groups have submitted and received feedback there is a general evaluation of the experiments value of presentation and feedback based on 4 question

1. Did you learn something from presenting your exercise
2. Did you learn something from GETTING feedback?
3. Did you learn something from GIVING feedback?
4. Was it worth the effort

Indicators of impact

The students had prepared presentations and demonstrated good knowledge of the substance. They were generally well-prepared and utilized presentation through projector fine. Especially 1 group was visibly nervous and was not at all confident in the situation. Professionally there were no big problems with their presentation, but it was clear that they were not used to or confident in an oral presentation.

There was not much oral feedback from the students who did not submit. However, the students contributed verbally with clarifying questions.

In general, the feedback score is above average and there are very few on the minimum score 1, but a part on the maximum score 5.

For the overall evaluation of the value of presentation and feedback, the score is above average

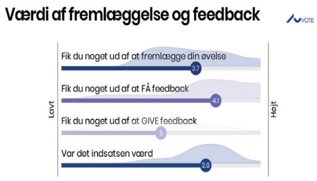


Figure *Value of presentation and feedback*

The big question, was it worth the effort, scores 3.9 on average. Here is the vast majority on 4, one at 5 and 2 on 3.

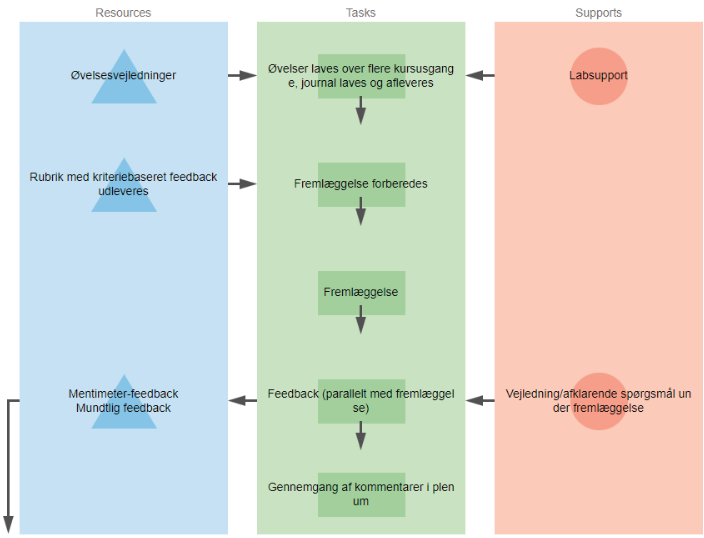


Figure *LDTool representation of learning design.*

EDU-IT role and benefits

Mentimeter is used to provide feedback. It ensures an easy, intuitive and immediate way to get feedbck from everyone, so not only those active contribute. At the same time, documentation is also available

Lessons learned and looking forward

The students perceived it as a positive way to get the material repeated and get a feedback on their work. There nodded when asked if it should be part of the course for the next semester as well, showing that there was a educational benefit from this experiment.
Several students also expressed that they had seen some other solutions to the exercises during the presentation and they would take this into account, if they were to do something similar in the future.

References

Biggs, J. B. & Tang, C. (2011): Teaching for quality learning at university (4th ed.). Maidenhead: McGraw-Hill.
Griffiths (2009) Teaching and learning in small groups.
David Nicol (2010): From monologue to dialogue: improving written feedback processes in mass higher education
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Just-in-Time Teaching Threads in C#

Henrik Kirk
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Keywords: *JIT, preperation, flipped classroom, lecture, exercises, self-study,*

Pedagogical challenge/purpose

The course consists of students from IT engineering which have a great knowledge of threads, and students from Health and Electric engineering.
For students from the latter two groups, this topic is new and experience tells us they are having difficulty with this. How can we solve this without wasting in class time ?

Context/course facts

I4SWD is taught on ASE as a 4th semester course for around 50-90 students. Students are coming from Information and communication Technology (IKT) and where it is a mandatory course and from different branches where it is an optional course. The course is a 5 ETCS point course which are evaluated with a 20 min plural exam with known subjects..

Learning outcomes and purpose of learning design

In this experiment the focus have been to teach students with different background, approx. half of the group have had the topic in some form before, while the other half have no knowledge of this. So the focus has been to get the students to prepare for the lecture and prepare in a degree where each student is ready to use this topic in practice and to build on this in theory.
In the experiment I've focused specifically on how to structure the curriculum to prepare before class and the theory we covers in lecture.

The out-of-class is structured so the students are reading the theory for the 'basic' threads topic, then solving exercises so they can use this basic theory in practice, then they an optional test which is designed so the students can test if they understand the basic problems, if not they can revisit the theory. After the basic theory is understood they can continue with the advanced theory, which lead to the in class activity.
In class we visit the parts of the basic topic the students are experiencing problems with and then continuing with the more advanced theory. After each topic in class the students will get time to solve exercises to get a practical experience with the topic.
This design hopefully connect the theory for each of these topics with some knowledge and experience about how this is applied in practice.

Indicators of impact

To measure the level of preparation done by the students, we have had to approaches The first was to use the test the students where given to test their own understanding and from this go through the theory behind the questions the students didn't answer correctly and secondly ask the student if their preparation was better or worse than before. See Future 3 for result of students own perception of there level of preparation

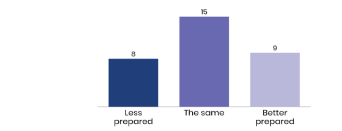
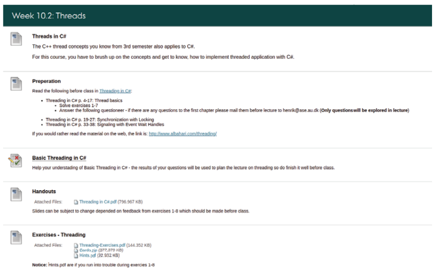


Figure 3: Where students better prepared? There was no significant changes.



Week 10.2: Threads

Threads in C#
The C++ thread concepts you know from 3rd semester also applies to C#.
For this course, you have to brush up on the concepts and get to know, how to implement threaded application with C#.

Preperation
Read the following before class in Threading in C#:

- Threading in C# p. 4-17: Thread basics
  - Solve exercises 1-7
  - Answer the following questioneer - if there are any questions to the first chapter please mail them before lecture to henrik@ase.au.dk (**Only questions will be explored in lecture**)
- Threading in C# p. 19-27: Synchronization with Locking
- Threading in C# p. 33-38: Signaling with Event Wait Handles

If you would rather read the material on the web, the link is: http://www.albahari.com/threading/

Basic Threading in C#
Help your understading of Basic Threading in C# - the results of your questions will be used to plan the lecture on threading so do finish it well before class.

Handouts
Attached Files: Threading in C#.pdf (796.967 KB)
Slides can be subject to change depended on feedback from exercises 1-8 which should be made before class.

Exercises - Threading
Attached Files: Threading-Exercises.pdf (144.352 KB)
Cordo.zip (377,379 KB)
Hints.pdf (22.932 KB)
Notice: Hints.pdf are if you run into trouble during exercies 1-8

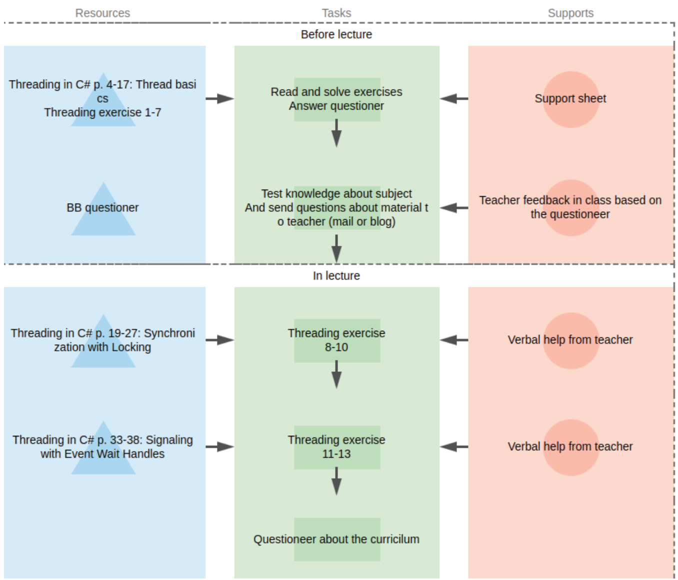


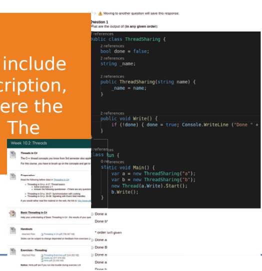
Figure 2. *LDTool representation of learning design used in I4SWD*

Learning design and Educational-IT

The out-of-class activities in this experiment has to purposes, for IKT students to revisit the thread programming and for the students which have the course as an optional course to teach them the basic theory of Threads and asynchronous programming. The out-of-class material consists of basic theory and exercises to familiarize the students with the way to implement the theory in practices but also some texts on the more advanced topics like scheduling and Signaling between processes.

EDU-IT role and benefits

In the experiment I've updated the lecture plan, to include more preparation this includes better exercise description, 'cheat' sheet if the student is stuck and BB-test where the student can test them self before the in-class time. The lecture has been strutured as JiTT



Lessons learned and future

So the learning design showed that it is possible to move at least part of the lecture to self-study and thereby have more time in class for reflection and theory. But there are still some work get more students choosing the course as an optional course to prepare before class.

References
Simkins, Scott (2012) What is Just-in-Time Teaching (JiTT)?
Biggs, John (2012): Lifting the passive student in the taxonomy
Crouch, Catherine H, & Mazur, Eric (2000) Peer Instruction: Ten Years of experience and results

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Accelerering af læring med løbende udprøvninger

Martin Ansbjerg Kjær

Keywords: *Laboratorieøvelser, Løbende udprøvning. læringsdesign*

Pædagogisk udfordring

Erfaring har vist at de studerende ikke når det forventede taksonomiske niveau inden for kritiske elementer på det påtænkte tidspunkt I kursusforløbet. Kan denne læring accelereres?

Fakta om kursus

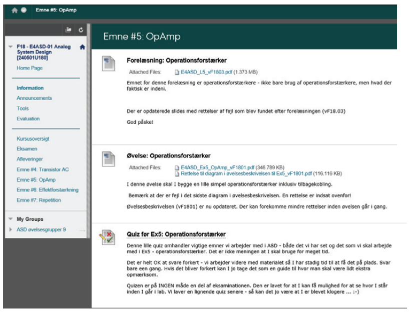
Analog Systemdesign er et 5 ECTS kursus I grundlæggende analog elektronik på 4. semester hos ASE og er bygget op omkring 7 forelæsninger over 5 emner. Til hvert emne er der typisk først 2 lektioner teori og efterfølgende 6 lektioners laboratoriearbejde. Øvelserne er bygget op så de studerende arbejder praktisk med det materiale de har lært under de foregående forelæsninger. Laboratorieøvelserne tjener desuden det formål at de studerende opøver god praksis i laboratoriet, så som fejlfinding, måleteknik, osv. Igennem de første emner lære de studerende om specifikke dele af pensum og hen mod slutningen af kurset begynder de at skulle kombinere de forskellige emner.

Læringsmål og formål men læringsdesign

Den sidste del af kurset sigter mod at den studerende behersker forskellen mellem AC/DC og storsignalmodeller og kan anvende det under dimensionering. Desuden skal den studerende behersker tilbagekobling i forbindelse med design af analoge kredsløb. Erfaringer fra den tidligere kursusafvikling har vist at studerende ikke har opnået det antagende taksonomiske niveau for at kunne kombinere elementerne og bruge dem i sammenhæng, dvs. de har på dette tidspunkt kun nået enkeltstrukturelt niveau. Dette eksperiment forsøger at accelerere læringen mod disse to læringsmål.

Læringsdesign og Educational-IT

Shields (2015) argumenterer for at løbende udprøvning kan være med til at styrke de studerenes selvtillid. Bjælkde (2017) et al. argumentere desuden for at det at den studerend løbende får tilbagemelding på sit eget læringsforløb generelt har en positiv indvirkning på læringen. Derfor er der lagt udprøvninger i form a små quizzer der udbydes over 3 omgange. Sværhedsgraden holdes konstant for at lade den studerende se progressionen i sin egen indlæring og give den studerende selvtillid. Desuden bruges det som en metode til vise de studerende hvad der er i fokus.



Figur 1: Eksempel på udprøvning lagt ind i BlackBoard.

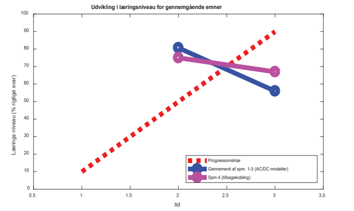
Hver udprøvning består af fire spørgsmål. Spørgsmål 1-3 omhandler forståelsen af AC/DC modeller og relateres alle til en figur med simuleringsresultater. De studerende skal så kombinere viden fra flere emner for at svare på 3 konkrete spørgsmål. De tre spørgsmål variere over de 3 gange, men sværhedsgraden forsøges at holdes ens. Spørgsmål 4 omhandler tilbagekobling og er et åbent spørgsmål hvor de studerende skal lave en vurdering ud fra deres erfaring og komme med et kort argument. Her er det argumentet som er vigtigere end deres konkrete vurdering. Det samme spørgsmål bruges ved alle afviklinger. Det tilstræbes at spørgsmålene har en sværhedsgrad således at kun de 10% dygtigste studerende vil kunne besvare alt rigtigt på 15 minutter ved første afvikling af quizzen og så hæves niveauet til 90 % efter sidste quiz er afviklet.

Quizzerne implementeres i BlackBoard som en samlet test under "Tests, Surveys and Pools". Spørgsmål 1-3 implementeres som Multible Choise mens spørgsmål 4 er implementeret som " Short Answer".

Resultaterne kan downloades efter afviklet besvarelse og behandles i Excel og Matlab. Svarene for spm. 1-3 kombineres med en simpel gennemsnit. Spørgsmål vurderes af underviser og tildeles enten rigtig eller forkert.

Effektindikatorer

Læringsniveauet estimeres med en simple betragtning af andelen af rigtige svar. Designet af kursusforløbet lægger op til at niveauet stiger jævnt under afviklingen som illustreret med den røde stiplede linje I figur 2.



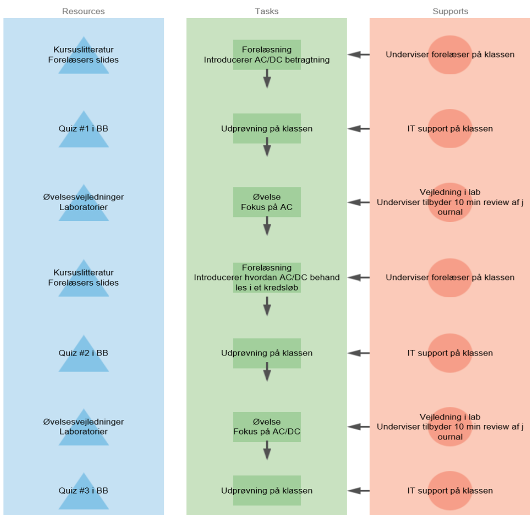
Figur 3: Forventet og målt progression I estimeret læringsniveau.

Udprøvning 1 kunne ikke udføres af tidsmæssige årsager.

Det estimerede læringsudvikling som males ved udprøvning 2 og 3 er vist som den blå og lilla linje I figur 2. Resultaterne afviger signifikant fra den forventede udvikling

Ved udprøvning 2 (som altså var første udførte udprøvning) brugte de studerende væsentligt mere tid ed planlagt. Ved udprøvning 3 (den sidste) blev tidsgrænsen håndhævet mere fast. Det forhold at de studerende havde mere tid til den første udprøvning end til den sidste kan forklare faldet i estimeret læringsniveau.

Det har senere vist sig at de studerende ikke nødvendigvis følger undervisningsplanen tidsmæssigt. Det betyder at ikke alle studerende har gennemført de tiltænkte læringsaktiviteter når en givet udprøvning udføres. Det er derfor svært at vurdere udprøvningens effekt på læringsniveauet.



Figur 2. LDTool repræsentation af læringsdesign til accelerering af læringsniveau.

Erfaringer

De studerende ikke følger læringsplanen rent tidsmæssigt hvilket gør at de ikke kan antages at have udført de påtænkte læringsaktiviteter på de tiltænkte tidspunkter. Dette forstyrrer datamaterialet meget og gør det meget uigennemskueligt. Desuden har det vist sig at fastsættelsen af sværhedsgraden er ret svær og det må forventes at det vil tage nogle afviklinger at få på plads.

EDU-IT

"Test" -funktionaliteten I BlackBoard bruges til at lave 3 udprøvninger. Værktøjet er godt integreret med det de studerende ellers burger og resultaterne er let tilgængelige for efterfølgende analyse.

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Experiment with active learners in small group teaching

Rikke B. Kjærup
Post doc

Keywords*: livestock diseases; small class; activating students; kahoot, padlet, concept maps*

Pedagogical challenge/purpose

Given lectures of 3 hours are often not motivating for the students. Therefore, the overall purpose of this project was to make the lectures less presentation-based and activate more students thereby obtaining a higher level of learning

Context/course facts

This learning design is intended for two lectures ("Infectious diseases in mink" and "Multifactorial and metabolic diseases in mink") in the10 ETCS master course "Livestock diseases and disease prevention where there are usually 10-15 students enrolled. The teaching consists of lecturing combined with theoretical exercises.

Learning outcomes and purpose of learning design

In this course, there are no specific requirements for the instructors on how to teach the students. As an instructor, I am responsible for two lectures about mink diseases. I have just started as an instructor in this course and it will therefore be the first time that I am responsible for the lectures. Looking at how the previous instructors taught the lectures it seems very teacher-focused with the students being passive-learners. This form of passive low-level engagement teaching methods does not support understanding as implied in the learning outcomes for the course that includes verbs from the relational level in the SOLO taxonomy (Biggs, 2012). To support the learning outcomes of the course and ***obtain deeper learning for the students,*** I want to change to lectures from being presentation-centred to being ***more problem-based and active learning centred*** by using tools such as padlet, mentimeter, strips and concept maps during the lectures.

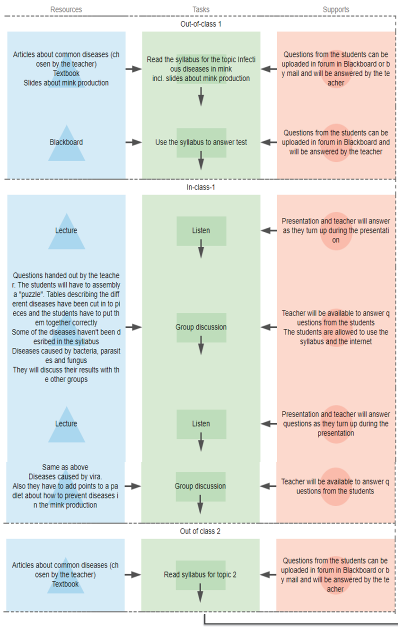
Figure 1: *Digital learning materials such padlet.com, kahoot and blackboard (for sharing of concept maps) was used.*

Learning design and Educational-IT

During module 2 of the teacher training programme, I thought about making a webcast going through some of syllabus. However, due to lack of time this was not possible and instead I put slides in blackboard as part of preparation for the students, including a quiz about the slides.

In the lectures I also included padlet, kahoot and a concept map (on paper of which I uploaded pictures to blackboard after the lecture) (Figure 1). Padlet was part of a group discussion where the students should put up their thoughts about questions made by me and then the answers were discussed in plenum. Kahoot was used during the lecture as clickers to see if the students understood the subject. I chose to let the students do concept maps on paper instead of using IT so I could assess the activity while it was ongoing (Figure 2).

Most of the out-of-class activities were reading of syllabus. Instead of going through the syllabus in a presentation I made different activities for the students (Figure 3). In the first lecture, the students assembled a "puzzle" (strips) with different terms and statements describing different pathogens followed by "cross-over-groups" to discuss their answers. In the second lecture, I gave an example on how to use the Hazard analysis and critical control point (HACCP) method before the students had to use the method in small groups and make concept maps, which were presented in class.



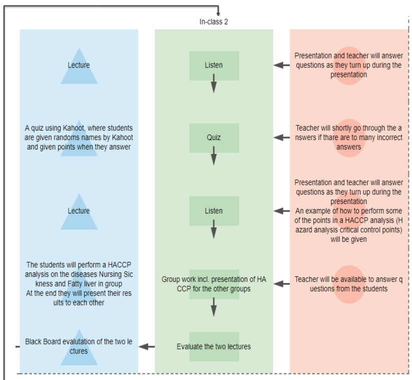


Figure 3. *LDTool representation of learning design used in lectures about mink diseases in the course Livestock diseases and disease prevention*

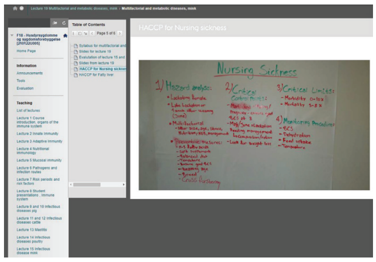


Figure 2. *Mink diseases as implemented in blackboard. A concept map from lecture 2 is shown.*

Indicators of impact

The student activity was assessed during the group work/discussions and my observations during the group work/discussion was that the students were actively participating in the discussions, and I received positive oral feedback from the students on the days of the lectures.

Beside my own observations the students had time to complete an evaluation at the end of the 2nd lecture. Reading these made it clear that I have succeeded in achieving the outcome that I intended since the students in general answered that they liked the shorter presentations, that they have to be more active during the lecture and it helped them to learn.

EDU-IT role and benefits

Benefits of using padlet/kahoot/concept maps are that it will activate the students and this it is important with active learning to get students involved in higher order thinking (University of Toronto). Active learning will also encourage the students to be engaged students as well as increase their content knowledge, critical thinking and recall of course content.

Lessons learned and looking forward

In general, this project has achieved in focusing the teaching more on active-students learning instead of a presentation-based lecturing. The two lectures were about diseases and making the students work more actively with the subjects made it easier for them to learn, and having the students do a HACCP analysis on a disease and presenting it to the others gave a higher understanding of the subject. Looking forward, if I want to make out-of-class activities where students have to be active I have to prepare them for it, since the small quiz I made had a low response rate

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From craftsman to university student: Exam practice in terms of peer feedback for Chemistry C, Access Course

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Assistant professor

Keywords: *Access Course; Chemistry; Peer instruction; small class teaching; assignments; exam practice; assessment;*

Pedagogical challenge

It is not a trivial task to go from a life as a craftsman to a life as a student.

In the grand scheme of things, the purpose of the experiment was to aid the transition from craftsman to student with focus on:

- reading and interpreting scientific information
- finding solutions to scientific problems
- **Main focus:** presenting the solutions in a well-structured manner.

Context

I teach at the access course at Aarhus University School of Engineering, where former craftsmen go through a 1-year course corresponding to a compact high school education. The focus is on the subjects that are relevant for becoming an engineer. In this work I consider the Chemistry C course which had 11 students this semester.

Purpose

I have focused on improving the quality of the students' home assignments which consist of former exam questions. In their home assignments I often encounter basic mistakes, such as:

- They do not understand the question.
- Their explanations are inadequate, i.e., it is not possible to follow their line of reasoning.
- The result/conclusion is not properly emphasized,

I would like to reduce these error types in this experiment. The primary goal of the learning design is thus to improve the students' performances at the final written exam. In the grand scheme of things, a general goal is to improve the students' skills in terms of reading and interpreting scientific information, arriving at solutions to scientific problems, and presenting these solutions in a clear and well-structured manner – all of which are important attributes in their future work life.

Learning design

The learning design is shown in Figure 2. They handed in an assignment, provided peer feedback (Nicol & Macfarlane-Dick, 2005) to each other for this assignment, introduced corrections based on the peer feedback, and handed in the improved assignment. I then corrected both the original and the improved assignments. Before the peer feedback, I explained the criteria for awarding points in terms of the explanatory rubric in Figure 1, which mimics the way points are awarded at the exam. This type of *constructive alignment* (Biggs, 1996) between course activities and the exam is by the students considered to be the most important aspect of a learning design (Machemer & Crawford, 2007).

	Understanding *Did the student understand what he/she was supposed to determine?*	**Method** *Is the applied method presented clearly? Is it correct for this exercise?*	**Conclusion/result** *Is there a highlighted conclusion, which answers precisely the question asked?*
GOOD	The information given in the assignment is interpreted correctly, and it is presented correctly and clearly. (1 point)	Yes. (3 point) If the result is a number (mass, volume, concentration etc.), the 3 points can be divided like this: • 1 point if all used equations are presented correctly, • 1 point if all calculations are presented correctly, • 1 point if the order of the calculations is clear from the presentation.	Yes. (1 point)
INSUFFICIENT	The information given in the assignment is in principle interpreted correctly, but it is not presented clearly. (0,5 points)	To some extent. (1-2 points)	To some extent. (0,5 points) Sloppy conclusion, too many digits, missing unit etc.
BAD	Some or all of the information given in the assignment has been misinterpreted. (0 points)	Not at all. (0 points)	No. (0 points)

Figure 1. *Rubric explaining how points are awarded.*

Indicators of impact

The experiment was carried out in connection with their Assignment 9, while they handed in the following Assignment 10 along with a self-evaluation rubric in the usual way (no peer review, out-of-class). I awarded points for Assignment 9 before and after they introduced corrections as well as for Assignment 10 (Figure 3). The average score of Assignment 9 increased by about 13 percentage points as a result of the exercise. More importantly, they received roughly the same number of points in the follow-up Assignment 10. These numbers indicate that they did learn something from the exercise – in particular, the clarity in their presentations of the applied method and the conclusion improved significantly. In the evaluation, they all recommended the exercise to be carried out again next semester. For example, they write (translated from Danish):

- *"nice to get an exposition of what an assignment must contain"*
- *"nice to get some more time instead of just looking at it for 5 minutes and not realizing the errors that you have made"*
- *"the fact that you could see a clear improvement of the corrected assignment gave you a self-confidence boost"*

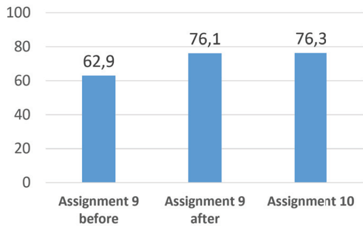

Figure 3. *Average score for Assignment 9 before and after peer feedback as well as for Assignment 10.*

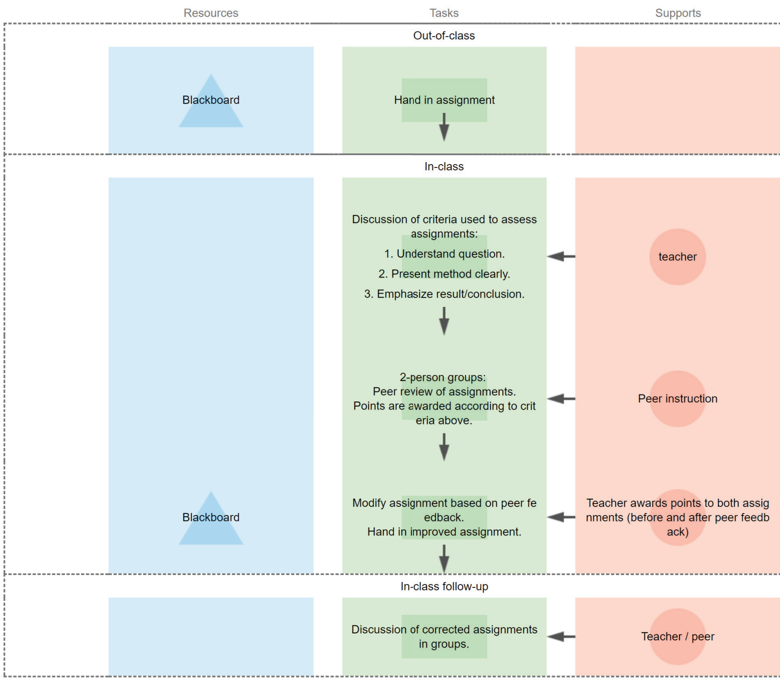

Figure 2. *LDTool visualisation of the learning design.*

EDU-IT role

The students at the access course have 6-8 hours *in-class* each day. For this reason it is not a useful approach to move significant parts of the teaching to *out-of-class* online exercises. In this experiment the role of EDU-IT was thus limited to using Blackboard in connection with handing in assignments and rubics as well as the final evaluation. Unfortunately, the peer feedback functionality in Blackboard is very limited, and it was therefore not possible to use it for the exercise (e.g., it is not possible to attach a file).

However, EDU-IT did play a significant role in my Math B course where I made screen casts to explicate what is expected from the students at the oral exam.

Lessons learned and looking forward

In general, the exercise was successful. However, some students were dissatisfied with the groups. Next semester I will carry out the exercise again and focus more on the group formation. I will also attempt to use Blackboard more in connection with feedback. Finally, I will adapt the exercise to be used also in the Math B Access Course.

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Long Distance Supervision (LDS)

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Keywords*: Molecular biology, PhD student supervision, laboratory work, manuscript preparation*

Context/course facts

This learning design deals with the supervision of PhD students that do part of their practical laboratory work at a foreign research institute (host institute). This is relevant for all PhD students at Science and Technology, Aarhus University, and for sabbaticals by the supervisor or move of the entire lab where students remain at the home institution to finish up their PhD work. The learning design also outlines a strategy for writing a shared manuscript with a PhD student physically working at a different institute at the time of writing.

Learning outcomes and purpose of learning design

The purpose of this learning design is to develop a toolbox and strategy to overcome the problems associated with LDS. Discussing science where theory, previous knowledge and newly available data all have to be weighed and taking into account is something best done in person. Scientists still travel across the globe to attend conferences even in this age of video-conferences and online tools. However, with the right combination of online tools and a clearly formulated plan, it should be possible to minimize potential problems associated with LDS. Specific learning outcomes are:

1) Student will learn how to conduct experiments at host institution without daily guidance of the main supervisor
2) Student will learn to prepare and present experimental data using various online tools
3) Student will learn to write a scientific manuscript for submission to a scientific journal

Learning design and Educational-IT

This learning design uses a mix of in-class (sessions with the PhD student) and out of class modules where the student works independently preparing presentations or manuscripts (see Figure 1). The design was tested together with a PhD student working in Munich, Germany and optimized accordingly. The learning design starts with an in-class meting with the student to prepare and discuss the stay at the host institution. The student is asked to formulate what should be achieved during the stay and to make a realistic time schedule for the work. At this stage it is beneficial to rely on the support of a representative from the host institution to assure that the planned work can be carried out and that the necessary support and equipment is available. After 2-4 weeks at the host institution the student is asked to prepare an overview of the obtained results (out of class) and share these results with the supervisor online via Skype or Adobe Connect. The data can be presented in Powerpoint, as a PDF or via the AU labbook. Feedback and discussion is provided by the supervisor and a plan for future experiments formulated by the student in agreement with the supervisor. Feedback to the student is best provided via an EDU-IT tool that allows for shared screen and a shared drawing tool such as Adobe Connect. These online meetings are scheduled every 2-4 weeks, in agreement with the student, for as long as the visit at the host institution lasts.

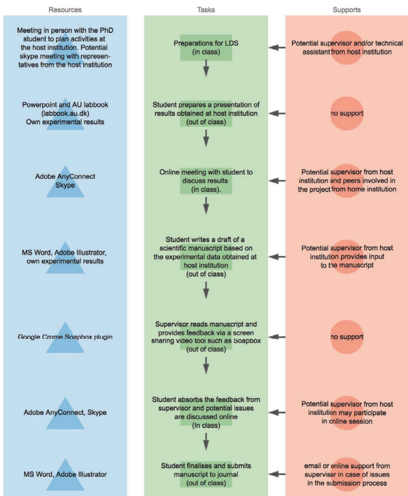

Figure 1. *LDTool representation of learning design used in LDS*
Link to learning design: https://needle.uow.edu.au/ldt/ld/CDXbChmq

LDS – manuscript writing

Typically, shared manuscript writing in the discipline of Molecular Biology relies on MS word with track changes to provide comments and corrections. This works fine with a student author if combined with meetings where the manuscript is discussed in person. However, my experience with LDS showed that the meta-communication with the students is not provided properly in this case and the educational value of this approach is thus rather poor. In a second attempt, the desktop capturing software Soapbox was used to present the manuscript comments and changes to the student with the necessary meta-communication (see Figure 2). This approach appeared to have much better educational value as it taught the student not only which changes to make but also why they should be made. This approach was thus chosen for the learning design shown in Figure 1.

Problem/Challenge:

Supervising from a distance presents some obvious challenges and has the inherent risk of students getting stuck and projects going off the rails. Potential problems range from 'out of sight out of mind' phenomenon, where the supervisor may 'forget' about the student that cannot easily stop by and knock on the office door to discuss the project, to miscommunication and misunderstandings. How are these challenges best overcome?

Impact and optimization

In the experiments leading to the learning design described here, I tested different forms of LDS. For discussing data and experiments with students located elsewhere, the preferable option is one that allows for sharing computer screens and has an possibility of a shared free drawing tool. Combining *Skype* with a presentation tool such as *PowerPoint* and drawing software such as *Adobe Illustrator* may be sufficient. Alternatively, *Adobe Connect* has both a share-screen option and a shared drawing board and may be optimal as an all-in-one solution. No quantitative data are available to evaluate the performance but the learning design shown in Figure 1 was tested in several sessions in a 'real life situation' with a PhD student located in Munich, Germany and changed according to the obtained results.

Lessons learned and looking forward

An important lesson learning was with respect to the shared manuscript writing with a PhD student located elsewhere. In this case, two different approaches were tested. In the pure text-based approach, corrections and comments on the manuscript were provided to the student as track-changes in MS *Word*. This approach did not lend itself well to meta-communication required to actually teach the student about the process of manuscript writing. In the second approach, a piece of desktop recording software was used to provide feedback on figures and part of the manuscript text (Figure 2). This approach appeared to work much better with respect to meta-communication and providing the student with the context for the various corrections and suggestions. One drawback is, however, that this approach, when used alone, is one-way-communication. It is thus probably advisable to follow up with a *Skype or Adobe Connect* session where the student has a chance to ask questions and discuss the suggestions made by the supervisor. This step has ben added to the learning design shown in Figure 1.

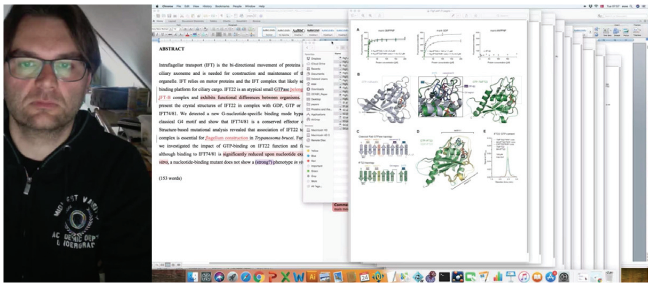

Figure 2. *Screen shot of a feedback video for shared manuscript writing with a PhD student working at the host institution. Both manuscript with track-changes in MS word and figures are preloaded and discussed in the video.*

EDU-IT role and benefits

LDS relies heavily on EDU-IT to provide the most optimal supervision at a distance. It includes preparation of experimental data presentations via AU labbook: labbook.au.dk
Sessions and feedback to the student is best given via Adobe Connect where the possibility to share screens and to use the shared drawing tool is very helpful.
For shared manuscript writing, experience shows that a desktop capturing video tool such as soapbox allows the supervisor to provide the best feedback (including meta-communication) to both text and figures of the manuscript. An example of such a feedback session is found here: soapbox.wistia.com/videos/YOZ6hDrTLb

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Peer feedback med Peergrade.io

Mikkel Bo Nielsen
Cand. Sc., adjunkt ved ASE, AU

Keywords: *Holdundervisning, Peer feedback, løbende opgave, peegrade.io, mentimeter.com, Youtube.com*

Kontekst og facts

MIPRM Projektledelse (5 ECTS) tilbydes efter 5. semester. Der deltager 20-40 studerende og kurset udbydes på engelsk og dansk hvert andet semester. Eksamen er en skriftlig kombineret 24 timers case-opgave (produkt: dokument og slideshow) kombineret med en mundtlig eksamen hvor produkterne danner grundlaget. I kurset stilles der desuden en formativ løbende opgave (5 delopgaver i en fælles case)

Læringsmål og designets formål

Læringsdesignet er målrettet mod flg. Indlæringsmål: Den studerende skal efter kursets kunne vurdere et projekts risici og udføre en risiko-analyse samt demonstrere forståelse for og planlægge kommunikationsprocesser

Læringsdesignets formål er at skabe alignment mellem undervisningen og eksamensformen samt at skabe aktivitet mellem lektionerne. En løbende opgave, se figur 1, er valgt til at skabe dette alignment mellem undervisning og eksamen.

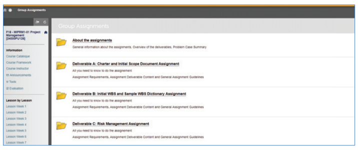

Figure 1. Den løbende opgave (udsnit) på BB

Dette medfører en udfordring i.f.t. at dække behovet for feedback af opgavebesvarelserne. Peer feedback er attraktivt da det, mindsker underviserbelastningen, skærper evnen til at læse projektdokumentation og at give kvalificeret feedback. Peer feedback er også en anvendt teknik i projektledelse og bliver derved et virkelighedstro og fagrelevant værktøj.

Udfordringen med at håndtere og administrere peer feedback blev faciliteret af Peergrade.io, se figur 2 herunder:

Figure 2. The intuitive userinterface of *Peergrade.io*

Læringsdesign og EDU-IT

I projektet er både Før (forberedelse og opgaver), Under (Undervisning, øvelser, diskussioner og eksempler) og Efter (løbende opgave) faserne blevet berørt og forandret med henblik på at skabe bedst mulig læring, se figur 3

I **Før-fasen** benyttes Blackboard (BB) til materiale-henvisning og den studerendes skal danne sig et overblik over området før lektionen. Desuden skal de studerende repetere case beskrivelsen. Der henvises også til en Youtube video om emnet. På BB er der en multiple choice quiz (MCQ1) der besvares via video og/eller litteraturen. Besvarelserne af MCQ1 benyttes som input til lektionen.
Under-fasen – I en dobbeltmoduls lektion om formiddagen gennemgås stoffet med indlagte mindre diskussioner, pair&share og øvelser med udgangspunkt i case-beskrivelsen. Disse udvikler trinvist et Risiko Register - en vital del af den tilhørende del-opgave.

Dette forløb var designet til at sikre at de studerende, efter lektionen, var i et godt indgreb med del-opgaven og overordnet havde forstået delopgavens indhold, detaljeringsgrad, form etc. og derved kan koncentrere sig om kvaliteten af indholdet.. Undervisningsstoffet fastholdes på BB og kan tilgås ved lektionsstart.

Efter-fasen: På BB aktiveres en multiple choice quiz (MCQ2) med eksamensspørgsmål fra en certificeret basisuddannelsen i projektledelse. MCQ2's formål aligner ikke til den løbende opgave eller eksamen, men repeterer og giver de studerende et indblik i niveauet for den certificerede uddannelse.

Opgavebeskrivelse og case er tilgængeligt på BB og Peergrade.io. Opgaven er ikke-obligatorisk og formativ og de studerendes motivation for at aflevere denne, er at der er et betydeligt overlap til eksamenen, hvor besvarelsen kan tilpasses til en anden case. Del-opgaven besvares i grupper med 5-6 medlemmer, hvilket passer med opgavetypen, aligner med eksamensvilkårene og giver de studerende bedre dybdelæring, Biggs & Tang 2011. Opgavebesvarelsen afleveres via Peergrade.io, hvor kriterier/feedback etc. afvikles og fastholdes.

Effektindikatorer

Læringsudbyttet i Før-fasen kan kvantificeres ved at ca. 75% så videoen og ca. 60% deltog i MCQ1 (ca. 80% rigtige). I Under-fasen blev der gjort analoge observationer. Den trinvise fremgang gav tydeligvis en, som ønsket systematisk og struktureret fremgang i.f.t. at behandle definerede risici og derved forme et *Risiko Register*. Idet opgaverne i den løbende opgave er formative er svarprocenten udfordret af de studerendes krydsfelt og motivation. 60% lagde opgaver op til besvarelse og alle disse afgav og modtog peer feedback – efter en del opfordringer.
Mentimeter-undersøgelsen, se figur 4, viste at Peergrade.io er et egnet værktøj og at de studerende har fået mere ud af at læse hinandens opgaver end at modtage feedbacken fra andre.

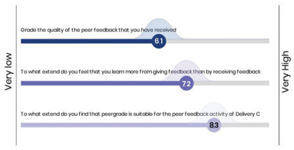

Fig. 4. Resultater fra Mentimeter.com effektundersøgelse

Der er dog flere der i bemærkningerne devaluerer peer feedback og ønsker sig underviser feedback: "Hvad er det rigtige".

Erfaringer og fremsyn

Den primære udfordring er at skærpe kriterierne for feedback – en mulighed er at lade de studerende selv sætte kriterier op. Derudover skal der arbejdes holdningsmæssigt på at peer feedback er ligeex så god og ofte bedre end en underviser-feedback. Sidst skal tidslinjen styres bedre således at feedback bliver givet hurtigere. Overordnet vil jeg gøre brug af den liste af "Dont's" som REF stiller op idet jeg demaksimerede ved f.eks. at de studerende ikke kendte kriterierne for feedback på forhånd.

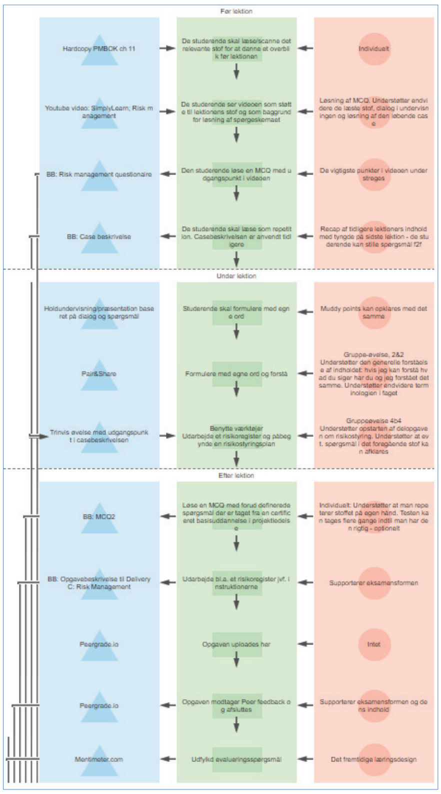

Figure 3. *LDTool repræsentation af læringsdesignet benyttet i projektet*

Pædagogisk udfordring og formal

Udfordringen i projektet er at aktivere de studerende med en formativ opgave, hvor der i deres øjne "kun" afvikles en peer feedback. Derfor er der blevet arbejdet på at aligne opgaven med eksamen og give peer feedback et fagrelevant formål

EDU-IT Rolle og fordele

Det digitale material bestod af video (youtube) i Før-fase,Multiple choices quizzer (Blackboard) i Før/Efter-faserne, henvisning materialer (Blackboard) i Før/Under/Efter-faserne, peer feedback værktøj (Peergrade.io) som benyttes i Efter-fasen og måleværktøj (Mentimeter.com) som benyttes i Efter-fasen. Alle de nævnte digitale værktøjer benyttes i projektets læringsdesign. Specielt Peergrade.io kan fremhæves – det har et meget intuitivt design

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Learning design: Finite Element Method

Mikkel Melters Pedersen
Assistant Professor

Keywords*: Mechanical Engineering; Classical learning design. Limited online, more face-to-face.*

Pedagogical challenge

The main challenge in this course is conveying numerical methods and programming skills to students with very limited experience in this field. The course is therefore supported by a number of extra-curricular lectures/ seminars on Matlab programming in order to support this shortcoming.

Context/course facts

The Finite Element Method (FEM) course is a mandatory course at the first semester of the master in mechanical engineering. It is a 5 ECTS course with teaching in 4 hour modules once a week for 14 weeks, usually with around 40-50 students.

The course basically explains the mathematical background behind the main numerical solution instrument in the mechanical engineering toolbox: FEM analysis. The carpenter-equivalent will be the hammer. The course is quite heavy on math and programming.

It is a standard course in the mechanical engineering curriculum and teaching follows a good, well-established textbook, which is used across many (most) universities.

The teaching is typically carried out as half lecture, half exercises. There are three types of exercises which the students solve right after the lecture under the supervision of the lecturer (and sometimes a teaching assistant):
1) theoretical problems from the textbook
2) programming exercises in Matlab
3) reporting exercises

Learning design and Educational-IT

The learning design is very classic, with focus on being in the same room as the students and talking to them face-to-face.

The learning design thus relies on the three steps for the students:

1) read material at home as preparation
2) come and listen to the lecture
3) try-out new knowledge in exercises.

The applied EDU-IT tools are:

1) file- and information sharing in BlackBoard
2) online forum for question asking (also anonymous)
3) online exchange of reports for peer-feedback

Particularly the latter is expected to help the students perform better at the exam (written, digital), because it also trains the non-core skills needed in this exam form, e.g. digitizing equations.

Thus, very little educational IT is employed and this is intentional. In the current teaching environment at the engineering department, we have the luxury of spending approx. 24h/week in the same room as the students. Typical class size is 15-25, so very often we get to know the names of many of the students. The remaining part of the week, students are free to come to the office to ask questions.

In the opinion of this author, most EDU-IT and the whole transformation to online learning, seems to be attempt to remedy the lack of actual interaction with the students, caused by too large classes and too little teacher time. Luckily, we are in a very different situation at the engineering department.

Furthermore, having tried the online, blended, etc. types of learning on the receiving end (as a student) during the Teacher Training course, I feel more and more confident, that the "old fashion, offline way" is not so bad. At least, it works well for me.

Learning outcomes and purpose of learning design

The overall learning outcome of the course is that the students "should know what goes on behind the surface" of the FEM programs they will use so extensively.

The FE method is a numerical method for solving differential equations, typically used for e.g. stress analysis.

An obvious way of learning a numerical method is of course to implement it. Luckily, this is now possible in a manageable amount of code, such that the students can actually make their own FE programs.

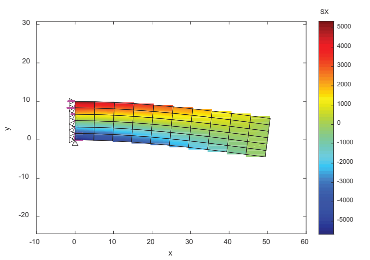

Figure 1: *Several programming exercises culminate in the students making their own simple finite element program.*

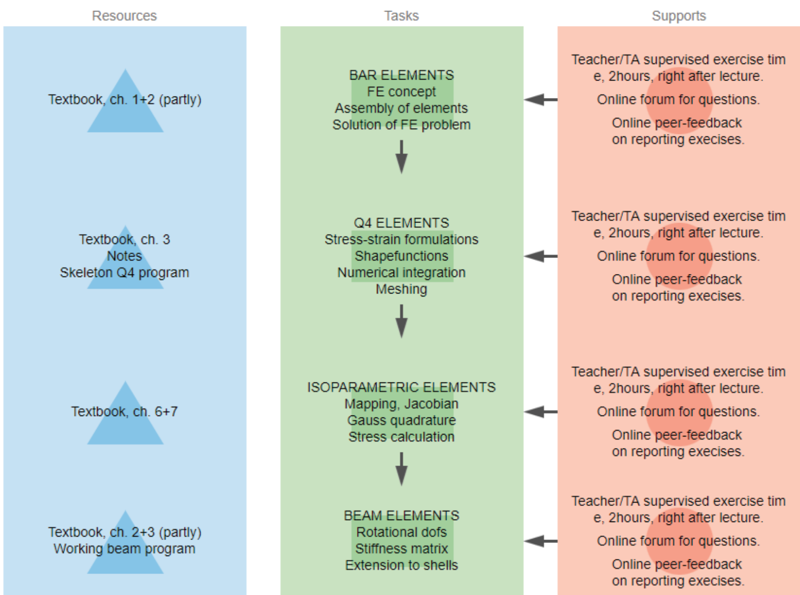

Figure 2: *LDTool representation of learning design: https://needle.uow.edu.au/ldt/ld/F9YRRCmK*

EDU-IT role and benefits

Lessons learned and looking forward

The present course is not yet fully matured and changes quite dramatically from year to year. It is thus not ready for recording of lectures, and probably never will be. However, smaller videos of some of the central derivations will be included in the future.

Activating students in- and out-of-class using peer instruction and webcasts

Thomas Tørring
Assistant Professor, Department of Engineering

Keywords: *Medicinal Chemistry, Biosynthesis; Small class lecturing; STREAM and Flipped classroom; Deep learning*

Pedagogical challenge/purpose

Previous years, the subject of natural products biosynthesis was limited to 2x45 mins in a 5 ETCS course. This year we have expanded both the course (10 ECTS) and the time spend on Biosynthesis 16x45 min + theoretical classes. Instead of broadening the cover material, I wanted to encourage a deeper understanding through active learning.

Medicinal Chemistry II: Chemical Biology and Biosynthesis

The course amounts to 10 ECTS points and is taught at the Department of Chemistry by Assoc. Prof Thomas B. Poulsen and myself. It is composed of 6 x 45 min per week and combines lectures and problem-solving sessions taught by a Ph.D-student. The course ends with a group project that aims to activate the tools and concepts taught during the semester. The project also forms the basis for the exam.

Learning outcomes and purpose of learning design

The learning outcomes described in the course catalog highlights the ability to **explain** and **utilize** the knowledge acquired on product to **predict** new molecules based on genomic data. Moreover, it describes the ability to **reflect** on the interplay between chemistry and biology in discovering new natural products. This is in sharp contrast to previous years where they were only expected to recognize and describe. I wanted to approach this by interrupting the classical lectures with short problem-solving exercises that the students could work on in pairs. I expected this active learning approach to allow the students to reach higher taxonomic levels inspired by previous work (Biggs 2012; Crouch & Mazur 2001). To align the updated learning outcomes with our assessment we have incorporated a group assignment by the end of the semester where the student have to use their gained knowledge to construct a wiki-page on a natural product.

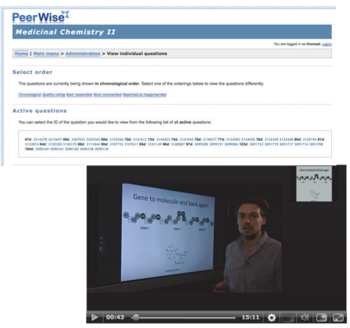

Figure 1: *Screen shot from the Peerwise website and a webcast on Polyketide Biosynthesis*

Learning design and Educational-IT

The learning design is presented in figure 2 and is roughly based on the STREAM model (Godsk 2013). My experiment was to move part of the planned lectures to a webcast format (figure 1), hoping that this would help students prepare for class as well as free up time during class to work more actively on problems in small groups. The webcast were designed to cover the most basic part of the curriculum and with a duration of approximately 15 minutes. In addition to the webcast, a section from a review paper was also assigned as curriculum. When meeting in-class, I started with a short problem for them to solve pairwise. The aim of this was to test if they had prepared for class by viewing the webcast or reading the assigned literature. By walking around and listening in on their discussions, I could evaluate their understanding. After each lecture, the students were given a problem set to solve before meeting with a PhD student in a typical theoretical exercise class. Moreover, they were encouraged to upload 1-2 questions on the Peerwise website (figure 1).

Indicators of impact

My aim was that the students would be able to understand natural product biosynthesis to a level where they could formulate questions of their own and critically approach the research literature. Therefore, I will use their questions on Peerwise and their final "Wiki-project" to evaluate the outcome of the experiment.

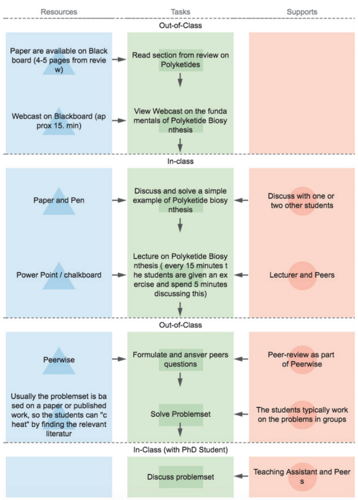

Figure 2. *LDTool representation of learning design used in Medicinal Chemistry II: Chemical Biology and Biosynthesis*

While most of the students actively used Peerwise to answer questions, only a handful of the students actually posted questions of their own (see figure 3). The final project on the other hand appears a large success - despite very few demands on length and scope, the many student have prepared thorough and insightful paper on the provided natural products

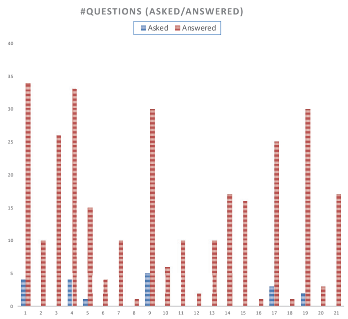

Figure 3: *Numbers of questions asked and answered on Peerwise.*

Lessons learned and looking forward

Overall, I think the re-design and experiment was a success – the students have clearly been able to gain a deeper understanding of natural product biosynthesis and I was actually impressed with their projects. However, there is also room for a lot of improvement. The webcast where merely inserted as links on blackboard and the Lifesize® video format caused a lot of unnecessary browser-specific errors. Next year I want to incorporate the video into a Blackboard learning path, where the students, after watching the video, are asked a few simple questions and maybe asked to describe some key terms in their own words. This would also allow me to change the lecture to address misunderstandings and highlight key questions. I was initially very enthusiastic about Peerwise, but out of 23 students only a handful of the student asked more than 90% of the questions.

EDU-IT role and benefits

Give a short description of your digital learning materials and provide them as attachments, links, screen dumps etc. (include pictures). In addition, describe which technologies and tools will you apply in your learning design (from The Toolbox, week 2, step 2)? In my opinion webcasts was an ideal solution to move content from in-class to out-of-class and enable the students to prepare for class by reading papers and viewing the webcast. We also incorporated Peerwise to enable students to construct questions of their own – this also engages them in a deeper learning.

References

Biggs, J., 2012. What the student does: teaching for enhanced learning. Higher Education Research & Development, 31(1), pp.39–55.
Crouch, C.H. & Mazur, E., 2001. Peer Instruction: Ten years of experience and results. American Journal of Physics, 69(9), pp.970–977.
Godsk, M. 2013. STREAM: a Flexible Model for Transforming Higher Science Education into Blended and Online Learning. E-Learn 722-728

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SCIENCE TEACHING POSTERS
BY PHD STUDENTS

Adventure race

- How to learn more during a competition

Learning Lab

Abstract:

As a common problem in learning process, the students cannot apply a new method in an appropriate way if they do not have a hands-on practice afterwards. In order to create a deep learning and encourage students to participate more in class activity, an adventure race for competitively solving a real problem was planned. It has been experienced that a competition can increase the eagerness of the students for learning.

COURSE FACTS

- **Course name:** Introduction to chemometrics
- **Level:** PhD
- **ECTS credits :** 3
- **Language:** English
- **Number of students:** 24
- **Your role:** Lecturer

TEACHING IN PRACTICE

1. Identifying a problem

I experienced that all students do not participate in the class activity during discussions and exercises. It usually resulted in a monotonous and boring class for students. Thus, desired outcomes cannot be expected from the class.

In this teaching activity, the main challenge is increasing the eagerness of students for participating more in the class activity and evaluating their own learning.

2. Planning a teaching activity

In order to challenge the students to evaluate their own learning outcomes and increase their efforts, the students were involved in an adventure race which enable them to compare their understandings with other students.
A prize, even a small one, can activate the students. During this activity, they can learn how to solve a real problem and choose the proper method. It is a groups activity and the students have the opportunity to learn from each other. As the problem covers all course materials, they can also comprehend the way for selection of the proper method among all possibilities.

References

The course entitled "Introduction to multivariate data analysis (chemometrics)"

3. Trying it out in practice

The students had one hour to solve the problem in groups of 2-3 people.
The problem is to develop a PLS calibration model that can predict the ethanol content (Alc %) in wine from Fourier Transform infrared (IR) spectra, (the data were provided for the students).

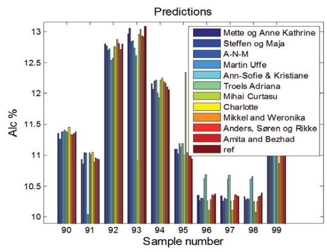


Figure 1: The prediction of the students for the percentage of the alcohol in every wine.

For evaluation of the activity of the students, the root mean square error (RMSE) of every group's solution have been calculated by considering the correct percent of ethanol content. The group with the less RMSE have the best solution and is the winner.

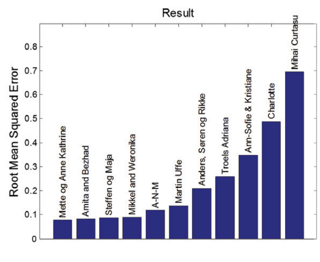


Figure 2: Root mean square error (RMSE) of each students solution to the problem.

MAIN POINTS

1. **Main problem/challenge:** Students evaluate their own learning.
2. **Teaching activity**: An adventure race.
3. **How did it go?** It was motivating and vibrant.
4. **What to do next?** After recognition of student's weakness in modeling, a problem solving session seems useful and necessary.

The activity was evaluated based on the students' effort in finding the best PLS model, but it seems useful to have perception of students on this activity by receiving the feedback.

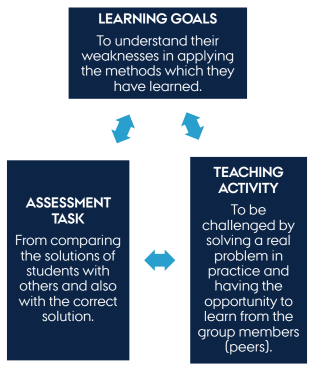


Figure 3: Constructive alignment

4. Looking forward

Competition can always make the people more eager to participate in the activity. Thus, it is a good way to motivate the students.

The reasonable next step might be a problem solving section which the students can get feedback from the lecturer/TA and have the opportunity to ask their questions.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Masoumeh Alinaghi
Metabolomics group
Department of Food Science

The experiment beyond the lab

- The fast route to the extended abstract in experimental physics

Learning Lab

Abstract:

One of the major challenges while teaching is focusing on what the student learns, in particular how can he/she extend what is learn to an abstract level. In order to fulfill this target an original teaching activity related to an experimental physics course is presented. The teaching assistant developed a systematic series of model examples related to the experiments concerning a more extended level of abstraction on the experimental theory/techniques. The students later presented their own model example related to the course learning goals.

COURSE FACTS

- Course name: Experimental Physics 2
- Level: bachelor
- ECTS credits : 5
- Language: English
- Number of students: 32
- Your role: teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

The main goal of a teacher should be assisting and stimulating the students so that they can possibly reach the "extended abstract" described by the SOLO taxonomy. The problem was identified by considering the learning outcomes of the lab course that are strictly related to given optical experiments, meaning that there is no room for extending the practical knowhow learned in the lab and applying it out of there. The extended abstract had to become easily accessible to the students.

2. Planning a teaching activity

"Everyone sits in the prison of his own ideas; he must burst it open, and that in his youth, and so try to test his ideas on reality."[1] When I first read this quote I realized that the most efficient way for an experimentalist to overcome the problem of limiting his ideas to the experiment is to extend them to the reality. Here comes the most exciting and time consuming part of my planning: preparing to solve actual problems of the real world related to every experiment so that I could show them the method to investigate reality. However, the most important part of the teaching activity is centered on the students to which, alongside with other TAs and the lecturer, I asked to give a presentation on how the experimental techniques can be applied in the optic research field and in the "real world".

References

1. *Albert Einstein, George Bernard Shaw (2012). "Einstein on Cosmic Religion and Other Opinions and Aphorisms", p.104, Courier Corporation*

3. Trying it out in practice

The first part of the activity consisted in 4 lectures presented by me at the beginning of every experiment. Here, a physical phenomenon occurring in the real world was analyzed by a proper comparison with the theory and the techniques learned through the experiment. For instance: the refractive index of air in the city of Venice during the peculiar phenomenon of "Stravedamento" or the phosphorescence of a laser through tonic water were shown.

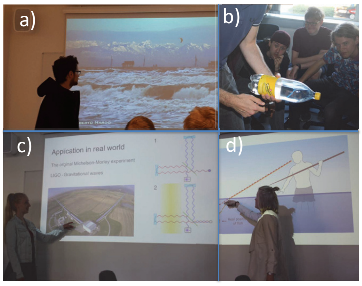


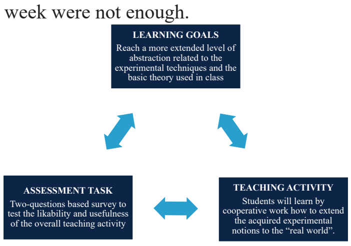
Figure 1: PhD student presenting the phenomenon of (a) "Stravedamento" and (b) phosphorescence. Students presenting application of (c) interferometry in LIGO international experiment and (d) refractive index of water for a fisherman.

The main body of the teaching activity consisted in the students providing a group presentation elaborated in group of four on a optical phenomenon from the real world The presentation received feedbacks by me, fellow PhD teaching assistants and by the course organizer. The group were made by mixing members of previously formed lab groups, so that ideas would be possibly intermixed among students who had different lab experiences. In order to elaborate this lecture students had to actively ideate, elaborate and lay out, both alone and in groups, the presentation. Not only the students received feedbacks from us, but we received feedbacks from them through a simple strategically designed survey that tested the satisfactory level of the activity.

MAIN POINTS

1. **Main problem/challenge:** make the extended abstract accessible
2. **Teaching activity**: extending the knowhow acquired in the lab to the real world by means of a presentation to/from the students.
3. **How did it go?** Results were estimated based on a survey: the first part of the activity scored a higher grade than the second.
4. **What to do next?** continue with this two-step structure of the teaching activity and give more time for the students

20 students took part to the survey, the average grade on the part of the activity concerning the teaching in class scored 8.7/12 on average. The most popular positive comment was that the teacher's presentations were motivating students through interest, on the other side for many students there was not enough theoretical support for the experiment. Finally, an average grade of 7/12 was given to the likability-usefulness of the second part of the teaching activity concerning the students presentation. Many students liked to expand their knowledge to examples in the real life, many also argued that instructions on how to present and the preparation time of one week were not enough.



4. Looking forward

Students were certainly inspired by the attempt of the teacher assistant to show how to extend the knowhow related to the experiment to the real world. Nevertheless, they were not able to replicate this example received from the teaching assistant: more time and clearer instructions must be given next year.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Experimental Electronic Structure Research
Department of Physics and Astronomy

Modified Visual Lists Exercise

Teaching critical thinking skills with small group activities

Learning Lab

Abstract: Engaging students in discussions is a great way to encourage learning. Visual lists are an effective way to break critical thinking into manageable stages that can be applied to many different thought processes. In order to create a safe environment for Danish students (that is sensitive to cultural classroom norms), I have developed a modified visual lists exercise that combines the safety of small group discussion, the logical step-wise process learned through visual lists, and the learning power of whole-class discussions to create a classroom activity that will encourage learning and understanding.

COURSE FACTS

- Course name: Organic Food Systems
- Level: Bachelor's Degree
- ECTS credits : 5 ECTS
- Language: Danish (with this particular lecture in English)
- Number of students: approx. 20
- Your role: Lecturer

TEACHING IN PRACTICE

1. Identifying a problem

Classroom discussions are a great way to engage students and teach the process of thinking critically about a topic. After attempting a whole-class discussion in order to get students to think critically about and questions underlying assumptions of social food movements, I learned that, culturally, Danes do not actively participate in classroom discussions the way I am used to in the United States. To overcome this cultural difference, I need to create a space where students feel safe discussing their thoughts and ideas.

2. Planning a teaching activity

I will use a modified visual lists activity to create a safe environment for the students.

Students will break into small groups and create a three-column chart. First, they will create a list of the reasons short food chains were/are believed to be "good" (eg. better for the environment). Next, they will identify underlying assumptions for each of these beliefs (eg. local farmers use environmentally-friendly techniques). Finally, they will try to think of reasons why and/or examples of when these assumptions are not true. Students will have 15 minutes to complete the activity. Before the students start, I will give one illustrative example. After the activity, we will reconvene and share some of their ideas for 5-10 minutes. Throughout the activity, I will walk around to listen to and, if necessary, guide the group discussions.

<u>Learning Goals:</u>
-**Identify** underlying assumptions of different social food movements
-**Explain** when/why these assumptions might not hold true.

3. Supporting student learning

In addition to creating a "safe" environment for students to engage in discussions, this exercise breaks the critical thinking process into three stages. In order to challenge assumptions, they must first know why short food chains and deemed "good" and what assumptions have lead people to this belief. Only then can they start to challenge these assumptions. By repeating the exercise with circular economy theory, I will reinforce this step-wise and logical critical thinking method. Additionally, by coming to the answers on their own, students are more likely to remember the material. To assess how successful the activity is, I will have students fill out a "ticket out the door". Additionally, I will ask students to answer evaluation questions on menti.com asking if they enjoyed the activity, if I presented it clearly, and if they found it a useful tool to learn how to think critically..

Short Food Value Chains

Why are short food chains believed to be good?	Assumptions that make column 1 true	When/why might these assumptions be wrong?
- They are better for the environment	- Farmers who sell their products locally are using sustainable farming practices	- Farmers who sell their products locally do not necessarily use more environmentally-friendly farming practices than farmers that sell their products globally

Figure 1: Modified Visual List Activity sample
An example of what the visual lists activity will look like for short food value chains. Students will create their lists on padlet paper.

The visual lists activity breaks the critical thinking process into three stages. Students will first fill out column 1. Based on their answers in column 1, they will fill in column 2. Based on their answers in column 2, they will fill in column 3.

MAIN POINTS

1. **Main problem/challenge:** Creating a safe space for group discussions to teach students critical thinking skills.
2. **Teaching activity**: Modified visual lists activity
3. **Supporting student learning:** This activity creates a safe space for students to discuss their thoughts and ideas. It also breaks the critical thinking process into stages, making the thought process more manageable.
4. **What do to next?** I will test out the activity in December. Based on evaluation and assessment results, I will continue to modify and improve the activity for future students.

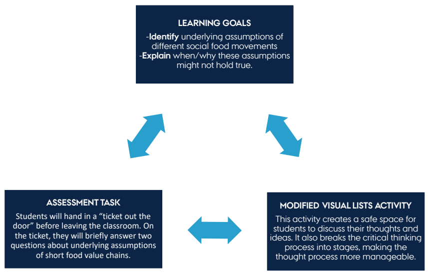

Figure 2: **Constructive alignment**
Alignment between learning goals, teaching activity, and assessment improves learning outcomes.

<u>"Ticket Out The Door" Assessment Questions:</u>
1) Answer yes or no and briefly explain *why:*
Short food value chains are *always good.*

2) Answer yes or no. If yes, give examples. If no, briefly explain why:
We make assumptions about the inherent value of short food value chains.

4. Looking forward

When I prepared to teach this class last December, I was unaware of the cultural differences in Danish and US classrooms. I quickly learned that whole-class discussions are much less engaging for Danish students. To address this issue and while still using underlying assumptions of social food movements to teach critical thinking skills, I have developed the modified visual lists activity. I will test this activity in December when I teach the course again. I will also use evaluation and assessment techniques in order to continually improve the activity for future students.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Agricultural Systems and Sustainability
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Phosphorus sorption index

- Better understanding through an exploratory lab work

Abstract: Inadequate knowledge and understanding of using Phosphorus sorption index (PSI) for estimating Phosphorus (P) leaching potential in lab measurements are found to be major challenge for students as they lack necessary practical knowledge especially when they come from different educational background. To have a better understanding of how to determine PSI, an exploratory lab exercise based on group investigation teaching activity method will be used as an alternative to overcome these challenges. Therefore, a teaching activity with the design of a strip sequence will provide the students with a general overview of each step in the protocol together with theoretical aspects. At the end, both students learning and TA method will be assessed through a one-minute paper. For the next step, this type of TA can be performed to improve skills to anayze the PSI data and obtain better overview of estimating P leaching potential in soil profile.

Learning Lab

Course Facts:

- Course name: Nutrient cycling and Environmental management
- Level : Master students
- ECTS credits : 10 ECTS
- Language: English
- Number of students: 15
- Your role: Lab instructor

TEACHING IN PRACTICE

1. Identifying a problem

The students participating in this course have different theoretical and practical knowledge. Thus, they may have inadequate knowledge and proper understanding of determinig PSI in lab measurement. I have chosen this challenge in my teaching activity (TA) because it is closely related to one of the key learning goals/outcomes of this course

2. Planning a teaching activity

In this teaching activity, students will obtain brief explanation of P sorption index and its application in estimating P leaching potential in soil profile. The TA will support the students on different steps to remember for using single addition of phosphorus in phosphorus sorption experiment. This will provide a better overview for students of the steps of lab analysis with the knowledge behind the application.

This TA will be more interesting because students will not focus on general standardized lab protocols. However, students will follow **exploratory lab exercise** which will be realized by a planned " **Group investigation" teaching approach.**

Learning goals:
Students are intended to learn P sorption index measurements by **improving their skills and knowledge with a better overview** of its application in estimating P leaching potential in soil.

3. Trying it out in practice

Firstly, I will give brief explanation on the principles behind PSI including the lab protocols to serve as a reminder of what they had learnt in the previous lecture. Secondly, the students will be divided into three main groups and will ask them to write on a piece of paper the procedures to follow in PSI experiment. I will give two examples and guide them in getting others steps. Then, each group will arrange the steps in proper sequence by walking round each group and giving them feedback. This activity is to be used for mini-lab experiments. I will help them to find answer if they have any question during the experiment. After each group finish their experiment, they will get together as a main group and share their measured soil P contents and discussed the implication. This TA has not been performed yet.

Figure 1: student measuring soil solution P using spectrophotometer

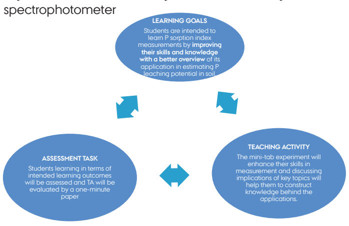


Figure 2: Constructive alignment
Alignment between (1) learning goals (2) learning activity and (3) assessment

MAIN POINTS

1. **Main problem/challenge:** Inadequate knowledge and understanding of P sorption measurements
2. **Teaching activity**: Group investigation technique with mini-lab experiments.
3. **How did it go?** It is my belief that this TA will help to achieve learning outcomes, although this TA has not been performed.
4. **What to do next?** Perform TA to improve skills to analyze P sorption index data and obtain better overview of application

PSI lab exercise

1. Take 1 ml of fitrate into 5 ml tubes and colour the solution (A day before the experiment, I will weigh 2 g of air-dried soil for each group and add 50 mmol/kg P and 2 drops of toulene to soil samples and place them in mechanical shaker for 20-h at 21^{0}C . Then solution will be centrifuged)
2. Allow the solution to stand for about 20 mins. Note the colour change
3. Measure the P contents in the solution using spectrophotometer. Note the intensity of coloure developed and the P contents measured
4. Subtracts amount measured from amount added to obtaind P adsorbed by the soil

The group will share their results and discuss the implications. Reports the results and comment on the implications for susceptibility of each soil type to P leaching

Text box 1. Procedure of lab activity

Students will be assessed individually at the end of TA session by writing a minute paper on what they learnt and to evaluate the teaching activity. Also, students assignment on mini-lab experiment will be included in their final report and which should be submitted in final course assessment.

Results from the evaluation of TA and the assessment of students will be presented in graphs to show the output of the TA.
It is my belief that this TA activity will go a long way to address the key challenge.

The brainstorming section will help them to construct their knowledge based on the intended learning outcomes.

4. Looking forward

This TA activity has not been performed yet, we can not reflect or evaluate on what work well in terms of learning outcomes. Nevertheless, I believe that this TA will help the students to construct knowledge and improve their skills based on intended learning outcomes. Similar approach could also be suggested as the next step to analyze collected PSI data to obtain better overview of phosphorus leaching potential in soil profile.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Musibau Oyeleke Azeez
Soil fertility
Department of Agroecology

Spectroscopic analysis

- Helping students getting an overview of which information to study

Learning Lab

Abstract:

Students often find the task of solving NMR and IR spectra confusing and overwhelming. Using a scheme to collect the relevant data helps them get an overview. By letting the students develop a scheme for solving ^{1}H-NMR themselves they are forced to discuss the different aspects of a spectrum. A poll showed that most students found this exercise helpful even though they knew the scheme beforehand.

COURSE FACTS

- Course name: Organic Chemistry I: Functional Groups and Reactions
- Level: First year bachelors
- ECTS credits : 10
- Language: Danish
- Number of students: 23
- Your role: Lab instructor

TEACHING IN PRACTICE

Identifying a problem

When students start looking at spectroscopic data they often lack the overview of which information to focus on. They tend to lack the understanding of the spectroscopic method and focus on table values in their spectrum solving approach leading to confusion and difficulty in explaining their solution.

Planning a teaching activity

The teaching activity is designed in a manner such that the students will have to discuss the characteristics of ^{1}H-NMR spectra. Rather than just hand them a scheme to fill they need to consider by themselves which information will be relevant for an analysis as well as discuss it with peers. This is thought to help the students get an overview of which information is relevant and why.

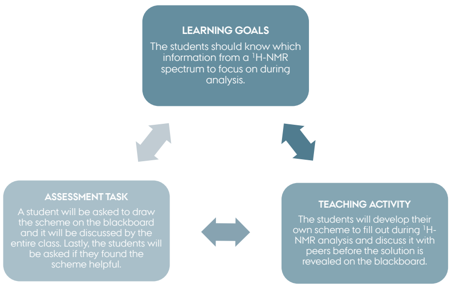


Figure 1: **Constructive alignment**

A short introduction of the subject just before the teaching activity was thought to help the students remember the subject and make it easier for them to discuss it with peers.

Trying it out in practice

The teaching activity was comprised of eight steps:

1) A small introduction to NMR spectroscopy is given by the instructor.
2) The teaching activity is introduced to the students.
3) The individual students make notes on which information is relevant for analysis of ^{1}H-NMR.
4) The students discuss their notes with a peer and make a scheme.
5) A student is asked to draw the scheme on the blackboard.
6) The instructor ask the students to comment on the solution presented on the blackboard.
7) The final scheme is left on the blackboard throughout the class during which the students solve spectra.
8) The students answer a Mentimeter poll in order to evaluate the success of the teaching activity.

The student who was asked to write his solution on the blackboard was also asked to explain each entry in the scheme in order to test his understanding and make sure all students understood the scheme as well as get the students familiarized with the appropriate way of formulating the data. The effects of this was clearly observed throughout the class in the discussions between the students but also in the discussions with the teaching instructor.

MAIN POINTS

1. **Main problem/challenge:** Students lack the overview of which information to focus on from spectroscopic spectra.
2. **Teaching activity**: The students need to develop a table for H-NMR analysis
3. **How did it go?** The teaching activity went well and most students found it helpful.
4. **What to do next?** For future lessons the teaching activity could be expanded to include schemes for ^{13}C-NMR and IR.

The Mentimeter poll showed that most students already had a scheme for solving ^{1}H-NMR spectra but despite that fact most students found the teaching activity helpful.

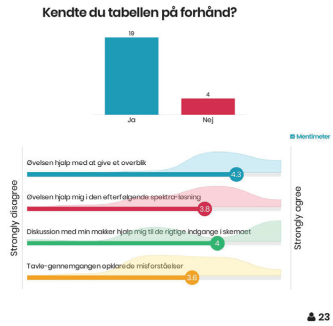


Figure 2: **Mentimeter poll.**
Poll 1: Did you know the scheme beforehand? Yes/No.
Poll 2: Students rate four statements from 1 to 5 with 5 being strongly agree and 1 being strongly disagree.
Statement 1: The teaching activity helped get an overview.
Statement 2: The teaching activity helped me in the spectra-solving.
Statement 3: The discussion with a peer helped me obtain the correct entries in the scheme.
Statement 4: The walk-through on the blackboard clarified misconceptions.

Looking forward

The teaching activity went really well with most students finding it helpful. Furthermore, it was obvious during the rest of the spectra solving exercise that the students had a general idea about how to approach spectra solving and a good vocabulary regarding NMR.
To improve the teaching activity it could be expanded to include schemes for solving ^{13}C-NMR and IR.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Mette Bakke
Gothelf Lab
Interdisciplinary Nanoscience Center

Location-Based Approach for Cell Biology Teaching

Learning Lab

Abstract: For Bioscientists and Medical Students, it is of fundamental importance to recognize and correctly locate cellular and sub-cellular components. Teaching Activities developed for these students are often microscope or laboratory based hands-on exercises, which put a great emphasis on the correct understanding of Biological magnifications and Scale Bars. However, this process always require a certain degree of logical and mathematical thinking, while in real-life situation we size and/or estimate distances based on senses (vision in particular). The following teaching activity is designed to Reproduce Biological Scales and Relative positions of Subcellular Organelles in a Real-Size Room Scale.

COURSE FACTS

- Course name: *Mikroskopisk Anatomi*
- Level: *1st Year Students - Medicine*
- ECTS credits : *4 (out of 10)*
- Language: *Dansk (English is currently accepted)*
- Number of students: *50-55 over 2 TAs*
- Your role: *Teaching Assistant*

1. Learning Challenge

Within my first experience as a TA in the course of "*Mikroskopisk Anatomi*", I observed how hard it was, for most students, to quantify and assess the importance of Scale Bars on Light and Electronic Microscopy (LM and EM) specimens and pictures Even when students showed a correct understanding of the mathematics behind the Calculation of a Picture Magnification, they were often unable to extrapolate and compared the resulting Size Scales with objects of the same dimensions. Therefore, it was very difficult, for most students, to "artificially imagine" how the Real Size of some Microscopic Structure would change, if the Magnification was increased by X-fold.

Humans use vision to assess Spatial Dimensions, not mathematical thinking. Cell Biology itself, especially when activities based on Microscopy are employed, is an extremely spatial subject, in which stress is put on the Location of Cellular and Subcellular Components, Cell polarity, and organelles relative positions.

2. Teaching Activity

The following Teaching Activity has the purpose of increasing students awareness of Biological Dimensions (μm and nm) by comparing sub-cellular organelle localizations in a Real-Size Setting.

The Learning Goals are a better Understanding of Biological Scales and an Complete Review of the Whole Cell Biology program. In addition, the movement and precise localization of students within the class will help them to compare themselves, and their "physical presence", to the Cell Components they represents.

The Activity also summarizes the overall course content (the 8 lectures I am TA for).

KEYPOINTS

1. **Main problem/challenge:** Improve the Understanding of Biological Dimensions
2. **Teaching activity**: Location-based Recall Test
3. **How did it go?** Will be performed *Oct 2018*

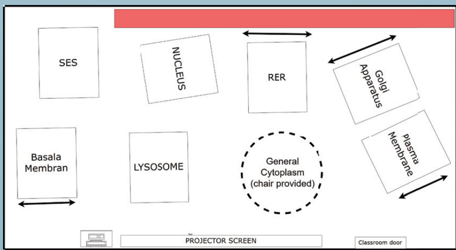
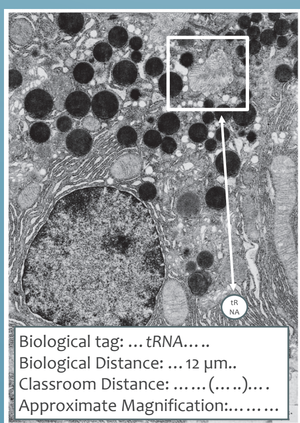


Figure 01: **Representation of sub-cellular locations.** Each table within the TØ classroom will represent a given cell organelle. Notably, the tables are already not-uniformly located, which means the Teaching Activity does not require furniture relocation. Notably, selected Tables (=organelle) have a defined Polarity (*bidirectional arrows*) and students will need to discuss how to allocate themselves correctly while respecting the Organelle's polarity

Histones
Mannitol-6-Phosphat (not-P)
Sphingomyelin
T-Ribonucleic Acid (=*tRNA*)
Tubulin
Chlatrin
Ubiquitin
Lumen

Figure 02: Examples of "Biological Tags" given to Students. A total of 55-60 Tags will be prepared by the TA beforehand on small paper strips, which represents Biological elements that the students encountered during the Course. Students can consult their PC and bibliographic material in case they do not recall the meaning of their tag, but the TA will encourage them to Discuss Among themselves if they feel they have no memory of their tag. Lumen is underlined in connection with Fig. 03



◀ Figure 03: **Material for the Second Part of the Activity.** This EM pictures (which student encountered within lecture 4 /8) represents a pancreatic secretory cell and the Lumen is underlined with a White Box. In this example, the student *tRNA* (italics in Fig.02) who will receive this picture will have to move to the Table "Plasma membrane" and find the student having the nametag "Lumen". Additionally, he will be asked to report an approximate Classroom Distance between the two elements. The Biological Distance, instead, will be provided by the TA

3. Detailed Description of Teaching Activity

Practicalities

1. The Activity Will take place within the second-to-last class
2. Duration: 1 hour (out of 2 total classroom hours)
3. Two TAs will manage the Activity
4. A description of the Activity will be provided on Blackboard at the beginning of the course, and students will be encouraged to read the description before class
5. During TØ, students are already distributed on 7 Different Tables

Descriptions

The activity is based on the fact that Students are normally Unevenly distributed inside the class and sit on 7 tables scattered around the room (Fig 01) Each table will represent a given cell organelle of a pancreatic secretory cell. Each student will be randomly given a **tag** (paper strip) representing sub-cellular components (Fig 02)

The sub-cellular components will represent a biological element which students encountered in previous Lectures, but will not be of immediate recognition (Ex: RNA will be "Ribonucleic Acid). In the second part of the activity, students will receive printed LM or EM pictures of selected cell components studied during the course. Students are asked to provide an approximate Classroom Distance between their Tag and the picture indicated in the element. The Real Biological Distance will be indicated in the picture (Fig 03)

The TAs will be continuously available during the exercises to address students questions.

Step-to-Step Execution

1. TA introduces the Activity (5 min.)
2. Assignments of Names / Organelles (5 min)
3. Students allocate themselves in the right table (15 min). Discussion among students is encouraged at this point
4. TA asks 1 student / table **why** he/she chose that location (10 min). If wrong, students will be asked to switch to the right place.
5. TA distributes Printed pictures (EM or LM) and introduces second part of the activity (5 minutes). One half of the class does the exercise first, the they switch (20 min)
6. From the Classroom Distance, students are encourage to calculate the approximate Magnification compared to the "Real World" settings. This part of the Exercise is Additional, and students are encouraged to finish them home if they run out of time.
7. TA and Students comment the Results and address eventual questions (10 min.)

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Luca Bordoni
Biomedicine - South

Hands-on roots

- Identifying nutrient deficiencies in root system development

Learning Lab

Abstract: The study of roots and root architecture development is one of the biggest challenges for students who chose to focus on plant nutrition. Roots are the unseen plant parts, and it is difficult to relate and to identify how aboveground symptoms can be mirrored underground. Hands-on roots is an activity that was designed to familiarize students with root growth in limiting nutrient transparent media, so that these students could build on their previous knowledge of the aboveground nutrient deficiency symptoms and easily relate them to root health, growth and architecture.

MAIN POINTS

1. **Main problem/challenge:** Students have a difficult time identifying limitations on crop root growth and relating these to aboveground plant symptoms
2. **Teaching activity**: Hands-on roots - identifying nutrient deficiencies in root system development
3. **How *will it go*?** Hopefully students will be engaged and excited about a new way of learning and acquiring knowledge.
4. **What to do next?** Improve the root setup, illustrate more nutrient deficiencies, get feedback after student assessment

COURSE FACTS

- Course name: Crop Nutrition and Physiology
- Level: MSc
- ECTS credits : 10 ECTs
- Language: English
- Number of students: 20 students
- Your role: Instructor

TEACHING IN PRACTICE

1. Identifying a problem - The study of roots and root architecture development is one of **the biggest challenges** for students who chose to focus on plant nutrition. Roots are underground, so we **cannot see them**. Their growth is difficult to predict and **nutrient deficiencies** can greatly affect normal root development. From my TA experience I could see that students had a hard time picturing the different factors that can affect and dictate root growth, which was **prejudicial** towards their understanding of **nutrient limitations belowground**. Furthermore, it was difficult for them to **associate** nutrient deficiency symptoms aboveground to their belowground counterpart.

2. Planning a teaching activity – To address the challenges posed above, I've designed an activity where **roots grown** in different nutrient deficits can be **observed** in **transparent media**. This allows the students to understand how **limiting nutrients** can affect root growth and determine root architecture. Focus is also put on getting the students to relate their **previous knowledge** on the aboveground symptoms of nutrient deficiency with the new information - **how is the belowground plant part affected by the symptoms observed aboveground**.

3. Trying it out in practice - After a **lecture** on **root growth**, focused on how **limiting nutrients** shape root growth, students will be divided into groups and given a major nutrient (P, N, K). Here, they have to relate the **nutrient of choice** to the **built-up knowledge** on how that nutrient shapes root and shoot growth, making a **concept map**. Afterwards, making use of the small class size, they receive **feedback** on their concept maps by group.
In the second stage, each group received a **fully developed root system** grown in a nutrient deficient agar media.

Figure 1: Several root systems growing in transparent agar media – preparation for the activity

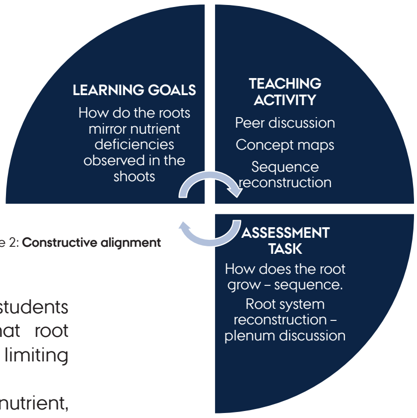


Figure 2: **Constructive alignment**

Given the root systems, the objective is for the students to **reconstruct** the phases that shaped that root systems development, relating that to the limiting nutrient, **building up on previous knowledge**.
Afterwards, each group presents their major nutrient, and the root system reconstruction is taken up in a **plenum discussion**.

The plenum discussion is directed in order to relate the phases of **root development** to **nutrient deficiency symptoms** that they had observed in the **shoot** in previous course activities.
Closing down the activity, Mentimeter will be used to evaluate how interest was spiked and how the students have liked "Hands-on roots"

4. Looking forward – and what to do after October
- Hoping for the students to engaged, ask a lot of questions
- To be able to relate root symptoms to shoot symptoms and use this knowledge at their exam.
- **If successful:**
- More nutrients next time, to prepare students for limiting minor nutrients.
- Use allotted time in a wiser manner, making the activity flow better.
- Alternatively ask the course coordinator for more time.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Carmina Falcato Cabral
Crop Health – Plant Adaptations and Mutualism
Department of Agroecology

Problem Solving Class

- **An attempt to organize ideas**

Learning Lab

Abstract:

Solving problems is THE major thing required to do Mathematics. When beginning to study math my believe is that students should learn to do this in structured way early on, which allows them to organize their ideas in a way which helps them come to a solution or a prove.

COURSE FACTS

- Course name: Linear Algebra
- Level: Bachelor, 1st year
- ECTS credits : 10
- Language: Danish
- Number of students: 60
- Your role: TA (substituting a peer)

TEACHING IN PRACTICE

1. Identifying a problem

From my teaching experience with students on the first year of their bachelor I can tell that the one thing which is the most difficult to learn for the students is how to attack a difficult problem. Especially when there are no or little subquestions which lead the student along a more or less unique path to a solution of the given problem.

2. Planning a teaching activity

This teaching activity will give the students a practical tool at hand which they can use to organize their ideas in a way which naturally might lead them to a solution of a given problem.

3. Trying it out in practice

I handed out the pdf on structured problem solving, inspired by the mathematician George Pólya to the students and briefly went through the steps. Then I gave them an exercise, which was related to the weekly exercises we discussed just before the activity.

The students divided themselves into groups of three and started discussing the problem. I went around guiding them and led their attention to the plan they were asked to follow. Since I only set aside 30 minutes for the activity and the problem turned out to be a bit too hard

I had to give several hints, which sadly took a great deal of the thinking proces from the students. I planned to ask for written anonymous feedback but due to a tight time schedule and due to the level of difficulty of the chosen problem I just managed to get some oral feedback after the activity.

1 Understand the Problem

a) Identify the terms involved in the problem.

b) Look up their definitions in the book.

c) Write out what the assumptions say as explicitly as possible using the definitions.

d) Write out what you need to show as explicitly as possible using the definitions.

2 Devise a Plan

a) Can you find examples satisfying the condition? Do they satisfy the thing you need to prove?

b) Here is a problem related to yours and solved before. Can you use it?

c) If you cannot solve it, mutate the problem: Look at special cases. Strengthen the assumptions or weaken the thing you need to prove.

3 Carrying Out the Plan

a) Check every step.

b) If there is a problem, start over.

4 Looking back

a) Reflect on the problem.

b) Can you think of new related problems to solve?

c) Can the result be used elsewhere?

Figure 1: The structured problem solving plan, inspired by Pólya

MAIN POINTS

1. **Main problem/challenge:** Organize ideas of problem solving.
2. **Teaching activity**: Structured problem solving with the help of Pólya's plan.
3. **How did it go?** Not as intended, level of difficulty has to be adjusted.
4. **What to do next?** Refine the implementation of the activity.

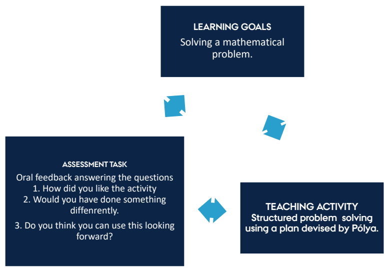


Figure 2 **: Constructive alignment**

4. Looking forward

As became clear above the teaching activity didn't worked out very well in practice. The problem I chose was too difficult and I should have given them more time to digest the given plan. One idea for improvement could be to present the ideas of the 4 steps in the plan before the entire teaching session and then to use it on some more problems with increasing level of difficulty.

Perhaps it would be purposeful to actually go through the whole thinking proces based on a concrete problem.

Although the feedback part failed because we ran out of time and the students had to rush to the next lecture I got the oral feedback that it was a good idea in general, but that I should have chosen another easier problem or given them twice the time.

In regards to this I would set a side more time for feedback next time.

After all, it was an enlightening experience to try something else and see the students reaction on it and I am sure I will try to refine the implementation when teaching next time.

References

George Pólya, *How to Solve It.*

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Jan Christensen
QGM
Department of Mathematics

Phosphorus cycling mapping

- An exercise to increase understanding of concept

Learning Lab

Abstract: In order to improve the students understanding of the phosphorus cycle I developed a student activity, where all students actively should work with the topic. In small groups the students had to draw arrows between the different pools of phosphorus in the soil on a magic white board. All students worked engaged with the topic, and most of them liked and learned from the activity. For next year I will improve the activity by dividing the phosphorus cycle into the organic and inorganic part, and I will also assess the learning goals by a 1-minute paper.

COURSE FACTS

- Course name: plant nutrition
- Level: bachelor
- ECTS credits : 5
- Language: danish
- Number of students: 12
- Your role: lecturer

TEACHING IN PRACTICE

1. Identifying a problem

It can be difficult for students to understand how phosphorus is cycled between different pools in the soil, and hence also why only a small part of applied phosphorus fertilizer is available for plant uptake.

2. Planning a teaching activity

In order for students to get an improved understanding of the phosphorus cycle I planned an activity where the students themselves should actively work with the concept.
In the teaching activity the students are divided into groups, where they have to draw arrows between the different pools in the soil.
The learning goal of the teaching activity is that they ***understand how phosphorus cycles in the soil.***

Figure 1: engaged and active students explain their phosphorus cycle to each other

3. Trying it out in practice

I divided the 12 students into 4 groups. On a power point I wrote the names of the different soil phosphorus pools, and I asked each group to write the names of all the pools on separate post-its notes. Then I handed out a magic white board for each group, and with white board makers they should connect the different pools with arrows, starting either with the application of organic or inorganic fertilizer (2 groups for each fertilizer type). My idea was to make four new groups, and then to ask them to compare the two cycled. But when listening to their conversations, I decided to combine two groups (with different topics) together and make them present their work for each other.

I assessed the students learning by walking around in the room, looking at their cycles and listening to their discussions. Furthermore, I asked questions when I heard something, that they might had misunderstood.

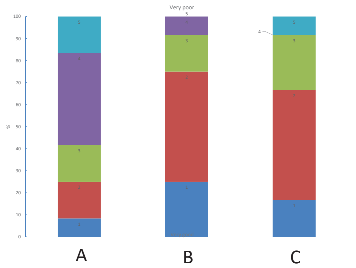


Figure 2: Evaluation on a scale 1-5 (1 is best, 5 is really bad). A) How well did you prepare? B) Did you like the teaching activity? C) Did the activity improve your understanding?

MAIN POINTS

1. **Main problem/challenge:** It can be difficult for students to understand how phosphorus cycles in the soil through the different pools
2. **Teaching activity**: Mapping the phosphorus cycle
3. **How did it go?** Fine. I believe that all students learned the intended outcome
4. **What to do next?** Improve the activity by changing the expert groups to inorganic and organic phosphorus cycle

The students evaluated the teaching activity on a scale 1-5, where 1 is the best (figure 2). 75 % answered 1 or 2 to the question if they liked the activity. 67 % answered 1 or 2 on the question on if the activity improved their understanding. From this I learn that most students improved their understanding of the phosphorus cycle.

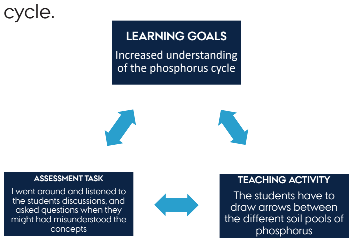


Figure 3: **Constructive alignment**

4. Looking forward

Overall the activity worked well, and the students were engaged in the exercise. In the evaluation of the entire lecture one student wrote: "well balance between lecturing and student activity". I therefore, believe that having this student activity in the course makes the students more engaged in their own learning process and essentially learn more. For next year, I would like to change the concept of the teaching activity a bit, so instead of organic and inorganic fertilizer, half of the groups will focus on the organic phosphorus cycle and the other half on the inorganic. I will change the assessment of their learning goals to a specific question on a 1-minute paper.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Julie Therese Christensen
Soil fertility
Department of Agroecology

Problem Solving Class

- An attempt at structure

Learning Lab

Abstract: Many students have problems solving complex exercises in Mathematics. This is a problem because understanding Mathematics is wholly dependent on understanding the problems that it deals with. Therefore I wanted to try to give my students some heuristics they could use to solve problems. The heuristic process that I presented to them was developed by George Pólya.

COURSE FACTS

- Course name: Differential Equations
- Level: Bachelor
- ECTS credits : 5
- Language: Danish
- Number of students: 60
- Your role: Instructor

TEACHING IN PRACTICE

1. Identifying a problem

Most students are at a loss when asked to solve complex math problems. They do not know where to start and most of the time their teachers do not give them the heuristics necessary to solve a given math problem. I wanted to bring these heuristics out into the light so that the students could attain strategies for future math problems.

2. Planning a teaching activity

Giving the students a heuristic process for solving exercises will help them solve exercises in the future if they learn how to apply the heuristics and it will provoke them into thinking about how one goes about solving an exercise.

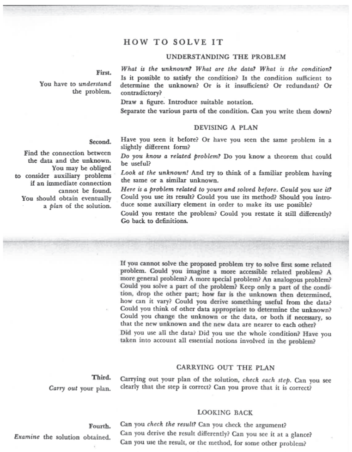
Helping students solve exercises is of paramount importance in mathematics which is a wholly problem-oriented subject.

3. Trying it out in practice

I did Structured Problem Solving. I gave the students an exercise and asked them to solve it using a heuristic process with 4 steps developed by the mathematician George Pólya.

For evaluation I wanted the students to fill out a piece of paper with a description of their process attempting to solve the exercise.

Sadly, they did not do this but instead I got a lot of papers with solution attempts on them.



HOW TO SOLVE IT

UNDERSTANDING THE PROBLEM

First. You have to *understand* the problem.

What is the unknown? What are the data? What is the condition?

Is it possible to satisfy the condition? Is the condition sufficient to determine the unknown? Or is it insufficient? Or redundant? Or contradictory?

Draw a figure. Introduce suitable notation.

Separate the various parts of the condition. Can you write them down?

DEVISING A PLAN

Second. Find the connection between the data and the unknown. You may be obliged to consider auxiliary problems if an immediate connection cannot be found. You should obtain eventually a *plan* of the solution.

Have you seen it before? Or have you seen the same problem in a slightly different form?

Do you know a related problem? Do you know a theorem that could be useful?

Look at the unknown! And try to think of a familiar problem having the same or a similar unknown.

Here is a problem related to yours and solved before. Could you use it? Could you use its result? Could you use its method? Should you introduce some auxiliary element in order to make its use possible?

Could you restate the problem? Could you restate it still differently? Go back to definitions.

If you cannot solve the proposed problem try to solve first some related problem. Could you imagine a more accessible related problem? A more general problem? A more special problem? An analogous problem? Could you solve a part of the problem? Keep only a part of the condition, drop the other part; how far is the unknown then determined, how can it vary? Could you derive something useful from the data? Could you think of other data appropriate to determine the unknown? Could you change the unknown or the data, or both if necessary, so that the new unknown and the new data are nearer to each other?

Did you use all the data? Did you use the whole condition? Have you taken into account all essential notions involved in the problem?

CARRYING OUT THE PLAN

Third. *Carry out* your plan.

Carrying out your plan of the solution, *check each step*. Can you see clearly that the step is correct? Can you prove that it is correct?

LOOKING BACK

Fourth. *Examine* the solution obtained.

Can you *check the result?* Can you check the argument?

Can you derive the result differently? Can you see it at a glance?

Can you use the result, or the method, for some other problem?

Figure 1: The problem solving heuristic from Pólya's book.

MAIN POINTS

1. **Main problem/challenge:** Students lack math problem solving heuristics.
2. **Teaching activity**: Structured Problem Solving.
3. **How did it go?** Not well.
4. **What to do next?** Refine the activity.

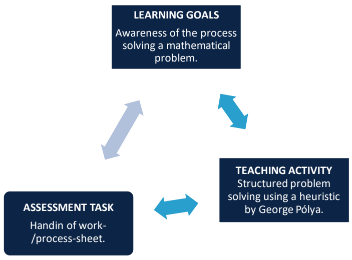


Figure 2: **Constructive alignment**

4. Looking forward

I do not think the activity worked well overall. The exercise chosen was probably too difficult and the sheet with Pólya's process was too wordy to allow the students to quickly get a handle on the situation. Both these things need to be remedied before this activity is attempted again. I did the activity with second year students but I think it is more appropriate with students that have just begun their (serious) mathematical education.

I will say that having the students solve exercises in class allows me to better assess their skills and understanding which is difficult when doing exercise sessions as we normally do them. This has given me food for thought.

References

George Pólya, *How to Solve It.*

Similarities and dissimilarities
- Seeing the difference

Learning Lab

Abstract: Seeing the differences between two very similar processes can be difficult for the students as they often lack the overview and proficient understanding when first encountering the subject. Therefore a teaching activity (TA) was designed where students had to asses statements and evaluate whether a statement were true for either, both or neither processes. The students all evaluated the TA as good and as a helpful tool for understanding similarities and dissimilarities between two processes.

COURSE FACTS

- Course name: Fundamental Molecular Biology
- Level: Bachelor
- ECTS credits : 10
- Language: English
- Number of students: 85
- Your role: Instructor

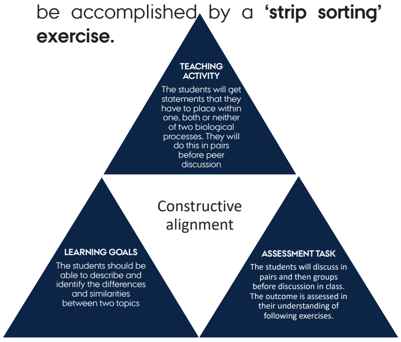
TEACHING IN PRACTICE

1. Identifying a problem

Students enrolled in fundamental molecular biology courses often encounter a number of different cellular processes where many of them are alike. Based on my experience as an instructor and as a student I have found that it can be difficult to get an overview of several alike processes. The goal with the TA is therefore to help the students **obtain a better overview** by identify the parts that are common and which parts differ between processes.

2. Planning a teaching activity

The students should be able to **describe** the processes of replication and transcription by **identifying** and **explaining** each statement to eachother and whether the statement fits to one process, both or neither in order to better understand the molecular details of each process and why they are similar/dissimilar. This will be accomplished by a **'strip sorting' exercise.**



3. Trying it out in practice

The TA is carried out **as part of the theoretical exercises** after the students have completed both subjects to help them obtain a better **overview** and **understanding** of the two processes. The students will work on the TA **in pairs** for 15 minutes and then discuss with **other groups** for 5 minutes before the correct answers will be discussed **in class**. After obtaining a correct overview of the processes, the students are asked to take a snapshot of the TA, for later use in the exams. Finishing, the students will evaluate the TA by answering questions on menti.com.

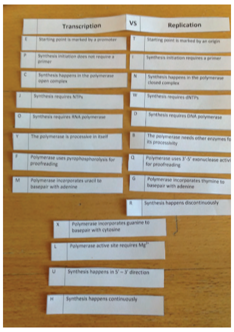


Figure 2: **The 'sorting-strip' TA.** The left column represents the statements that fits to the process of replication and the right column represents the equivalent statements that fits with the process of transcription. The bottom strips represents the statements that are true for both processes. The statements that are not true for either process is not shown here.

The TA was well explained and the students understood the aims of the exercise (fig 3). Overall, the TA was very successful and the students found it helpful **to get a better overview** of the similarities and dissimilarities of two alike processes (fig 4.).

MAIN POINTS

1. **Main problem/challenge: Lack of overview and** understanding of similar processes
2. **Teaching activity**: Statements evaluated for either, both or neither of two processes
3. **How did it go?** The TA was successful
4. **What to do next?** The TA could be implemented as standard when dealing with several similar topics/subjects

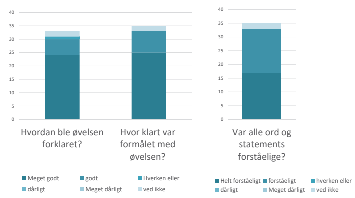


Figure 3: **Evaluation of the presentation of the TA.** Overall, the students understood the exercises and the aim, but some of the words and phrases used might have been a bit unclear.

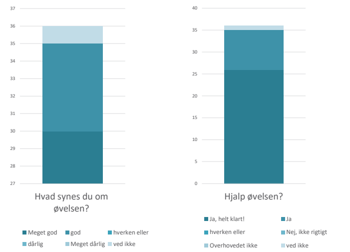


Figure 4: **Evaluation of the TA.** In general, the students liked the exercise and nearly all found it very helpful.

4. Looking forward

In general, the aims of the TA was accomplished and the students obtained a better overview of similar processes. Some found it a little difficult to understand and therefore statements could be altered to better the learning outcomes of the students. This kind of TA could be implemented as a standard in the theoretical exercises of courses with many similar processes that have to be understood by the students.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Solving NMR and IR

- Extracting the Available Information

Abstract:

Students often struggle with understanding the information that can be obtained from NMR and IR spectra and lack the necessary overview to be able to solve these spectra in an organized fashion. Consequently, a teaching activity designed as a think-pair-share activity was introduced to encourage the students to identify which information are available and obtain general schemes to give the students the necessary skills to solve spectra in an organized way. The students evaluated the activity by a mentimeter poll which revealed that it provided a better overview. As such, this TA could be successfully implemented as introduction to the spectra part of this course.

COURSE FACTS

- Course name: Organisk Kemi I: Funktionelle grupper og reaktioner
- Level: Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 16
- Your role: Laboratory Instructor

TEACHING IN PRACTICE

1. Identifying a problem

As a teaching assistant in laboratory exercises of Organic Chemistry I, I have noticed that students often struggle to identify and extract available information from ^{1}H-NMR-, ^{13}C-NMR and IR spectra. Furthermore, they are generally unsure how to methodically solve spectra.

2. Planning a teaching activity

The students should be able to interpret simple NMR- and IR spectra. The teaching activity (TA) is designed to allow the students to identify and acquire the relevant information available in different types of spectra. Furthermore, the students are going to develop general schemes for solving spectra methodically.

This will be accomplished by a think-pair-share activity.

3. Trying it out in practice

Organic Chemistry I laboratory exercises include 3 x 4 hours spectra solving. The TA was performed on the first day to allow the students to consider and understand which information is available in different types of spectra. Furthermore, they develop general schemes for solving spectra in an organized fashion.

Initially, the teaching assistant presented 3 slides of repetition on NMR and explained what was required of the students for 3-4 minutes. The students were asked to think about which entries could be relevant for their schemes by themselves for 2-3 minutes followed by discussion of their schemes in small groups of 2-3 persons for a couple of minutes. Then one student for each spectrum revealed their answer on the blackboard at which point the answers were discussed on class. The schemes were left on the blackboard for the remaining session. Afterwards, the students were solving spectra for 3-3.5 hours. Lastly, the students were asked to evaluate the exercise by answering a mentimeter questionnaire.

^{1}H-NMR:

δ (ppm)	# H	Multiplicitet	# Nabo H	J (Hz)	Tolkning

^{13}C-NMR:

δ (ppm)	Intensitet	Tolkning

IR:

$\tilde{\nu}$ (cm^{-1})	Intensitet	Type	Tolkning

Figure 1: **General schemes developed by the students**.

4. Evaluation

The students responded very well to the TA, and most of the students found that it helped them gain overview and helped them solve spectra in the subsequent part of the session. All steps of the exercise was graded around 4/5 or above and the discussion in small groups helped the students obtain a useful scheme for solving spectra while the class discussion helped the students clear up misconceptions. Most of the students (10 out of 16) had never prepared or seen the tables for solving spectra before the TA.

MAIN POINTS

1. **Main problem/challenge:** Gain overview and understanding of spectra and enable the students to solve these in an organized way.
2. **Teaching activity**: A think-pair-share activity developing schemes for solving spectra.
3. **How did it go?** The TA went well – I believe the students gained useful knowledge and an increased understanding of the topic.
4. **What to do next?** The TA could be implemented as introduction to the spectra part of the laboratory exercises.

Figure 2: **Evaluation of TA.**

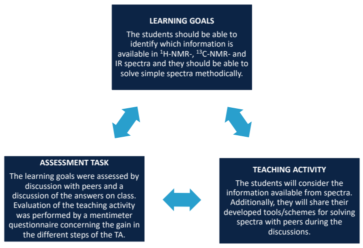

Figure 3: **Constructive alignment**

5. Looking forward

The students were encouraged to identify which useful information could be obtained from the different spectra and discussing their answers, thereby helping them gain a better understanding of the topic. Furthermore, the TA helped the students combine theory and practice for development of a general and useful tool to gain the necessary overview to solve spectra. The activity could be expanded to include MS spectra which was not covered. The activity should be implemented as part of the laboratory exercises before asking the students to solve spectra, as it was well assessed by the students.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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FLASH-REVIEW ON STATISTICS

RECALLING THE BASICS

Learning Lab

Abstract:

When students arrive to the Applied Statistics course, they have different levels on the understanding of some basic statistical concepts, fundamental for later understanding more complex concepts of applied statistics. This activity aimed to solve this problem by using the "Think-Pair-Share" paradigm, where students could first think by themselves about a problem, and later discuss it both in pairs and in group guided by the teaching assistant (TA). The activity was a successful experience, where students engaged in the discussion and felt that the activity helped them remember/re-learn some basic concepts that had been forgotten or never previously understood.

COURSE FACTS

- Course name: **Applied Statistics**
- Level: **2nd year Biology students**
- ECTS credits : **5**
- Language: **Danish/English**
- Number of students: **20 x 3 groups**
- Your role: **Teaching Assistant/Problem solving**

TEACHING IN PRACTICE

1. Identifying a problem

The **students have different levels** when they come to this course. Many of them have forgotten or never really understood some basic concepts in statistics that are fundamental for later learning and understanding the more complex and applied concepts thought in this course.

2. Planning a teaching activity

This teaching activity intents to **help student recall** (re-learn) previous concepts from their Introduction to Statistics Course. At the same time, it **facilitates the TA to know the level** of the students on some basic concepts in statistics, **identifying weak points**, where the TA can focus and spend extra time explaining.

By presenting the students with three basic statistical questions, and allow them to think by themselves and later use pair and plenum discussions, they could recall/learn the difference between continuous and factor variables, that p-values are associated with rejecting or accepting the null hypothesis of a test, and how to interpret the values in an analysis of variance table.

3. Trying it out in practice

The activity took place during the **first day of problem solving exercises**, after lecturer had introduced the course and reminded them some basic concepts. During the activity, the students were presented with a small power point presentation that **asked them about 3 basic statistical concepts** (Figure 1). The activity was based on the **"Think-Pair-Share" paradigm** and separated in three parts:

1) Students **answered the questions by themselves**, introducing their answers in Menti.com.
2) Students **formed pairs**, had the possibility of discussing the same questions **(peer-feedback)**, and filled in again the mentimeter. The second questionnaire had an **extra question to assess** whether the activity (discussing with a peer) helped them improve their answers (Figure 2).
3) At the end, the students were actively asked to participate in **plenum discussion** where we went through the mentimeter results and discussed the hardest and most confusing concepts (**TA-feedback**).

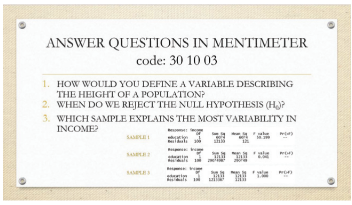

Figure 1. Example of one of the power point presentation slides, containing all three questions.

MAIN POINTS

1. **Main problem/challenge:** Level variability among students.
2. **Teaching activity**: Flash-Review recalling basic statistical concepts.
3. **How did it go?** It was a successful experience, students were happy about the discussions.
4. **What to do next?** Implement this activity as a part of the first day problem solving exercise.

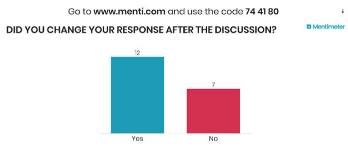

Figure 2. Results of the extra question in the second questionnaire **assessing the value of pair-discussing.**

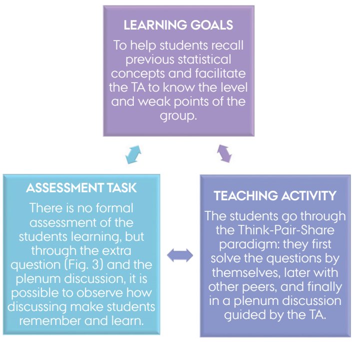

Figure 3: **Constructive alignment**

4. Looking forward

The activity was a success. When later asked, students were happy about the discussion and felt that going through these questions helped them remember/re-learn some basic concepts that had been forgotten or never previously understood. Spending time on the basics and repeating them using easy examples in the discussion was a worth time investment that helped them comprehend some previously missed ideas. I think that making this activity part of the program will ensure the recalling of fundamental concepts, reduce misconceptions and facilitate later understanding of more complex ideas.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Soil organic nitrogen – why does it matter?

- Increasing understanding by linking pools and fluxes of dissolved organic nitrogen in a soil

Learning Lab

Abstract:

A "Mini-lecture-group-discussion" were used to give the students some tools to help them with the interpretation of the dissolved organic nitrogen (DON) cycling in the plant soil systems. Traditionally the cycling of DON have been studied by indirect methods, because a direct method is not available. Therefore there is a high demands for interpretation of results, and consequently a risk of misinterpretation. To help students connect fluxes to pools of DON in the plant soil system, I designed a teaching activity where the students were able to use new knowledge to complete the exercise. After a mini lecture on the topic, the students where given a figure (figure 1) showing selected pools of DON together with a list of fluxes and the students were given 5 minutes to discuss in groups how to link these pools and fluxes. Afterwards through a class discussion we link each pools with the relevant fluxes. The teaching activity were evaluated by a "Ticket out the door", with three questions (figure 2).

TEACHING IN PRACTICE

1. Identifying a problem

There is a high demands of interpretation when studying the cycling of DON in the plant soil system. The pools are what can be analyze, but the fluxes are of most important.
Student typically don't have the experience or the overview to connect the concentration of certain pools of DON to the relevant fluxes in the plant soil system.

2. Planning a teaching activity

The teaching activity consists of two elements. First a mini lecture will introduces the terminology, name both the pools and the fluxes.
Secondly the students will be given a figure showing the pools of the DON cycle in a soil plant system and a list of the fluxes, fig. 1.
This activity will help the students to use the new knowledge from the working memories and make it transfer to the long term memory.

MAIN POINTS

1. **Main problem/challenge:** Lack of experience or overview to connect the concentration of certain pools of DON to the relevant fluxes in the plant soil cycle.
2. **Teaching activity**: "Mini-lecture-group-discussion" and to evaluate the teaching activity: "Ticket out the door"
3. **How did it go?** Overall well, but the execution could be better.
4. **What to do next?** Work on the execution and to give the student more time and space to work out the answer on their own before jumping in.

COURSE FACTS

- Course name: Soil fertility and Biology
- Level: Master
- ECTS credits : 5
- Language: English
- Number of students: 6
- Your role: Plan and conduct a 3 x 45 minutes session on the topic "Soil organic nitrogen"

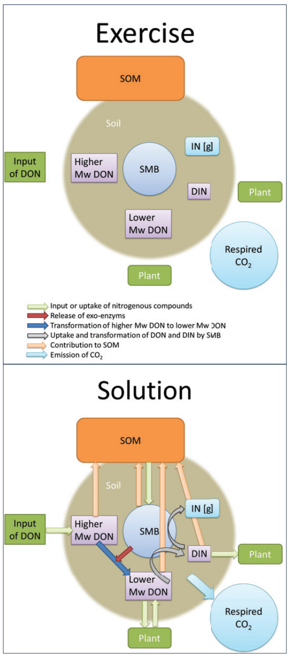
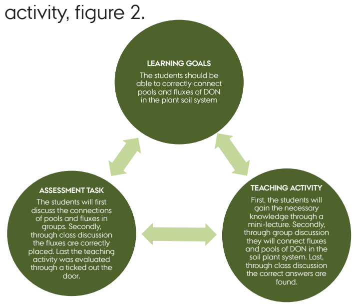


Figure 1: Showing the exercise (top) the students were given and the solution (bottom) that was handed out after the class discussion.

3. Trying it out in practice

The teaching activity was initiated by a mini-lecture (10 min), based on both known and unknown literature, explains the steps in the plant soil DON cycle.
Afterword the "Exercise", figure 1, were handed out. The student had 5 min to discuss in groups of two, to connect the pools with the given fluxes. Some of the students asked questions underway, but most were focused on the exercise.
When time ran out, we had a class discussion were one of the students were "pen-holder" at the black board. Doing the discussion I adjusted the students work.
After the discussion I handed out the "Solution", figure 1.
After the class I asked the students to fill out a small questionnaire to evaluate the activity, figure 2.



		How good was your understanding of the organic nitrogen cycling in the plant soil system before this lecture?			
		Very good	good	poor	none
How well did the teaching activity (the exercise) help you gaining a better understanding of the organic nitrogen cycling in the plant soil system?	Very good		16,7%		
	good	33,3%		50%	
	poor				
	none				
Would you, instead of the teaching activity, have preferred the teacher to go through the organic nitrogen cycling in the plant soil system step by step?					
yes: 66,7		no: 33,3			

Figure 2: Questionnaire used to evaluate the activity

4. Looking forward

Based on the first two questions in the questionnaire, it seems that the teaching activity went well, 50% of the students went from a poor to a good understanding, 16.7% went from a good to a very good understanding, but 33.3% went from a very good to a good understanding. The last question revealed that 66.7% of the students would have preferred not to have the teaching activity. This tells me that I need to work on the execution of the teaching activity. Next time I will introduce the teaching activity before starting the mini lecture, I think the students will be more open to it, if they are prepared for it. I also need to work on given the students more time to answer my questions, I think they will learn more efficient if they are allowed to move in on a question instead of been given the correct answer already after the first try.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Department of Agroecology

From the lecture to the report

- Identify and organize elements through a brainstorming and a sequence strip

Learning Lab

Abstract: Long lectures make students inactive, sleepy and terminate the class by a report can frighten them a bit. The goal of these teaching activities (TAs) are to help the students to recall specifics elements in a more relaxed situation while re-activating them for starting the report. The students felt more confident after they got guidance and feedbacks from me through the brainstorming and the sequence strip. The assessments of the TAs were positive: the students found the activities useful since in average they could only recall half or less than half of the expected elements they would need in the report.

COURSE FACTS

- Course name: Advanced crop Science. "Organic manure I"
- Level: Master
- ECTS credits : 10
- Language: English
- Number of students: 8
- Your role: Assistant lecturer. Introduce students to a report at the end of a lecture

TEACHING IN PRACTICE

1. Identifying a problem

After a 2 hours lecture about organic manure, the students had to start a report which consisted of calculating a manure application rate. Lots of information were given by the lecturer previously and the students might not be able to link all the information to the report. I chose 2 TAs which could help the students to recall/identify and organize the elements which are useful to make their report.

2. Planning a teaching activity

The TAs takes place after a 2-hours lecture and before starting a report.

In the report, the tables representing a manure application plan were already "prepared" (elements of each column written) so that the students had only to make the calculations and filled in the correct numbers to find the manure rate and other mineral fertilizer supplementation. The TAs consisted for the students to find the different elements of each column of the tables by themselves before they can actually obtain the report. The students needed to identify the key elements by brainstorming during 5 minutes in group of two. After sharing their results with the rest of the class, the pairs needed to organize the elements through a sequence strip.

Based on their solutions, I gave them feedbacks as well as the report that they could start.

3. Trying it out in practice

I asked the students to form pairs that will also work together on the report. I asked the students to imagine that they were farmers and brainstorm on the elements they had to take into account for making a manure application plan. After 7 minutes of brainstorming, they shared their answers that I wrote down on the blackboard. I helped them to recall the missing elements. Then, I asked to organize the elements through a sequence strip. I precised that it was several possibilities but at least they should differentiate the initial parameters from the intermediary and final parameters. After 5 minutes of reflection, I walked between groups and asked them to argue on their solutions and guided them on alternative options. I gave them feedbacks and handed them the report to start afterwards.

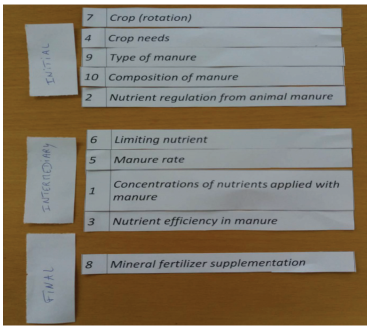

Figure 1: Results of a sequence strip. Strips could be organized differently among the 3 categories: Initial, intermediary and final

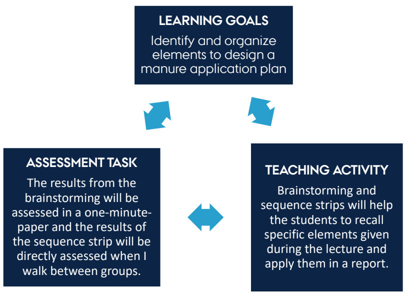

Figure 2: **Constructive alignment**

MAIN POINTS

1. **Main problem/challenge:** Recall and organize information given during a lecture
2. **Teaching activity**: brainstorming and sequence strip
3. **How did it go?** Good. All students participated but they did not find a lot of right elements. This was due to the fact that the focus of the lecture and the report were slightly different.
4. **What to do next?** I will give the lecture next year and try to adjust better the topic of the report to the lecture. Therefore the TAs would be relevant for both as a conclusion of the lecture and an introduction to the report.

The TAs were assessed through a one-minute-paper at the end of the session.

Were the teaching activities useful for you to recall knowledge given during the lecture?

Extremely useful	Very useful	Somewhat useful	Not so useful	Not at all useful
-	7/8	1/8	-	-

How many elements did you find yourself?

0	1	2	3	4	5	6	7	8	9
-	-	-	-	2/8	6/8	-	-	-	-

Figure 3: Assessment of the TAs and the learning goal of the brainstorming

All the students found the teaching activities somewhat or very useful. Indeed, they could recall only 4 to 5 elements out of 10. Many other elements given by the students were not in the list but they could still use them later in one of the question of the report. Few elements given by the students were right but expressed in different words. In order to use the same vocabulary, I chose to reformulate their answers on the blackboard and gave them printed strips instead of using their own words written on a postits for example.

4. Looking forward

The students were active and participative in both teaching activities. The activities helped them to recall elements given in a lecture and applied them in a practical exercise. A next step would be to improve the link between the lecture and the TAs by putting more emphasis during the lecture on the key elements to recall later in the TAs and in the report.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Soil fertility
Department of Agroecology

Observation techniques in animal behavior studies

- Concept understanding through a view list

Learning Lab

Abstract: Choosing the most appropriate observation technique is an important step in animal behavior studies. Using a view list, students worked in groups to determine the most suitable observation techniques in different animal behavior tests. Subsequently, they listed their choices and arguments in a magic paper and presented in plenum. Based on students' answers and evaluation, the teaching activity was relevant to understand the presented concepts and should continue in future courses. Although, extra time should be offered for group discussion.

COURSE FACTS

- Course name: Behaviour in Domesticated Animals
- Level: Masters
- ECTS credits : 10
- Language: English
- Number of students: 7
- Your role: Lecturer/TA

TEACHING IN PRACTICE

1. Identifying a problem

The development and implementation of an animal behaviour study requires choosing a behaviour observation method. Students often have difficulties to distinguish between different methods and select the most appropriate one for a given behaviour test.

2. Planning a teaching activity

Initially, students were presented to theory on data collection, observation techniques, and reporting in animal behaviour studies. Thereafter, they were divided in groups and assigned to a testing situation. Using a view list, they were expected to learn and distinguish presented observation techniques. Such knowledge should be useful when they prepare their protocols to conduct a practical exercise in one animal system at some point in the course.

- Learning goals:

Through group work and plenum discussion, students were intended to reflect on different observation techniques and critically compare them upon examples of given behavioural studies.

References

Martin and Bateson, 2007. Measuring Behaviour, An Introductory Guide - chapter 5. Recording methods

3. Trying it out in practice

The students watched two short video clips, one on play behaviour in calves and another on feeding behaviour in cows. Other information, such as time length and goals of the tests, were provided. Subsequently, the students were divided in two groups and each group came up with the most suitable observation techniques to answer a specific task in one testing situation. After 20 minutes of group discussion, they were asked to list on a magic paper the strengths and weaknesses of their choices (Figure 1) and discuss them in plenum.

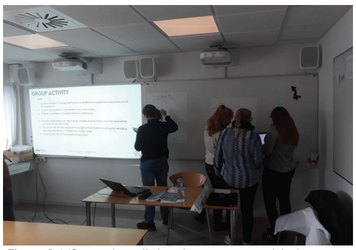

Figure 1: MSc. students listing the outcomes of their group discussion.

The whole teaching activity lasted 35 minutes. At the end, the students answered two short questions in a minute paper:

1. Give one advantage and one disadvantage of the continuous recording in comparison to the time sampling.
2. The teaching activity helped you learn and distinguish the different recording rules (Likert-scale).

MAIN POINTS

1. **Main problem/challenge:** limited time for group discussion before presentation in plenum.
2. **Teaching activity**: View list.
3. **How did it go?** Successfully. Based on students' feedback, I believe the teaching activity was helpful to make them understand the presented topic.
4. **What to do next?** Provide more videos of behaviour testing situations.

4. Results

- All answers to question 1 were satisfactory.

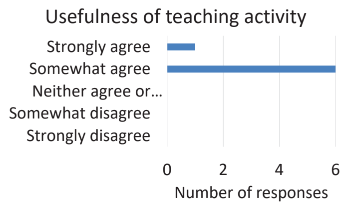

Figure 2: Present students' opinion about the usefulness of the teaching activity.

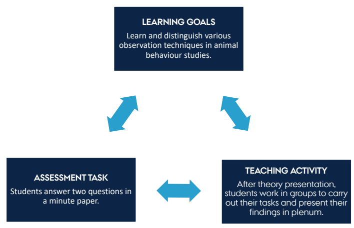

Figure 3: Constructive alignment

4. Looking forward

The teaching activity worked well because students cooperated, critically thought and actively participated in it. Afterwards, their responses were appropriate and based on good arguments. This activity should be employed in future courses, based on the students' evaluation. However, a slightly longer period of group discussion should be provided and a greater number of students would be welcome.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Behaviour and Stress Biology
Department of Animal Science

Eight kinds of spectroscopy

- and how not to confuse them

Learning Lab

Abstract:

In the course *Modelling I: Chemical Bonding and Spectroscopy*, a key part of the curriculum is learning how to use spectroscopic selection rules to analyze and predict spectra. Many students express that they lack an overview of this topic. This challenge is addressed with a teaching activity – an incomplete document with most of the relevant information but key parts removed – the students then need to fill in the blanks. The activity was a success and may be used for several topics in several courses.

COURSE FACTS

- **Course**: Modelling I: Chemical Bonding and Spectroscopy
- **Level**: Bachelor
- **ECTS credits:** 10
- **Language**: Danish
- **# of students**: 13 (114 in total)
- **My role**: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

Based on my experience both as a student and as a teacher, it is clear to me that spectroscopy is a confusing part of the Modelling I course. Indeed, several of my students have expressed that it is difficult to keep track of the many kinds of spectroscopy and their differences – especially knowing when a certain selection rule is appropriate. One of the students argued that the missing link was an *overview*.

2. Planning a teaching activity

The easiest way to give my students an overview would be to to write and hand out a document with relevant formulas and figures. But to truly understand and remember the contents, it is very important that the students – at least partly – make it themselves. Else, they might as well just re-read the text book.

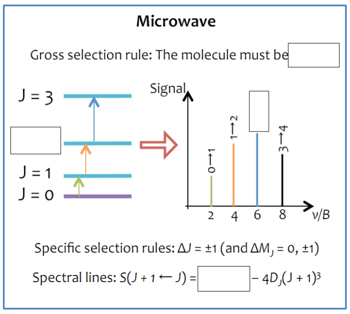

Figure 1: Part of the incomplete document. Here, microwave spectroscopy is summed up in a few key sentences, formulas and figures – with empty boxes that the students must fill out.

The heart of the teaching activity is an incomplete document with all the relevant information but with parts of formulas, selection rules, text and figures removed (see Fig. 1). The students then fill in the blanks in pairs, discuss their solution with another group and by the end of the day, all of them have a comprehensive guide to applying selection rules and analyzing and predicting spectra – a central part of the learing goals of the course.

3. Trying it out in practice

The teaching activity was performed as follows:

1. I gave a short introduction.
2. The students worked on the document in pairs while I helped.
3. The groups teamed up with another group and discussed their results while I circled the room
4. Next week, we assessed the activity and I handed out the solution.

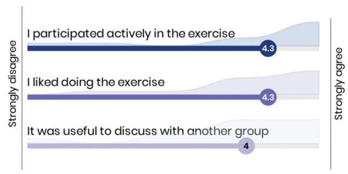

Figure 2: Key results from the assessment of the activity.

A majority of the students felt they participated actively, liked doing the activity and found it useful to discuss with another group (Fig. 2). While only a few used the document in preparing for the next week's exercises, all who did found the exercises easier – and every single student intended to use the document in the future. In short, the students learned something, got an overview of a difficult topic and went home with something to use in the future – and they even liked doing it. As revealed by the constructive alignment analysis (Fig. 3), the activity helped achieve the learning goals it was designed to.

MAIN POINTS

1. **Main problem:** Spectroscopy can be very confusing!
2. **Teaching activity**: A fill-in-the-blanks exercise to get an overview of spectroscopy.
3. **How did it go?** Very well – most students felt they had learned something and all planned to use it in the future.
4. **What to do next?** Expand the activity to cover more topics and other courses.

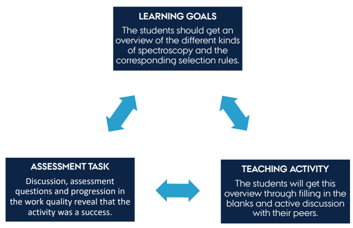

Figure 3: A constructive alignment analysis shows the connection between the learning goals, activity and the assessment.

4. Looking forward

The activity helped solve the problem it was meant to, but it's not limited to the topic of spectroscopy. Similar activities could be developed for other topics in this and other courses. A fill-in-the-blanks exercise is particularly relevant when dealing with a large and perhaps confusing topic. In designing future incomplete documents, I learned that it's important to think about what is left blank – if too much information is removed, the result may be more confusing than helpful.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Frederik Thorning Frederiksen
Photophysics, Photochemistry, and Photobiology Group
Department of Chemistry

Confocal Imaging

- Towards beneficial and hassle-free imaging experiments

Learning Lab

Abstract: the confocal microscope is an instrument that is available for common use in our department. There is a system that is already created to track the users and their usage of the microscope. However, there has not been a common resource for teaching microscope new-comers how to utilize the microscope without damaging it and without damaging their own samples. It has been my role to teach many new comers in my building. However, one-session can be too short to tackle all issues. Therefore, it is important to take an initiative to create an online resource that would help with teaching new users the basics of the microscope function, how to use it and perhaps also how to troubleshoot certain issues.

COURSE FACTS

- Course name: --
- Level: all levels
- ECTS credits : --
- Language: English
- Number of students: --
- Your role: Instructor/demonstrator

TEACHING IN PRACTICE

1. Identifying a problem

When new confocal microscope users join the department, they often need direct instruction from someone who knows how to use the confocal microscope. Usually one person will be assigned to teach the new comers. However, teaching is usually done according to the sample that the user wishes to analyze at the time, which makes the teaching session very specific and not very useful for troubleshooting problems or for avoiding issues that might damage the microscope or the sample. Therefore, there has to be a solution for this problem.

2. Planning a teaching activity

In order to give the users an active (re)-demonstration and a detailed resource to fall back on when in need, I made an online video (as a part of series of videos to come) giving basic explanation of what an inverted microscope is and what it can do and how it can be used. This video is followed by a questionnaire that the users would need to answer before they can be registered as a user on the confocal microscope. This questionnaire is intended as a review to the acquired knowledge through the direct learning session as well as the online demonstration video.

References

Introduction to Microscopes – Teaching Video

https://www.youtube.com/watch?v=KSBLGzFd0kI

3. Trying it out in practice

First the users were given a direct hands-on teaching session on the microscope. After that, they were asked to (whenever they can) watch the online video and answer the questionnaire. The questionnaire included a test part to test their knowledge, and a survey part to see how they felt about the activity and if they benefited from it.

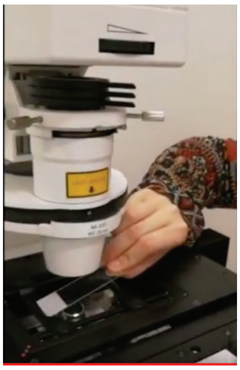

Figure 1: Snapshot from the online demonstration video

The questionnaire covered aspects such as what a microscope is, what are the different types of microscopes, and how do they function. Also how to image a sample, how to improve signal to background ratio, and how to troubleshoot problems on the microscope. If the users had passed 50% of the questions, they were allowed to use the microscope. Otherwise, they were encouraged to try again as many times as it required and they were welcomed to ask questions and these questions would later be posted online as frequently asked questions (FAQs) so other users can benefit as well.

MAIN POINTS

1. **Main problem/challenge:** Lack of resources for new confocal microscope users.
2. **Teaching activity**: Online video and questionnaire
3. **How did it go?** It was well-received by the 2 participants that tried it thus far.
4. **What to do next?** Expand the resource to include all previously untackled issues or unused features.

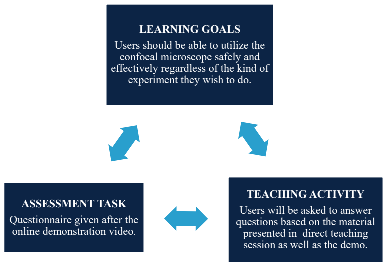

Figure 2: **Constructive alignment**

4. Looking forward

The preliminary phase of the TA went well. The users thought it was quite helpful to do this online resource since it is also accessible at any time and can be used for revision or for finding solutions to aspects not tackled during the direct teaching session. However, they found the questionnaire to be exam-like but they were positive about the fact that they can repeat this questionnaire as many time as it takes to get a good score. This ensures no real exam-like pressure when doing the questionnaire, and at the same time, it also ensures that the users have acquired the knowledge needed to use the microscope safely, freely and effectively.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Nabavi Group
DANDRITE- Molecular Biology and Genetics

The urban acoustic environment
- Qualitative assessment

Learning Lab

Abstract:
The use of qualitative assessment for the urban acoustic environment can be challenging to approach for a student, who normally uses quantitative measures. A teaching activity is developed as a introduction to the subject, where the students get the change to relate qualitative assessment to their own experiences. The activity is to create a mind map and is carried out at the end of a traditional lecture. The students engage easily in the activity and evaluate the activity as being very relevant. The activity could be developed further to contain the overview of even more parameters.

COURSE FACTS

- Course name: Architectural Acoustics
- Level: 2nd year of master
- ECTS credits : 5
- Language: English
- Number of students: 6
- Your role: Lecturer

TEACHING IN PRACTICE

1. Identifying a problem

The use of qualitative/subjective assessment methods for the urban acoustic environment is introduced to the students for the first time during the lecture. It can be a challenge for engineering students to think beyond the quantitative measures and understand how the function and overall context of an urban space affect the perception of the acoustic environment.

2. Planning a teaching activity

They goal of the activity is not to master a certain skill or technique, but to start seeing a subject from a different perspective. The teaching activity is to create a mind map, where the students get the change to relate new definitions to their own experience. The activity is suitable in a very small class and opens up for discussion and sharing of different viewpoints.

Figure 1: The students drawing a mind map

3. Trying it out in practice

The activity was carried out at the end of a lecture. During the lecture, a overview of the subject was presented were concepts and definitions were explained. At the end, the subject of the lecture was summed up in a single slide, where key parameters were listed under several headlines. Finally, the parameters were linked to several known urban sites in a small mind map on the blackboard. This became the introduction to the activity, and the students worked in pairs developing a similar mind map, with urban sites of their own choice. As the students had seen an example and had some key parameters listed, it was easy for them to engage. While they were working in pairs, the lecturer kept working on the mind map on the blackboard. After the activity, the maps were compared and the different viewpoints considered. At the end of the session, the students were asked to give feedback on the activity and the whole class engaged in a discussion about the perception of sound in urban areas. The students found it very relevant, especially as they started thinking about the urban acoustic environment in their 'everyday' and how different spaces have different acoustic characters, dependent on various parameters.

MAIN POINTS

1. **Main problem/challenge:** Hard to understand the subjective evaluation of urban acoustic environments
2. **Teaching activity**: Mind map
3. **How did it go?** Overall a very successful teaching activity were the students were engaged
4. **What to do next?** Use the teaching activity as a standard introduction to the subject and develop a better assessment of student learning.

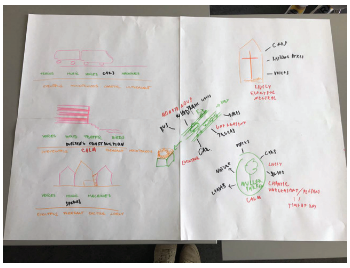

Figure 2: Mind map drawn by the students

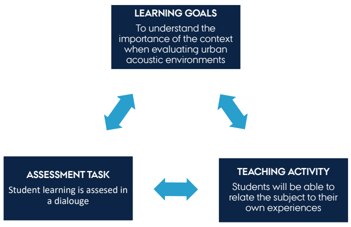

Figure 3: Constructive alignment

4. Looking forward

Overall, the teaching activity was successful and the students found that it got them to think about how the experience of the acoustic environment in different places is dependent on the context. The activity was found to be a very good introduction to the subject but it could also be expanded in the following lessons and used as a tool to gather the information from the different lections in one place. The assessment of student learning could also be developed, specially for larger classes.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Department of Engineering

Implementing the "Fish bowl" teaching activity in geophysics

- Making the students understand what they do not understand

Learning Lab

Abstract: Implementing the "Fish bowl" learning activity in the course "Fundamental Geophysics" made the students reflect upon what they were finding difficult when dealing with the geophysical topic "Radiometry and borehole logging", by writing down clarifying questions. The following evaluation test with the exact same questions on Blackboard showed that most of the students understanding in the specific topic improved. Additionally, the final "Mentimeter" test revealed that most of the students learned something from this activity, since they felt that they improved their ability to reflect upon what they found difficult when dealing with "Radiometry and borehole logging".

COURSE FACTS

- Course name: Fundamental Geophysics
- Level: Bachelor
- ECTS credits : 10
- Language: Lectures in Danish and exercises in English
- Number of students: 16
- Your role: TA during TØ

TEACHING IN PRACTICE

1. Identifying a problem

When teaching a new and complex topic in "Fundamental Geophysics" such as "Radiometry and borehole logging", I often experience that a majority of the students are having difficulties in **apprehending** and **expressing** what exactly they are finding hard to understanding.

2. Planning a teaching activity

Based on the problem addressed above I decided that the "Fish bowl" learning activity could help the students to think about what they do not understand when dealing with a specific geophysical topic, by making them write down their questions. This will intentionally improve the students ability to reflect upon what they find difficult when dealing with a complex topic and intentionally lead to improved knowledge in this topic.

Learning goals: Improve the students knowledge and ability to express what they are finding difficult to understand concerning "Radiometry and borehole logging".

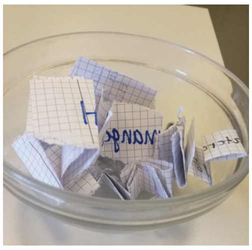

Figure 1: The students questions in a "Fish bowl".

3. Trying it out in practice

At the end of the TØ lesson I asked the students to write down at least one question each concerning this week topic "Radiometry and borehole logging". At the end of the TØ lesson I collected all the questions in a bowl, see Figure 1.
Before the next week TØ I had picked the five most relevant questions related to the learning outcomes of the course, and prepared them, so that I was able to answer the questions at TØ. The answers to the rest of the students questions were uploaded to Blackboard.

Furthermore, I also made a power point presentation with the five picked questions, so that the students could discuss the questions in smaller groups and thus give one or more groups a chance to answer the question before I did in plenum.

To evaluate whether the students knowledge in "Radiometry and borehole logging" improved, I made a test on Black Board with the same five questions to be answered the following week. The results are shown in Figure 2.

Question	Correct answers
What is Compton scattering?	100 % (14/14)
What does the negative crossover	85.7 % (12/14)
How can I find the true porosity of a using the neutron log?	78.6 % (11/14)
What is a laterolog?	92.9 % (13/14)
How does the SP gamma log differ gamma log?	100 % (14/14)

Figure 2: This table shows the five questions I picked and the results of the follow up test on Black Board. 14 students answered the test.

I also made a "Mentimeter" test to asses whether the students felt that they achieved something by doing this learning activity, and especially evaluate whether they felt that their ability to reflect upon what they did not understand improved. The results of the "Mentimeter" evaluation are shown in Figure 3.

MAIN POINTS

1. **Main problem/challenge:** It is hard for the students to apprehend and express what they do not understand.
2. **Teaching activity**: "Fish bowl"
3. **How did it go?** Great – most students gave satisfactory answers on the questions and felt that they improved their ability to reflect upon what they do not understand.
4. **What to do next?** Implement this teaching activity as a weekly exercise in this course

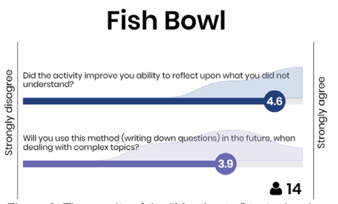

Figure 3: The results of the "Mentimeter" test, showing that most students got something out of the activity. 14 students participated.

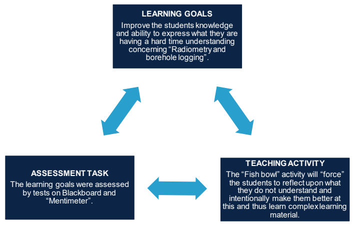

Figure 4: **Constructive alignment**
Alignment between 1) Learning goals, 2) teaching activity and 3) assessment task.

4. Looking forward

It seemed that the student felt more comfortable with writing down their questions instead of asking them out loud in the class room. The teaching activity set the scene for good group discussions, before I answered the questions in plenum, which is a good thing since the exam is oral. Overall, this teaching activity went well since most students were able to give satisfactory answers on the Blackboard and "Mentimeter" assessments.
A next step could be to implement this "Fish bowl" teaching activity as a weekly activity in the course, and make the Blackboard evaluation count in the final grade.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Centre for Past Climate Studies
Department of Geoscience

Introducing a tool to reduce complexity

- Concept maps gives a visual and simple overview

Learning Lab

Abstract: It can be difficult to connect key enzymes, hormone actions and cellular reactions as students are expected to do. Concept maps can easily serve as a visual note book to help with this task. Introducing concept maps to students was warmly welcomed and could easily be implemented as a part of the theoretical exercises in the future.

COURSE FACTS

- Course name: Metabolism – concepts and design
- Level: 2nd year bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 25
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

In the course Metabolism – concepts and design, students are expected to compare and connect metabolic processes within the human cells but also identify and describe metabolisms across tissues. This is a very complex task, which demands a good overview and the ability to understand metabolisms from a greater perspective as well as on a very detailed level. It can be difficult to distinguish and compare pathways without easily loosing the big overview.

2. Planning a teaching activity

To give the students a visual overview, concept maps were introduced as a tool to connect pathways, molecules, enzymatic reactions and so on. Concept maps have the advantage that the degree of detail is individual and depends on the student's own needs. Moreover, concept maps can be expanded easily when the knowledge increases and more subjects are introduced.
After creating a concept map over a specific subject, the students should have a better overview of the metabolic reactions and be able to connect it to other metabolisms.

3. Trying it out in practice

The concept map was introduced in the last 15 minutes of the theoretical exercise. An example of a mind map was shown to visualize the idea (see figure 1 upper part), and a list of relevant words from the exercises and lectures was presented as inspiration. The students were introduced to an online platform to make the concept maps, but were also handed out a piece of paper for them to choose between. All groups chose paper for their concept maps, as it was easier to work together.
The students worked concentrated on the concept maps, some groups focused on understanding the words, whereas others were able to connect the words to a higher degree (see figure 1, lower part).

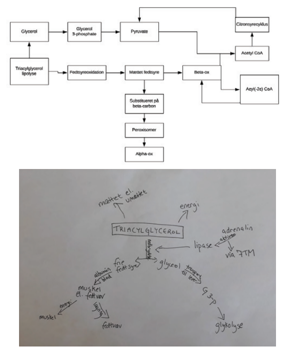

Figure 1: Two ways to make concept maps
Upper part: A concept map made online was shown to the students as inspiration for their own concept maps.
Lower part: A concept map made by one of the groups on paper

MAIN POINTS

1. **Main problem/challenge:** Connecting different metabolisms adds to the general complexity
2. **Teaching activity:** A concept map can simplify, visualise and connect key words from different metabolisms
3. **How did it go?** It went very well and in general students found it to be a good tool
4. **What to do next?** Implement the teaching activity after every theoretical exercise

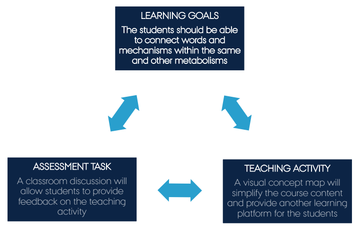

Figure 2: Constructive alignment

4. Evaluation and discussion

We evaluated the teaching activity by a classroom discussion afterwards. All students agreed that it was helpful and a good tool to make notes for the exam. Some said it would be nice to expand the concept map after every theoretical exercise, others preferred doing it as part of exam preparations. Ideally, evaluation could be performed at the end of the cpourse after implementing the concept map in the classes and as tool for exam notes.

4. Looking forward

Overall the teaching activity was successful and feedback from the students said that they found it useful to visualize and simplify the metabolism, we worked with. In future theoretical exercises, the last 10 minutes could be dedicated to work on expanding the concept map, not only as preparation for exam, but also to expand the learning by letting the students discuss and repete concepts with each other in their own words.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Maria Stenum Hansen
Section for Molecular Nutrition
Department for Molecular Biology and Genetics

How to become an arthropod ecologist within a week

Learning Lab

Abstract: During a five day field course first year bachelor students must get familiar with arthropod ecology, identification of species, recognize higher level taxons and conduct their own ecological project. To do this successfully they must combine new information with knowledge from other courses. Conducting a project and get an overview on the same time can be challaging for some students. During this teaching activity the students will get the chance to plan and reflect on their project as well as training them to give ecological relevant feedback to their peers. On every course day a small seminar will prepare the students in a form that resemble the final assessment for the course.

COURSE FACTS

- Course name: Zoology Field course (part of Eukaryotes | Zoology)
- Level: bachelor
- ECTS credits : 10
- Language: danish
- Number of students: 20-35
- Your role: Lecturer

TEACHING IN PRACTICE

1. Identifying a problem

During a five day field course in zoology the students are expected to be familiar with arthropod taxonomy, learn to identify species, and conduct a small ecological project. They arrive with very little experience, but must be able to construct a project within arthropod ecology from day one (figure 1). They must include knowledge from prevous courses and from earlier sessions in this course to do this sucesfully. This task can be challeging and overwhelming for some students.

2. Planning a teaching activity

The teaching activity aim to give the students the ability to combine a very brief and high level overview of the taxonomy and ecological niches in the arhtropod class with their knowledge on study design and scientific projects. They must use this activity as a tool to design their project, give and get feedback and use their gained knowledge on ecology during the week. Peer exerciserces (seminars) will occur dayly throughout the week. As both project planning and a high level understanding of arthropod ecology are learning goals, the actvity will be central for students to pass the course.

3. Trying it out in practice

The teaching activity will be tested in july 2018.

Before the week starts a cheat sheet will be handed out to the students, that contain a taxonomic overview and a project planning tool that describes the what a project must consist of (figure 2).

The teaching activity is framed as a group investigation that consists of a session once a day throughout the week. A kickstart workshop, three seminars and a final seminar that funcitons as the course evaluation.

A working document that will subject to feedback by a sister group and a TA. The reviewed version will be presented by one of the groups the following seminar.

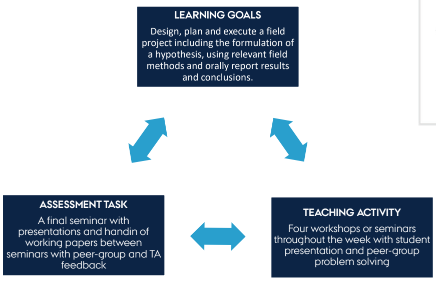

Figure 1: **Constructive alignment**
Assesment, activity and learning goals for the course are connected.

MAIN POINTS

1. **Main problem/challenge:** The students must design and plan a project within arthropod ecoloy albeit they have very little experience.
2. **Teaching activity**: Group investigation. Groups attend workshops, deliver a working document and provide feedback
3. **How did it go?** The activity will be tested in july 2018.
4. **What to do next?** The course will be evaluated by the students at the end of the course. Depending on their feedback the implementation should be revised.

Figure 2: **Cheat sheet**
Cheat sheet for students to efficiently give students a relation to the subject that they are working with.

4. Looking forward

The activity should provide tools that help the students to design their projects, but also train the students in general academic deciplins as providing feedback to peers, collaborations, research presentations and problem solving. At the end of the course the students must fill in an evaluation that provide an overview of the students perception of the activity.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Natural History Museum Aarhus
Center for Biodiversity Dynamics in a Changing World
Ecoinformatics and Biodiversity – Department of Biocience

Structuring a scientific report

- Improved writing through strip sequences

Learning Lab

Abstract: Writing a scientific report can be a challenge for students. Besides being aware of the science and describing well how an experiment was conducted and what were its outcomes, the structure of a report is important. It follows the structure of a scientific paper, which is something students will be confronted with both when writing their thesis and later on, when they want to publish their own findings. Therefore, a strip sequence was used to help students getting a better overview of the individual steps and to analyse what is special about content and writing style of each. This should help students to write better reports and to spend less time writing them in the future. Thus, this teaching activity could successfully be implemented as standard assignment, using the waiting time of some of the experiments.

COURSE FACTS

- Course name: Materials Chemistry II: Experimental Materials Chemistry
- Level: Bachelor, 6th semester
- ECTS credits : 10
- Language: English
- Number of students: 10
- Your role: TA in laboratory exercises and correcting reports

TEACHING IN PRACTICE

1. Identifying a problem

For some students, it is a challenge to structure their reports which are supposed to have the same setup as a scientific paper. Since the approval of all laboratory reports is a prerequisite for taking the exam, this is a required skill. Furthermore, it is needed beyond the scope of this class: The students are in the third year and working on their bachelor project parallel to taking this class, so it is important for them to be able to structure their work appropriately.

2. Planning a teaching activity

The teaching activity helps students to
- Apply the structure of a scientific paper
- Examine how the style and the content of the sections differs

This will be done using a strip sequence. The logic behind the structure of a report will become more obvious when the students have to put the headings of the individual sections into the right order. By ordering example sentences to this, students realize what style and content are characteristic of each individual section.

3. Trying it out in practice

The teaching activity was conducted while the students had to wait for a running measurement. They were divided into groups of two for solving the strip sequence. At first, they put the headlines into the right order. After that, they sorted the example sentences to each headline. One member of each group then swapped with another group and they discussed the differences between their solutions. Afterwards, a short discussion of the results followed and every student got an example solution for taking home. Finally, the students were asked to write a minute paper with feedback for the teaching activity and hand it to the TA after the class. Including the discussing, the teaching activity took around 10 min.

Figure 1: Students arranging the strip sequence

MAIN POINTS

1. **Main problem/challenge:** Structuring a scientific report
2. **Teaching activity**: Strip sequence
3. **How did it go?** Successful, the students would even like to expand it
4. **What to do next?** Make a second set and add more details to the example solution

The feedback from the students was throughout positive. Words that were often mentioned on the minute papers were "fast" and "good"/"nice". Several students even suggested to expand the teaching activity to include subsections that have to be sorted or to have more slips with example sentences for each section.
However, the students were reluctant to take the example solution with them.

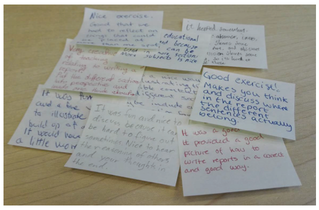


Figure 2: Minute papers as feedback for teaching activity

4. Looking forward

The teaching acitivity fits very well into the busy schedule of the module while combining skills important both for Experimental Materials Chemistry and the students' bachelors projects. Considering the timing of the teaching activity, it is well suited to fill gaps where students have to wait for measurements.
Two improvements can be made for repeating the teaching activity next year:

- Introduce it earlier in the semester and do it twice, e.g. before and after the first report
- Add general points about content and writing style of each section in the example solution so that it can be a reference for students while writing reports or their bachelor project

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Jennifer Hoelscher
Supervisor: Mogens Christensen
Department of Chemistry and iNANO

Immediate Feedback Assessment Technique

- Developing intuitive understanding

Abstract: Multiple-choice testing procedures that do not provide corrective feedback facilitate neither learning nor retention [1]. This activity utilizes *immediate feedback* and *answering until correct* as teaching methods for developing intuitive understanding of physical concepts within electromagnetism, waves and optics.

Learning Lab

COURSE FACTS

- Course name: Electromagnetism, waves and optics
- Level: Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 20
- Your role: Student assistant

TEACHING IN PRACTICE

1. Identifying a problem

When learning physics we often develop new understanding based on our day-to-day experience with the world around us. Although we surround ourselves with electrical devices we do not feel the magnetic field of a conducting wire as noticeably as we experience the pull of gravity. Upon entering the world of electricity and magnetism it can therefore often be a challenge to **develop an intuitive understanding of the concepts and phenomenon** associated with this field of study.

2. Planning a teaching activity

The activity focuses on the course learning outcome:

"Describe the theoretical connections within electromagnetism, waves and optics"

This will be done through analyzing different physical scenarios, first individually, then in small groups, and lastly in plenum. Contemplating and discussing different physical situations, including predicting the future outcome of a system will help the students develop an intuitive understanding of such systems. The students will receive immediate feedback on their perceptions, which is beneficial for learning [1].

Reference:
[1] M. L. Epstein, Immediate Feedback Assessment Technique Promotes Learning and corrects inaccurate first responses, *The physiological record*, **52** (2), 2012.

3. Trying it out in practice

The activity is conducted in three parts. The students are presented for different concepts within electromagnetism, waves and optics, formulated as questions with accompanying possible answers. The students first answers these questions **individually** with their initial impression of the situation. Secondly, the students compare their answers in **small groups**. Each group will be provided with a "scratch card" in the form of a multiple choice sheet. Behind the right alternative a star is hidden, providing the students with immediate feedback to their answer. The group will together discuss and agree upon a single answer to each question. 5 points will be given by finding the right solution by the first scratching, 3 points for using two tries, and 1 point for locating the correct solution after scratching three fields.

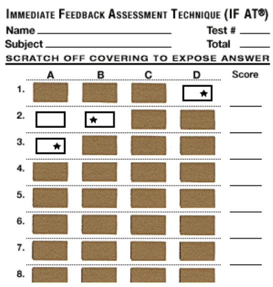


Figure 1: Scratch card in the form of a multiple choice sheet. A star is behind the correct alternative.

Lastly, the questions are again analyzed in **plenum**. The TA controls an open discussion witch includes all the groups. The thought process behind both wrong and correct solutions are discussed.

MAIN POINTS

1. **Main problem/challenge:** Develop an intuitive understanding of concepts within electromagnetism, waves and optics.
2. **Teaching activity**: Three-step analyzes of a physical scenario.
3. **How did it go?** Great. The students engaged in meaningful discussions, learned from each other and enjoyed the teaching activity.
4. **What to do next?** Implement discussion questions and immediate feedback when introducing new concepts

The individual learning outcome is assessed continuously by the TA through listening to the students during the group discussion, by the correctness of the scratch cards and the final plenum discussion. The students evaluate their individual learning outcome through a 5 min questionnaire. More than 80 % of the students changed their opinion on one or more of the exercises during the group discussion and reported an understanding of their initial incorrect perception.

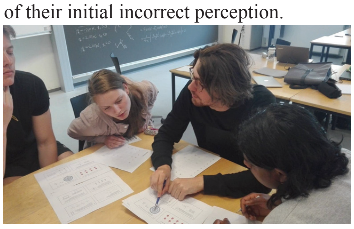


Figure 2: **Teaching activity.** Students discussing the problem exercises in small groups in the second step of the teaching activity.

4. Looking forward

The teaching activity went as planned and all the students were engaged and interested in discussing the questions. The scratch cards provided an extra feeling of importance in analyzing the scenarios and made the students want to be absolutely certain of each answer. More importantly, the cards provided the students with immediate feedback to confirm or refute their perceptions. My impression is that thought questions and immediate feedback is a good learning strategy that could easily be included as a short introduction to every new topic.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Ann Julie Utne Holt
Supervisor Philip Hofmann
Department of physics and astronomy

Quiz Your Knowledge

- Revision for Atomic and Molecular Physics

Abstract: It was almost the end of the Atomic and Molecular Physics course and upon conducting a mentimeter survey we found that students were finding certain topics like Zeeman effect, quantum numbers and the notation difficult to understand. They also asked for an overview of the course topics. Hence, we designed a quiz with two rounds – one round for the quantum numbers, term symbols and Zeeman effect, and another for the rest of the course topics. We included peer review, plenary session and group discussion. The activity was successful as the students had fun and at the same time met their learning goals. Feedback was taken in the form of a mentimeter survey and also by direct observation of the students during the activity. The next step will be to improve the activity using the students feedback and implement it the following year again.

Learning Lab

COURSE FACTS

- Course name: Atomic and Molecular Physics
- Level: 2nd year Physics
- ECTS credits : 5
- Language: English
- Number of students: 22 (x3)
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

We thought that the best way to find out what the students found difficult was to ask them directly. A mentimeter survey was a good tool. Through the survey we identified that most students found certain topics like **the notation**, **the different quantum numbers** and **Zeeman effect** difficult to follow. Some students mentioned that they wanted a **quick overview** as the course was almost complete. We decided to tackle both these aspects in the activity that we designed.

2. Planning a teaching activity

We organized a quiz with two rounds. The first round was aimed at **identifying** the different quantum numbers, **calculating** them and using it **to explain** fine and hyperfine splitting of energy levels for a simple atom. It also included Zeeman effect. The second round was in pop-quiz style with 10 questions covering all the topics taught in the course. We included some questions that the students themselves had asked during the earlier TØ sessions.

Learning Goals:

- **Identify** the different quantum numbers
- **Calculate** the various quantum numbers for a simple system
- **Explain** fine and hyperfine splitting of energy levels
- **Reflect** on the various topics taught during the course and find a connection between them

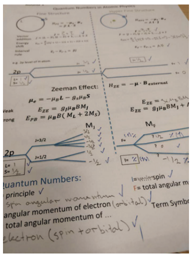


Figure 1: Example of a filled in "Round 1" sheet with student corrections

3. Trying it out in practice

The students were asked to form groups of about 4. First, the rules of the quiz were explained. The first round consisted of a summary sheet (Figure 1), in which some quantum numbers, energy levels and simple formulae were left out for the students to fill in. They were given 5 minutes to work together on it and were allowed to refer to their notes and the text book. Then the groups were asked to exchange the sheets for peer review. To review, the answers were discussed by the TA with the whole class.

In round 2, the questions were projected on a screen and students had to fill in the right answers in the sheet that was handed to them. Again, they worked in groups. There were 10 questions from various topics covered during the course, several of which were questions asked by the students to the TA during earlier sessions. The groups were asked to exchange their sheets again for peer review. The answers were discussed and clarified by the TA with the whole class.

The scores were totaled and the winning team got a bag of chocolates which they shared with the rest of the class.

MAIN POINTS

1. **Main problem/challenge:** Understanding quantum numbers and notation
2. **Teaching activity**: revision "pub" quiz
3. **How did it go?** The students were all engaged and they said they found it useful
4. **What to do next?** Implement activity during revision session before the exam

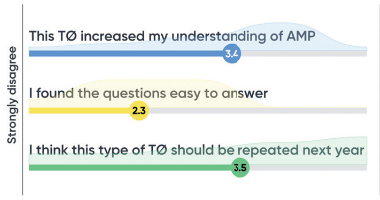


Figure 2: Evaluation results on mentimeter. Sixteen students participated in the evaluation.

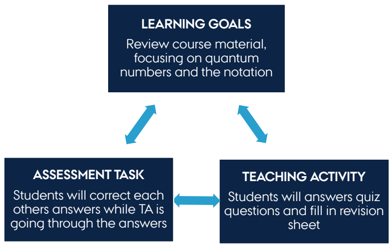


Figure 3: Constructive alignment. The students will learn about the course material by doing a quiz and checking each others answers.

4. Looking forward

Overall the teaching activity was a success. The students were engaged throughout the quiz and asked questions during the discussion session. The evaluation is shown in Figure 2 and from this it is clear that the students found it useful. However when repeating the exercise we will make some questions easier to answer to boost their confidence. In conclusion, positive feedback such as "the group quiz worked really well" and "It was great as repitition!" make it clear that this exercise should be repeated in following years.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Klara Volckaert and Rijutha Jaganathan
Hofmann group and Hornekær group
Department of Physics and Astronomy

Factors affecting metabolic rate of ectotherms

- Using mind maps to understand connections

Learning Lab

Abstract: Connecting important factors that affect metabolic rate in ectotherms, can be a challenge for the students in the Animal Physiology course taught at Bioscience. In this teaching activity I asked the student group to put all the factors that they already knew in a mind map (in one colour), which opened for a discussion of the factors that they had not mentioned. Afterwards, the students were given a second colour, and asked to add/remove factors that they now knew. The different colours allowed the students and me to see that they had improved after our discussion.

COURSE FACTS

- Course name: Animal Physiology
- Level: Bachelor (elective)
- ECTS credits : 10
- Language: English (Danish)
- Number of students: 35
- Your role: lab instructor

TEACHING IN PRACTICE

1. Identifying a problem

The lectures in this course are all in the first part of the semester, and later in the semester the students can find it difficult to make connections between important concepts, such as the factors that can affect the metabolic rate (MR) of ectotherms. The curriculum mentions at least 8 factors that all can interact, as well as independently affect MR in different directions, and here I want to give the students an opportunity to reflect on them.

2. Planning a teaching activity

I plan the teaching activity such that the students can help each other remember and connect the factors that can affect MR in ectotherms by using a mind map. I will give them a chance to show what they already collectively know (in one colour), before we go through the lab exercise and a discussion of the factors, and they were given a second colour to add to their mind map (Fig. 1). By using two colours, I can direct the discussion towards the factors that they miss, and they can see which factors they may have trouble remembering (which I think can help them when they study for their written exam).

3. Trying it out in practice

After a brief introduction to the lab exercise by the professor, I asked the student group to create a mind map of the factors that can affect MR in ectotherms (in **red**). After the experiment had been prepared, we had a discussion of the factors that they had put down, and I guided them to the factors that they missed. Then the group was given the opportunity to add/remove factors (in **green**). None of the five groups that went through this teaching activity could name all of the factors from the beginning (Fig. 2), but 4/5 groups ended up with a complete mind map (the 5th group did not put all of the factors down, even after we talked about them). In general, the students were positive about the exercise, but some of them (the group from above) sounded like they did it more for my sake than their own.

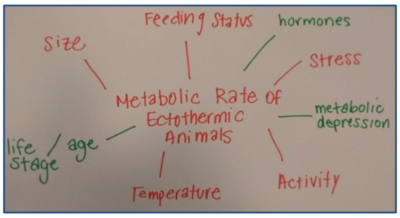


Fig.2: **Mind map by one of the groups**
The students were asked to write the factors that they thought could affect the metabolic rate of ectotherms (in **red**), before the exercise. In the end of the lab, after discussions about potential factors, the students were allowed to add (or remove) factors (in **green**). This group had 5 of the 8 factors most important in the course after their initial discussion, and later added the last three.

MAIN POINTS

1. **Main problem/challenge:** Some students struggle to connect the factors that can affect metabolic rate of ectotherms
2. **Teaching activity**: Mind map, discussion and re-assessment of mind map
3. **How did it go?** The students seemed to understand which factors are most important, and how they affect metabolic rate
4. **What to do next?** If I were to use this teaching activity again, I would ask the group to elaborate on the ways and directions that these factors affect the metabolic rate of ectotherms

4. Looking forward

In student groups that seemed very interested in the course, the mind map was well-received, and they participated vividly in the discussions and asked questions. In less motivated groups, my perception was that they just waited for me to say the factors. This is a difficult challenge, and maybe a mind map is not the best way to activate these students, instead a "picture lottery" or a memory match game could be used, to gamify the activity.

If I were to use this teaching activity again, I would ask the students to make arrows showing which way a factor affect MR.

LEARNING GOALS
The students should be able to name the most important factors that can affect metabolic rate of ectotherms

ASSESSMENT
After the students' first mind map, we discuss the factors that they have put down. After this discussion and the experiment has been started, the group could add/remove factors if they wanted. The number of factors written in the first colour is then compared to the number of factors in the second colour.

TEACHING ACTIVITY
The student group gets a chance to write the factors that they already know (in one colour). After we go through the experiment, the group is asked to add any new factors that they now know can affect metabolic rate (in a different colour)

Fig. 1: **Constructive alignment**
The teaching activity is designed to give the students a chance to recall the important factors that affect MR in ectotherms, and to open for a discussion of the factors that they missed (Assessment). Through the assessment, the students had the possibility to add "new" factors to their mind map, so that they in the end had an overview of the important factors.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Lisa Bjerregaard Jørgensen
Zoophysiology
Department of Bioscience

Dynamic analysis of structure

- Understanding FEA-program through exercises

Learning Lab

Abstract:

Assessing the quality of the results of a Finite Element Analysis (FEA)-program is not always easy, why many students end up - blindly trusting the results given by the program. Therefore, I held a lecture on doing dynamic analyses of structures using a FEA-program and together with the students assessed the results by comparing with analytical results. The activities showed that the students were able to achieve matching results on their own afterwards.

COURSE FACTS

- Course name: Stål og dynamik
- Level: Bachelor (7th semester)
- ECTS credits : 5
- Language: Danish
- Number of students: 40
- Your role: Lecturer

TEACHING IN PRACTICE

1. Identifying a problem

The students are learning how to do dynamic analyses of structures analytically and using a FEA-program in the course. The FEA-program is however very sensitive towards how a structure is created and analysed. Therefore, it is not always easy for the students to relate the two, and be able to assess whether the program gives correct results. Therefore I have chosen to help the students by creating an overall guideline for creating and analysing structures in a FEA-program.

2. Planning a teaching activity

My teaching activity will provide a structured set of guidelines (utilizing Technique #10: Structured Problem Solving [1]) on how to approach the problem of creating and analysing dynamic structures in a FEA-program. By breaking the approach down to simple steps, it will give students a starting point for such a problem.

Furthermore, throughout the teaching activity, the students will have to do what I have just shown them, thereby making them utilize the new knowledge they just got. While in the end, the students needed to solve a problem on their own, with a beer as the prize for a correct answer.

References

[1] Active Learning and Adapting Teaching Techniques, by Centre for Teaching Support & Innovation, University of Toronto

3. Trying it out in practice

I started out by talking about the mentimeter they filled out at home, where they needed to tell if they already knew the FEA-program we were to use. After that we made use of a Strip-Sequence, in order to see if they understood the overall sequence of setting up a structure and analysing it in the program. I wanted to see if they were able to understand the big picture before going into detail.

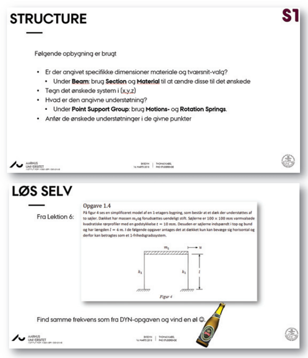


Figure 1: Two of the slides from the Power-point. The first is 1 of 4 overall guideline slides they end up with. The last is their final assignment at the end of the lecture.

Afterwards, we took each section (S1-S4, see Fig. 1) at a time; I would talk, show it in the program and afterwards let them do it themselves. In the end, we had a whole structured set of guidelines, along with good protocol and situations where they should be extra careful. Finally, they had to do an assignment on their own, where they started out with a Think-Pair-Share activity before starting.

MAIN POINTS

1. **Main problem/challenge:** Understanding challenges of a FEA-program.
2. **Teaching activity**: Structured Problem Solving / Strip-Sequence / Think-Pair-Share
3. **How did it go?** Very well, I felt that all students got the idea of solving dynamic problems using a FEA-program
4. **What to do next?** Implement it in the course permanently

Based on the final assignment, the students learned what I intended.

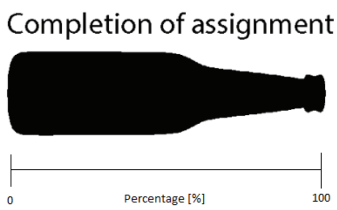


Figure 2: Assessment was made by making the students show their final results, before getting their prize: a beer. The black part shows a successful exercise by a student.

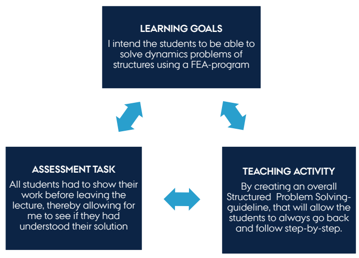


Figure 2: Constructive alignment

4. Looking forward

I would say that the teaching activity worked very well. I introduced the link between analytical and numerical results by discussing the differences and showing the problems of the numerical approach in a FEA-program. The students were able to work with their program in between my talks, thereby allowing for an active classroom. In the end, they all showed good results. As a next step, I would try and implement harder problems. Throughout the lecture, some of the better students quickly got bored, while others had troubles. By having additional things for the good students, the lecture would improve.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Thomas Kabel
Structural Dynamics and Monitoring
Department of Engineering

Helping first year students design an experiment

- Overview through facilitated brain storms

Abstract:

For first year students, designing an experiment can be confusing and overwhelming. To counter this, the students were made to discuss possible experiments with their partners, and later as a facilitated brainstorm in plenum. Many students expressed to have liked the exercise and to have a better overview, while it is unclear whether it had much influence on their final experimental programs.

COURSE FACTS

- Course name: Experimental Physics and Statistical Data Analysis
- Level: 1st year
- ECTS credits : 10
- Language: Danish
- Number of students: ca. 20 pr. class
- Your role: Laboratory instructor

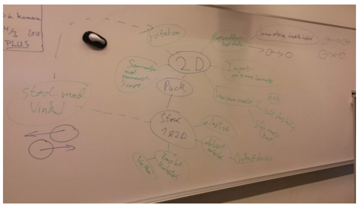


Figure 1: A picture of the board after the brainstorm in plenum. A wide range of properties and situations have been mentioned.

Figure 2: Results from the poll that the students were asked to fill out. Most students seem to have liked the exercise and to have found it meaningful. From 21 students 17 responses were obtained.

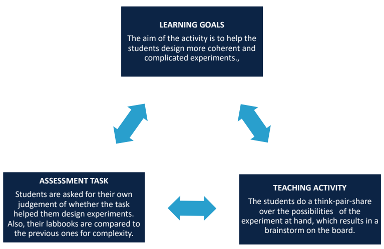


Figure 3: **Constructive alignment of the activity.** The most reliable assessment of the academic gains of the exercise are naturally the logbooks.

TEACHING IN PRACTICE

1. Identifying a problem

In the new experimental courses at physics, the students are given a lot of freedom in terms of adjusting the experimental program according to their interests, which can be confusing and overwhelming for first year students with little or no experience.

As a result, many students have a hard time constructing a meaningful experiment, and many of the final programs were simple and identical to those from other groups.

2. Planning a teaching activity

In the last experiment of the course, students examine collisions between circular pucks on an air-hockey table in one and two dimensions, which offers a wide range of possibilities regarding the experimental program.

The aim of the activity is to help the students design and set up more complex and differentiated experimental session by giving them a better overview of the possibilities of the equipment in terms of properties and phenomena that can be examined, as well as witch properties can be varied in a meaningful manner (i.e. mass, collision angle, or the elasticity of the collision).

3. Trying it out in practice

On the first day of the lab exercise (out of three), the students were asked to spend one minute thinking about anything interesting that could be examined in this experiment, and then discuss it with their partner. After a few minutes, I facilitated a discussion in plenum, where most students and at least one from each group participated while forming a mind map on the board (fig. 1). At the end of the class, the students were asked to fill out a mentimeter survey to asses their own view of the activity (fig. 2). Several weeks later, when the labbooks of the experiment were handed in, their complexity and variation between groups was compared to the last experiment, which is not being told to the students (find constructive alignment in fig. 3).

MAIN POINTS

1. **Main problem/challenge:** Students have difficulties planning experi-mental sessions.
2. **Teaching activity**: Think-pair-share and brainstorm in terms of variations , phenomena, properties, and that could be investigated.
3. **How did it go?** Although the students liked the task, it is unclear if the final logbooks were affected directly.
4. **What to do next?** Future sessions could include more detailed planning rather than just phenomena.

4. Results and observations

In carrying out the activity, the execution itself went well, and a lot of students got into it, even though it took a while for the discussion to take off. Getting the activity started, however, was difficult, since the day started with general equipment trouble, and since a lot of the discussion in small groups seemed to stray away from the topic quickly. The students do not seem to be used to this kind of learning activities.

While assessing the logbooks, the complexity does not seem to have increased on average, but there has been a far larger variety in the goals of the various groups' experiments.

In the survey, the students express to mostly have liked the exercise and found it meaningful, as well as it helped them get an overview of the exercise. Several expressed it in person as well, and I will keep doing this activity next year.

5. Looking forward

Many students liked the given task and said later that it had helped them get an overview of the possibilities of their exercise, and that they had liked this beginning of the session. It is still unclear, though, if it resulted in a direct improvement of their experiments.

Next year, it would be useful to begin each lab exercise with a similar session, but to put emphasis on different experimental programs rather than only the various properties and situations that can be investigated.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Claus F. P. Kastorp
Surface Dynamics Group
Department of Physics and Astronomy

Molecular Microbiology

Understanding the workflow in laboratory project

Learning Lab

Abstract

In the course “Molecular Microbiology” the students have a hard time archiving an understanding of the workflow in a project. All student was able to follow the protocol but few understood why they perform the task. To remedy this strip sequence was created that combined the flow of steps in this project in a sequential way.

Course facts

- **Course name:** Molecular Microbiology
- **Level:** Master
- **ECTS credits:** 10
- **Language:** English
- **Number of students:** 20
- **Your role:** Lab instructor

Main points

- **Main problem/challenge**
  The students do not understand why they perform the different steps or what is the reason of following this workflow?
- **Teaching activity**
  Strip sequence
- **How did it go?**
  All the students completed the strip sequences, and contributed to discussion of the chosen combinations.
- **What to do next?**
  Implementing knowledge of understanding the workflows in the lab project. Very few students were go out of their way to gain knowledge of this work flow, and have need to walkthrough in the appendix which gave the student the necessary knowledge in a convenient space.

Teaching in practice

Identifying a problem

This lab course was over a period of 10 weeks, with independent specified group work. Before, they can start the project it needs to be clear that the student should understand why they are performing each step in this sequence rather than following a protocol as they would follow a cooking recipe. Understanding what you are doing and why you are doing is an essential part of becoming a competent and independent researcher, which is a goal of this course, and trying to prepare them for their Master research projects.

Planning a teaching activity

To understand why these multiples steps are in this working flow, a strip sequence approach was chosen. Each student had given these strips with a two column answer sheet. They were asked to make the strips in sequence and note in one column. Then each student discussed their sequence with neighboring student and update their sequence. The scientific logic behind each step in this particular sequence have been discussed.

Trying it out in practice

The activity was performed three times independently during the project time. Each time, all the strips and sheet were given to each student and they perform the activity according to the instructions. After acivity, sheets were collected from the students and assessed the students understanding from the column sequence which they sequenced independently. In 1st week only 3 students have correct strip sequence. Then in the 4th week 11 students have correct sequence while in 8th week it become increased up to 18 students. These output showed that almost all the students learn what was intended by using this activity. According to the students output, this activity proved very helpful for the understanding of working flow in the project and planning for the next steps.

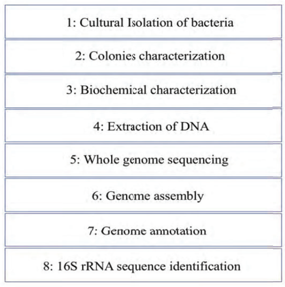


Figure 1. Picture of the strip sequence

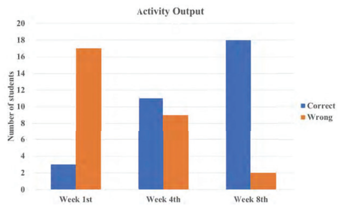


Figure 2. Evaluation of the students

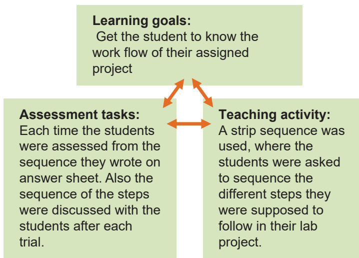


Figure 3. Constructive alignment focusing on the learning goals, assessment tasks and the teaching activity

Future aspects

This type of project in this course was tried for the first time that is why by doing such acitivty improves the student long term learning. The strip sequence activity could be used as a supplement to the teaching, to make sure that the students understand what and why they are doing during their project. In the feedback, the students liked the teaching activity and were willing to be incorporated at other courses as well having such chain of steps. In my experience with my classs, I will recommend to other instructors as well to incorporate this type of activity in their teaching.

AARHUS UNIVERSITY
SCIENCE AND TECHNOLOGY

iNANO

Nasar KHAN
Biofilm Group
Interdisciplinary Nanoscience Centre

Understanding laboratory protocols

- How to avoid students "following the recipe"

Learning Lab

Abstract:
In laboratory courses, students sometimes forget to reflect upon the laboratory protocol and treat it like a baking recipe, thereby limiting their own learning. This teaching activity intends to force the students to reflect on the protocol and hence increase the understanding of the experiment.

COURSE FACTS

- Course name: Chemical Technolohical Project 1
- Level: Bachelor
- ECTS credits : 5
- Language: Danish
- Number of students: 20
- Your role: Laboratory instructor

TEACHING IN PRACTICE

1. Identifying a problem

In a lab course, I find that the main challenge is to make sure that students reflect on why they are doing what they are doing, in stead of just "following the recipe".

In the course Chemical Technological Project 1, the students design their own experiments in groups and decide on a procedure on their own, which already counters the tendency of "following the recipe". However, I have noticed that some of the groups find procedures on the internet, and I am unsure of whether they then have the intended understanding of the steps. I would like to ensure that they do in fact reflect on the procedure.

Another issue I have noticed and discussed with some of the students is that in some of the groups one or two people may be making most of the decisions and doing most of the thinking, maybe because some are naturally more confident or dominating than others. I would like to ensure that everyone in the group feels they contribute and understand the experiment so that no one feels overwhelmed and just does what they are told.

2. Planning a teaching activity

In Chemical Technological Project 1, the students design their own experiments in groups. Before class, they upload their intended laboratory protocols to blackboard for the instructor to see.

To make sure that the students understand the protocol, they will be asked to describe the intention of each step in the laboratory protocol. Furthermore, they will be asked to explain why they have chosen the procedure that they have, to make them reflect on possible alternatives.

To evaluate the teaching activity, the students will be asked whether the teaching activity increased their understanding of the laboratory protocol using mentimeter.

3. Trying it out in practice

The teaching activity was not performed in practice. I will be instructing Chemical Technological Project 1 again next year, where I will try to implement the teaching activity.

MAIN POINTS

1. **Main problem/challenge:** Lacking reflection on laboratory protocol.
2. **Teaching activity**: Students are asked to explain the intention of each step in the laboratory protocol and for possible alternatives.
3. **How did it go?** The teaching activity was not performed in practice.
4. **What to do next?** The teaching activity should be tried in practice and evaluated by the students.

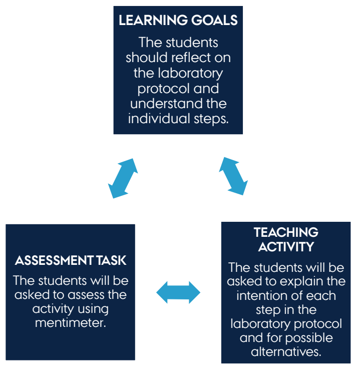


Figure 1: **Constructive alignment**
Alignment between 1) learning goals 2) teaching activity and 3) assessment task.

4. Looking forward

The teaching activity was not performed in practice. Next year, I will be instructing the same course again, and it would be nice to try the activity in practice.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Solveig Kjeldgaard
Department of Engineering

Active learning in laboratory exercises

- a strip sequence to 'think' before 'doing'

Learning Lab

Abstract: Laboratory protocols are often found difficult for the students to grasp as they lack the necessary practical experience and therefore become very dependent on the teaching assistant during the exercise. By performing a small teaching activity, students hopefully become more familiar with the protocol and can be more independent on the help and guidance from the teaching assistant, which instead can be used for questions of higher level than protocol related. Unfortunately, it has not been possible to try out the teaching activity in practice.

COURSE FACTS

- **Course name:** Food Structure and Enzymes.
- **Level:** Master level.
- **ECTS credits :** 10.
- **Language:** English.
- **Number of students:** 30.
- **Your role:** Teaching assistant in laboratory exercises.

TEACHING IN PRACTICE

1. Identifying a problem

Students in the laboratory tend to just follow protocols like a recipe without giving any thoughts to **why** they do what they do. Although they work actively, they do not learn. Therefore, this teaching activity was designed to help the students to be aware of the steps in the laboratory protocol through a collaborative and active learning activity, a strip sequence. The goal for the activity is to show the students the importance of reading and understanding the whole protocol before performing the experiment, and moreover making them a bit more independent of the teaching assistant.

2. Planning a teaching activity

The students will prepare for the exercise by reading material regarding the underlying theory. The laboratory protocol will be giving as a strip sequence on the day of the experiment (Figure 2), and is divided into four headlines, each representing different parts of subexperiments. Under each headline, the number of steps is giving and the students will have to place the steps under each headline – all steps from the four headlines are mixed. This is done in groups as learning is a social process. Afterwards, the groups will present the order of the steps and finally there will be a class discussion about the affect of different orders along with additional questions regarding the theory.

3. Trying it out in practice

Students should have been in the laboratory before, so they know the routines. They will not be presented with the protocol before the day of the laboratory exercises. However, they will be giving material to read as preparation. The students are already divided in groups and these will solve the activity together, before presenting the order to the class followed by a collective discussion.

Figure 1: Laboratory exercise.
Master students in a laboratory exercise from the teaching observation.

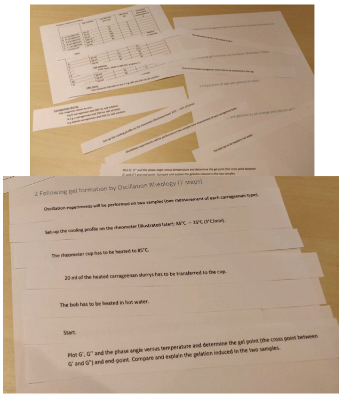


Figure 2: Strip sequence exercise.
Students will be giving four exercise headlines, each referring to different parts of the same experiment and sub experiments and are supposed to order the protocol sequentially – not knowing which strip belongs to which exercise.

MAIN POINTS

1. **Main problem/challenge:** Students often come into the laboratory with a premade protocol, which they rashly follow.
2. **Teaching activity**: Ordering the steps of the exercise in a strip sequence.
3. **What to do next?** Implement the teaching activity and try it out in practice.

4. Expectations

Since it has not been possible to try the teaching activity, some expectations are considered. From observing other teaching activities in the laboratory, students are very dependent on the teaching assistant in the performing of the experiment. Hopefully, this exercise will make the students more independent of the teaching assistant as he/she have will not be available at all times. In addition, by being more familiar with the protocol, fewer mistakes will be made.

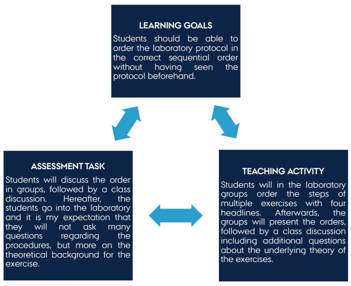


Figure 3: Constructive alignment
Illustration of the connection between the learning goals (what the students was intended to learn), teaching activity (the teaching) and the assessment task (evaluation of the intended learning).

4. Looking forward

Unfortunately it has not been possible to try out the teaching activity, but the materials have been prepared when the opportunity for being a teaching assistant arises and will definitely be included.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Heidi Thorgaard Kristensen
Food Chemistry and Technology
Department of Food Science

Biodiversity in crop production

- Lecture to inspire and introduce new terms in the sustainability debate

Learning Lab

Abstract: Advanced Crop Production is the last course the students at agro-biology take before they start writing their master thesis. At this level they should be able to discuss and apply advanced approaches to sustainable crop production and the teaching activity should reflect this. However, lectures are often a passive one-way communication from teacher to students. This lecture was structured as a conversation between lecturer and students with a variation of class discussions, problems solving, presentation and usage of concepts and group work. This ensured that all students participated in the discussions and were active learners. Future lectures should focus more on giving students ownership over new terms.

COURSE FACTS

- Course name: Advanced Crop Production
- Level: Master
- ECTS credits : 10
- Language: English
- Number of students: 10
- Your role: Lecturer

TEACHING IN PRACTICE

1. Identifying a problem

Passive learning. One issue is that lectures by PhD students typically become only presentation of results and do not provide the students with new terms. Another is that teachers often take the easy solution and split the teaching into 1) lecture and 2) student presentations of articles. When the aim is to make the students reflect and handle scientific knowledge independently, a more interactive teaching approach is better suited.

2. Planning a teaching activity

A lecture where theoretical exercises are integrated should enable the students to be active learners and process new ideas. When the teaching is driven by the inputs from the students, they need to use existing knowledge to reflect on a topic and to build new knowledge upon.

The aim of the lecture is to make the students use their existing knowledge about sustainability in agriculture and reflect on how biodiversity could be part of this framework. The students should have new specific terms in their vocabulary that help them describe the mechanisms that drive biodiversity based agriculture.

3. Trying it out in practice

In the lecture the students were invited to the conversation by presenting themselves and **their topics of interest** and their scientific backgrounds. They participated in **group discussions** about application of biodiversity in different systems and situations. The students worked with **identifying** classic diversity implementations from images. They were given the task of writing the **terms they remembered** from the lecture and then comparing their results in groups and they participated in **class discussions** about the topics covered.

I as lecturer facilitated the discussion, made the **introduction to the topic** and recapped the previous knowledge of the development in agriculture systems. I asked **definition questions** about monoculture and biodiversity. I introduced **new terms** about co-evolution and boom and bust cycles. I **presented a framework** for describing diversity in time, space and on different trophic levels. I gave an introduction to the **theory about mechanisms** in resource sharing and disease suppression.

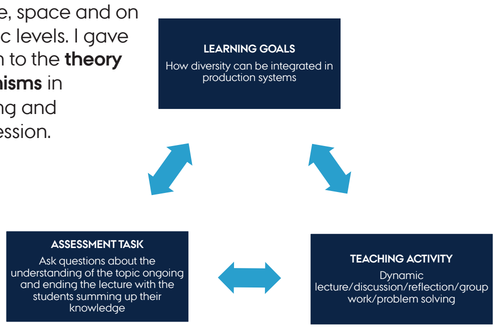


Figure 2: **Constructive alignment**

MAIN POINTS

1. **Main problem/challenge:** Passive learning approaches in lectures
2. **Teaching activity**: Integrated lecture, discussion and exercises
3. **How did it go?** Students were active and were able to solve problems
4. **What to do next?** Prepare next lecture with more flexibility to meet the students where they are

I presented the students with **examples** of applications and constraints in different situations they could use for class discussion and ensured the **lecture and the discussions were summed up** in the end. The lecture was supervised by the course responsible who gave feedback.

4. Looking forward

It worked very well to integrate activities. The students participated actively and were good at using their knowledge to ask relevant questions and identify problems. It was clear that they learned a lot and that the teaching activities sparked a lot of reflection. However it was not all the terms that I introduced that were adopted by the students. For my next lecture I will be more prepared for changing the lecture depending on the students' levels and make more room for the students to use the new terms and make them their own.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Rose Kristoffersen
Fungal pathology
Agroecology

Engineering review process

- Executing engineering review process to find bad system requirements

Learning Lab

Abstract:

Students within the Systems Engineering course are learning to design, compose and decompose complex systems, including hardware-software interactions, requirements engineering and overall architectural design of complex systems. Some of the biggest issues in systems engineering stem from incorrectly defined system requirements. Within the short exercise presented in this poster students learn how to recognize incorrect or impossible requirements by means of executing an engineering review process. This exercise hence trains students in the engineering review process itself as well as system requirements engineering.

COURSE FACTS

- Course name: Systems Engineering
- Level: Master
- ECTS credits : 5
- Language: English
- Number of students: 50
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

The student groups within the systems engineering course were to use engineering review process [1] on documents they constructed weekly in the course and record their observations and provide these to other group and the TA. The responsibility of the TA was to ensure that all the documentation is present and correct. As the TA it seemed to me that students misunderstood the review process and its outcomes. The same mistakes have shown every weeks despite feedback provided to students.

2. Planning a teaching activity

The teaching activity would address the weaknesses with direct input from the TA on the spot.
The students were provided with a system requirements specification document which intentionally contains:

- Bad requirements
- Incomplete requirements
- Impossible requirements

Further a minilecture with repetition of the engineering review process is carried out by the TA before the exercise.

The students are provided with review log sheet where they mark their observations and deliver it to the TA.

References

[1] Kapurch, S.J., NASA Systems Engineering Handbook, 2010, https://books.google.dk/books?id=2CDrawe5AvEC

3. Trying it out in practice

A short lecture with repetition of the engineering review process has been delivered to the students first, using power point presentation and whiteboard.

The system requirements specification document as been than distributed to groups of students (groups of max. 6) and a review log sheet, where the students were to note their answers has been distributed.

Students execute the engineering review process to identify wrong requirements and propose improvements. The review log sheets are collected after 25 minutes.

During the execution of the exercises the student groups are visited by the TA to provide guidance and clear possible misconceptions.

Overall the activity has received positive feedback with most group specifying it would be nice to have more such exercises and that their placing should be earlier in the course.

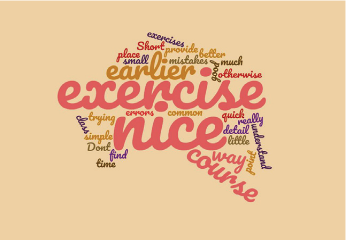


Figure 1: **Word cloud of the feedback provided by students for the teaching activity**.

MAIN POINTS

1. **Main problem/challenge:** Requirements review
2. **Teaching activity**: Apply engineering review process to system requirements
3. **How did it go?** Overall positive feedback received with request to place this type of exercises earlier in the course
4. **What to do next?** Plan more short exercises and propose their use within the course.

While the exercise feedback was primarily positive, some negative aspects have been raised:
- Late placement in the course
- Requirements document does not specify real life system
- Time to execute the exercise was too short

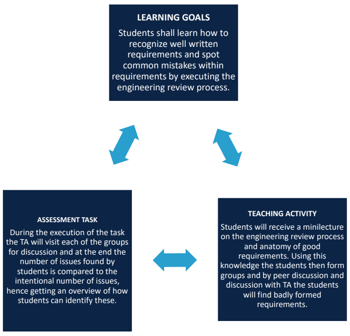


Figure 2: **Constructive alignment.** Assessment directly reflects the learning goals. Students were not informed on the number of issues within the document.

4. Looking forward

The activity as a whole was liked by students, even though it has been executed long after the students were introduced to the theoretical aspects of the topic. Major improvement to the activity is assigning a better timeslot to it, preferably scheduling it after the students execute their first engineering review on their own and include the mistakes observed after this. Also more of these short exercises can be planned to activate the students.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Tomas Kulik
Software and electronics Engineering

Recall activity

A jeopardy game

Learning Lab

Abstract: Long lectures which cover subjects within a teaching book can be weary but necessary. It is vital, therefore, to ensure that students recall key concepts of a lecture. To do this the students must subsequently reflect on the topics just been taught. Student were after a lecture ordered into groups where after a jeopardy game, covering the key concepts of basic immunology, was employed. The students in the respective groups complemented each other well in recalling concepts of the lecture. This led to nearly 60% of the students to answer 100% correct on a TRUE FALSE questionnaire. The jeopardy game, thus, is good for students to subsequently recall key concepts after a lecture .

COURSE FACTS

- Course name: Livestock Diseases and Disease Prevention Level: Master
- ECTS credits : 10
- Language: English
- Number of students: 7
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

Long lectures where subjects from a teaching book are presented can sometimes be necessary. Making the students subsequently remember what they have just been taught is a challenge but vital. A jeopardy game, thus, was prepared which addresses the subject being taught. This will render the students proactive after a lecture. Group work, moreover, will make the students complement each other as every person remembers different things.

2. Planning a teaching activity

The students should be able to recall key concepts of basic immunology. By ordering the students into groups and adding in a little competition in the form a jeopardy game with a prize for the winner, the students are engage to recall the pervious lecture and key concepts herein.

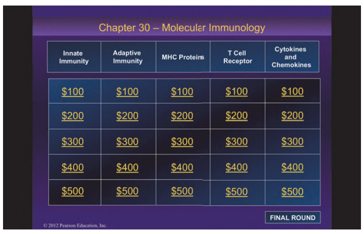


Fig. 1. Key concepts of immunology as part of a jeopardy game

3. Trying it out in practice

After the lecture, the students looked a bit tired. A small break of 10 min was held. Hereafter the students were arranged into groups and the jeopardy game was introduced. The students seemed relaxed and became proactive and somewhat competitive. After each jeopardy category was answered the question was summed up by addressing why the answer was right or wrong.

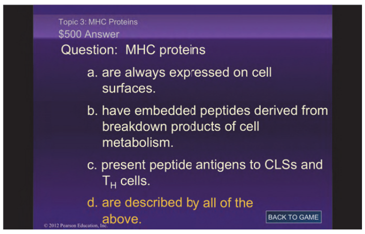


Fig. 2. Example of jeopardy category, question, and correct answer.

The students only failed at very few questions and they felt motivated by the game to recall key concepts of immunology and discuss the questions in groups. The TA was evaluated by a small true false handout (**Fig. 3**), which covered the key concepts of immunology. This proved that the majority of the students had recalled the concepts of basic immunology.

MAIN POINTS

1. **Main problem/challenge:** Recall key concepts of a long lecture
2. **Teaching activity**: Jeopardy game
3. **How did it go?** Nearly 60% of the students recalled 100% of the key concepts.
4. **What to do next?** Control the composition of groups so that every group includes at least one deep-learner.

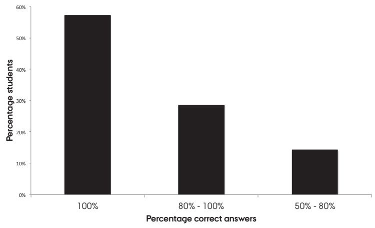


Fig. 3. Evaluation of TA in the form of TRUE FALSE questions regarding key concepts of basic immunology

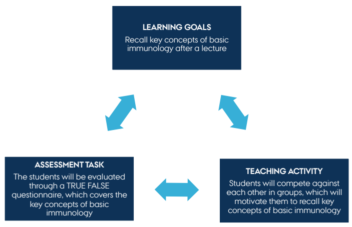


Fig 4. Constructive alignment

4. Looking forward

The students became very proactive during the TA, which helped create a relaxed and fun atmosphere, while focus on the subject were kept. In the future, to increase the number of students answering 100 % correct on the evaluation, the composition of the groups could be determined by the TA to include at least one deep-learner. This might enhance the chance of the individual group of answering correct in the TA.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Frederik Larsen
Immunology and Microbiology
Animal Science

Optimization of Nitrogen Use in Farms

Demonstrating the use of N optimization model

Learning Lab

Abstract: The optimal use of nitrogen (N) nutrients in farms is a major problem due to the environmental pollution concerns. This led to the development of a model toolbox to aid in the use of N fertilizers optimally at the farm level. However, due to the complexity of the tool, students find it difficult to operationalize it in the advanced crop science class. I decided to design a practical computer demonstration exercise to guide students on the use of this tool without any difficulty. The activity was assessed with both a recall exercise and a home work organized in pairs. The high performance by the students shows that the learning goal and outcome were achieved in this teaching activity. There is a room to apply it to different scenarios.

COURSE FACTS

- Course name: Advanced Crop Science
- Level: Masters
- ECTS credits : 10
- Language: English
- Number of students: 12
- Your role: Give a 30 demonstration of how to use N optimization model

TEACHING IN PRACTICE

1. Identifying a problem

Students studying crops science find it challenging to guide farmers on how N fertilizers can be applied based on crop requirements without polluting the ground and surface waters. The optimization model designed to achieve this is complex making it difficult for students to implement it for a given practical scenario.

2. Planning a teaching activity

The activity is intended to address the students' difficulty in using N optimization model which they need when they go to the field as crop scientists to educate farmers. Through this practical computer demonstration, I anticipate that students will grasp the techniques and practical way of using the optimization model. By the end of the activity, they will be able to have a practical overview and recall how the model is used.

The activity involves an assessment to determine students' level of understanding after the demonstration.

Learning Goals:

- Know the steps to run a nitrogen optimization model and apply it to any giving farm scenario.

References

Ramsden, P. (2003). Learning to teach in higher education. Routledge.

Osaki, M., & Batalha, M. O. (2014). Optimization model of agricultural production system in grain farms under risk, in Sorriso, Brazil. Agricultural Systems, 127, 178-188.

3. Trying it out in practice

The practical use of the N optimization model requires a computer with R program installed on it. This teaching is therefore carried in small computer lab. The procedures and commands for running the optimization model was prepared and distributed in advanced.

I started with a short (3mins) think-pair share to identify the steps used in the optimization model. This also activated the students.

I then asked students to open the commands which were prepared in the order of the steps they listed during the think-pair-share.

With the help of a projector, I run the commands while explaining each step. The students observe and followed it on their computers. Those in need of help were guided individually.

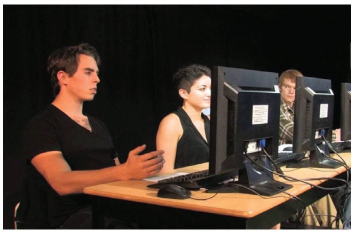


Figure 1 Students following demonstration on their computers

Table 1 Students' performance in the assessment of learning outcome

Questions	Correct answers (%)	Wrong answers (%)
1) List the steps in model use	11 (92)	1(8)
2) Home work exercise	10 (80)	2 (20)

MAIN POINTS

1. **Main problem/challenge:** Student finds it difficult to use the optimization model for N application
2. **Teaching activity**: Practical computer demonstration exercise
3. **How did it go?** Very successful. Positive feedback about the intended goals of the exercise
4. **What to do next?** Try an optimization model for phosphorus

From the assessment results, it is apparent that the demonstration helped students to grasp the procedures as 11(92%) listed the procedures correctly. Only one pair had a mistake in their home work exercise. The activity can therefore be described as successful in achieving the learning goal and outcome.

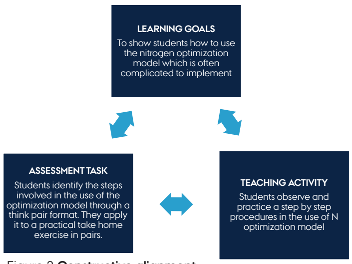


Figure 2 **Constructive alignment**
Link between 1) learning goal 2) teaching activity and 3) assessment

4. Looking forward

The students were active throughout the section with great attention following the brief introduction on the importance of N optimization in agriculture. They appreciated the usefulness of the N optimization model. With the help of the practical demonstration, students acknowledged the need for using the optimization model despite the difficulty in its implementation. The next step could be to change the environmental or farming conditions for students to extrapolate the knowledge gained from this activity to different scenarios. Another step will be to apply the model to optimize Phosphorus use which is also a major crop nutrient. Much time will be required in the future to allow for the practical exercise in the lab.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Noah Larvoe
Agricultural System and Production
Department of Agroecology

Laboratory Exercise

- Understanding thermal energy harvesters through practical experiments

Learning Lab

Abstract: At the end of the course Wearable Electronic Devices, the students are expected to do a project on some wearable/portable device of their own design that are to be powered by an energy harvester system. One such possible power source is called a Thermal Energy Generator (TEG), however understanding its operating parameters and how it works, and how to interface it correctly in order to maximize power transfer can be hard to grasp. For this reason a laboratory exercise was designed to help bring this understanding, and in the process also introduce demonstration boards designed to harvest power from a TEG. It should be noted that this laboratory exercise was run back in November, before taking the science teaching course.

COURSE FACTS

- Course name: Wearable Electronic Devices
- Level: Master
- ECTS credits : 10
- Language: English
- Number of students: 13
- Your role: Run a laboratory exercise.

TEACHING IN PRACTICE

1. Identifying a problem

The original plan for the laboratory exercises was to introduce several different energy harvesting techniques and technologies. However it was soon decided to focus primarily on just one type, a thermal energy generator (TEG), which can be seen in Figure 1, given the available time to actually learn about it with a practical experiment. Furthermore, after the laboratory exercises, the students had to create a project of their own and design it to be powered by an energy harvester, further limiting time.

The focus here however was the laboratory exercise itself, and introducing them to the TEG, and teaching them how to use it and extract as much power from it as possible. The challenge here was that the students came with different backgrounds, some where engineers who generally knows electronics already, and others may be physicists who may find Ohms law a little far away and needs some refreshing.

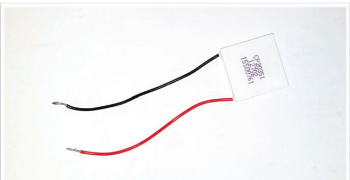
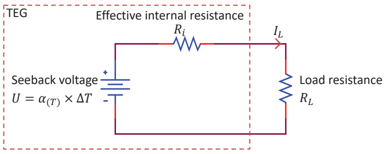


Figure 1: Picture of a thermal energy generator (TEG), it is about 2 cm x 2 cm x 0.5 cm.

2. Planning a teaching activity

The best way to learn about and understand an as of yet unknown piece of technology is to experiment with it. With the decision to focus on a TEG, a set of tests was designed to reveal how best to use it.

The advantage of starting out with the TEG is that it is a nice and linear component, that is easily visualized in a simple schematic (see Figure 2), and from there it is easy derive any and all relevant equations needed for the laboratory exercise.



$$P_L = I_L^2 \times R_L = \left(\frac{U}{R_i + R_L}\right)^2 \times R_L = \left(\frac{\alpha \times \Delta T}{R_i + R_L}\right)^2 \times R_L$$

Figure 2: Equivalent Circuit of a TEG with a load attached (R_L), and an expression for the power in the load (P_L).

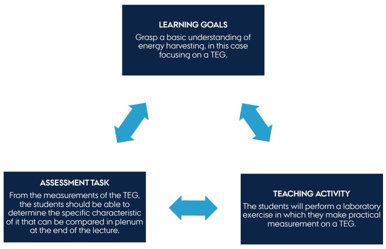


Figure 3: Constructive alignment

MAIN POINTS

1. **Main problem/challenge:** Identify the operating parameters of a TEG energy harvester, in order to maximize power harvesting.
2. **Teaching activity**: Hands-on laboratory exercise.
3. **How did it go?** My impression was that it went quite well.
4. **What to do next?** Expand the laboratory exercise into also covering other energy harvesters.

In short, the students must measure the open circuit voltage and the short circuit current of the TEG, and from this derive the effective internal resistance R_i. With R_i known, they can now determine the optimal load of R_L for the TEG and thus maximize power harvesting.

3. Trying it out in practice

Initially I started out with a 10 minute description of the task at hand, and introduced them to the TEG that they in groups of 2-3 people were about to measure on. Once they started I myself observed them work, and assisted them whenever questions about the measurements or use of the lab-equipment arose.

In retrospect I may have given to much guidance since true learning peaks when you are trying to solve a problem yourself, and not just following directions given out by the lecture/instructor.

4. Looking forward

The Laboratory exercise itself was a success, as it in a simple, yet clear way showed the students how a TEG works, and how to optimally use it as a power source and maximize power transfer. The feedback from the students was positive and that they had learned something new.
The next time the course runs though, it is the plan to expand the number of laboratory exercises to include for example small solar-cells. However, for the sake of the students projects at the end of the course, also to introduce some demonstration boards and small code examples for an ultra low power micro-controller board, so as to enable them to do fast prototyping.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Kjeld Laursen
Integrated Circuit & Electronics Laboratory
Department of Engineering

ICE LAB

From theory to practice

- How to encourage student independence in fieldwork

Learning Lab

Abstract:

A field course is a way for the students to get some hands-on experience, which is not also possible in a classroom. However, the gab between classroom theory and practical knowledge leaves the students unable to work independently in the field. To give the students a better overview and encourage independence, two teaching activities has been implemented: making a packing list and a strip sequence of the steps of the data acquisition methods, which the students will go through in the field. The simple activities helped the students to work more independently much earlier in the process.

COURSE FACTS

- **Course name:** Electrical and Electromagnetic Data Collection, Processing, and Interpretation
- **Level:** Master course
- **ECTS credits:** 10
- **Language:** English/Danish
- **Number of students:** 5
- **Your role:** Teaching assistant (TA) on the field course

TEACHING IN PRACTICE

1. Identifying a problem

Based on experiences from previous years teaching and participation in field courses, I find that it is difficult for students to transform theory into practice. Lack of overview causes a lack of project management. Consequently, the students are not able to carry out fieldwork independently. They don't have the ability to asses the consequences of their choice of method, equipment type and setup, as well as field strategies.

2. Planning a teaching activity

To encourage independence in the field, the students must be given a short overview of the relevant theory before going to the field as well as thoroughly introduction to the field equipment.

The main learning goals of the implemented teaching activity are:
The students should be able to:
1) Set up and handle instruments.
2) Plan a day-to-day measurement strategy taking into account limitations and assets of different setups as well as factors affecting data quality.

3. Trying it out in practice

Two teaching activities are implemented in the last lecture before the field course. The activities are introduced just after a short presentation of the relevant theory and the field procedures.

The students are divided into groups (2-3 students). First, the students make a sketch of the measurement setup and a list (a packing list) of all the necessary equipment/instruments. Secondly, the student work on a strip sequence, where they must find the right order of the steps in the data acquisition.

Figure 1: Students discussing instrument settings in the field.

Compared to the other methods applied in the field – to which the activities were not applied – the students took more part in the preparation of equipment for the method in question. This happened without encouragement from the TA and the packing list was such used successfully.

The results of the strip sequence was (by encouragement from the TA) brought into the field and used to go through the steps of the data acquisition.

In a follow-up session after the field course, the activities were discussed. The students told that the activities eased the learning curve, gave them a better overview of what was going to happen and such help them to a better start with the data acquisition.

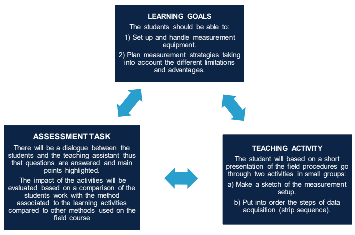


Figure 2: Constructive alignment for the teaching activity

MAIN POINTS

1. **Main problem/challenge:** Lack of overview and independence in fieldwork
2. **Teaching activity**: List the equipment and sketch the setup. Make a strip sequence of the data acquisition.
3. **How did it go?** The activities furthered the independency among the students .
4. **What to do next?** Implement the learning activities for all the methods treated on the field course.

4. Looking forward

The teaching activities furthered the independency among the students, who were better equipped to start data acquisition themselves. Consequently, the activities should be implemented for all methods studied on the field course. When the students turn in their written reports, we will see if the activities also had a positive influence on their ability to describe the methods in written form.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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HydroGeophysics Group
Department of Geoscience

Concentration calculation:

Basic teaching activity to encourage some initiative

Learning Lab

Abstract: Students arrive to an ecotoxicology lab, where we are about to complete an experiment looking at the effect of copper solution concentration on the feeding rate of an amphipod. While most students have read the manual beforehand, few attempt any of the copper concentrate calculations necessary to conduct the experiment. This teaching activity addresses this shortfall, and while it gets students to understand how to correctly calculate a concentration, the biggest take home message is for the students to realize that it is a good idea to demonstrate some initiative in their own university learning experience.

COURSE FACTS

- Course name: Ecotoxicology
- Level: 2^{nd} year Bachelor to Masters students
- ECTS credits : 10
- Language: English/Danish
- # of students: 4*10 = 40
- Your role: Monitor small groups in one lab of the course

TEACHING IN PRACTICE

1. Identifying a problem

Students seem to have trouble calculating a concentration of a chemical that they need for an experiment. Usually students read the lab manual before coming to conduct the lab, but **few attempt to calculate the concentration they will need** (Fig 2). Sometimes, one student has calculated this alone, comes prepared, and the rest of the students trust this calculation. 'Trust' is not good enough in science.

2. Planning a teaching activity

The **learning goal** for this teaching activity to get students to be able to confidently calculate a chemical concentration by themselves.

I intend the small group of students to learn how to calculate concentrations and volumes of substances needed, using the $C_1V_1 = C_2V_2$ formula (Fig 1). This teaching activity aims to cater to the lazy/unprepared/non-confident student by going through the calculation together as a class.

Of course, some students understood how to do the calculation more quickly than other students. This was fine: it gave the confident student the opportunity to teach another student, reinforcing their understanding. Better yet, if students disagreed, then they are more likely to remember how to complete the calculation if their understanding was challenged by their peer.

3. Trying it out in practice

First, I asked the students to try this calculation individually (5 min). Then, I split the group of 4 students into 2 groups of 2 students, and asked them to discuss their answers (10 min), and giving them the opportunity to either teach their peers or learn from their peers (*Think-Pair-Share*). I then walked through how to correctly do the calculation on the whiteboard (Fig 1; 5 minutes). The students had the opportunity to work individually and as a team in a non-intimidating environment.

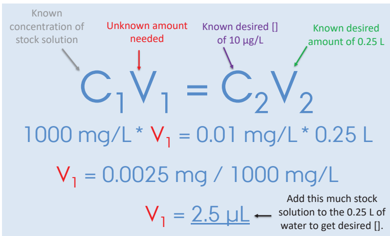


Figure 1. Demonstration of walk-through of calculation for making a [10 µg/L] copper solution from a stock copper solution.

The **learning goal was assessed** by:

1) Giving the students a new set of volumes and concentrations for which they were to solve the equation. Once each student could demonstrate that they could correctly do this individually, we moved on with the experiment.
2) The students were asked if the teaching activity improved their calculation skills (Fig 2).
3) The students are also asked to include this calculation in their lab report, submitted one week later. Here, I have another opportunity to give them individual feedback.

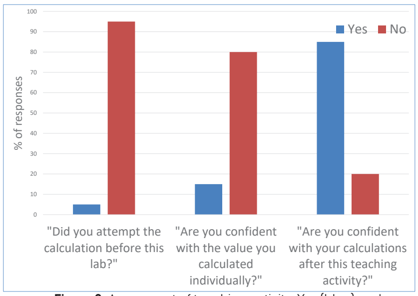


Figure 2. Assessment of teaching activity. Yes (blue) and no (red) responses. Responses from 8 students are shown.

MAIN POINTS

1. **Main problem/challenge:** Students generally don't come to the lab prepared.
2. **Teaching activity**: Think-Pair-Share, followed by a walk-through of calculation steps.
3. **How did it go?** Fine.
4. **What to do next?** Pray that the students understand that they should have the initiative to come prepared for class, unprompted.

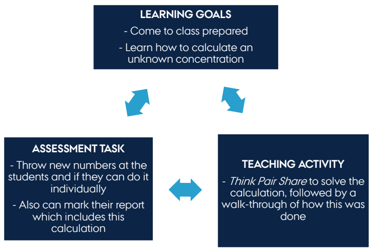


Figure 3. Constructive alignment

4. Looking forward

The walk-through improved the students' confidence in calculations (Fig 2).
A reasonable next step would be for the students to have the initiative to show up to their next lab prepared, having at least attempted any calculations beforehand. This is a pretty low bar, but is reflective of the pretty abysmal level of initiative I have seen in the students I have taught. In my initial feedback for this teaching in practice activity, I was asked whether the students were explicitly asked to come to the lab with this calculation done. I think that this misses the point; it is ridiculous to prompt university students on their every task. They are at university – not in grade school.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Chloe Malinka
Zoophysiology
Department of Bioscience

The scalar- and vector potential
- When and why are the equations valid?

Abstract

The fundamental equations of electrodynamics can be written in terms of the so-called scalar- and vector potential. If the potentials are changed in a specific way (called a gauge transformation) the physics of the equations remains the same even though the equations look different. This can be confusing – which equations are only valid after which transformations? To help the students understand this better, I used the 'Ticket out the door"-activity, where the students use their own words to explain *why* two statement about these equations are true or false. This revealed some misconceptions that were cleared up, and started a good discussion on the topic.

Learning Lab

COURSE FACTS

- Course name: Elektrodynamik
- Level: BSc
- ECTS credits : 10
- Language: Danish
- Number of students: 15
- My role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

Here, the equation for the scalar potential is derived. However, there are some subtle assumptions about the gauge in the derivation. Later in the course, these assumptions are no longer valid and new equations for the potentials occur. It is very important that the students the students **know when to use which equation** for the potentials, such that they can apply the correct one in an exam situation. It is easy to look in the book for an equation for the potentials and stumble upon one that is not applicable.

2. Planning a teaching activity

In this "ticket-out-the-door" teaching activity I give the students two statements. They must write on the ticket whether or not the statement is true of false and also **write why this is so as precisely as they can.** The two statements are:

1) Maxwell's equations are *only* valid in the Coulomb gauge.
2) Poisson's equation for the scalar potential is *always* valid.

Both statements are false. This activity forces the students to think about which assumptions are made when the equations are derived. Afterwards, the answers are analyzed and common mistakes and inaccuracies are discussed in class.

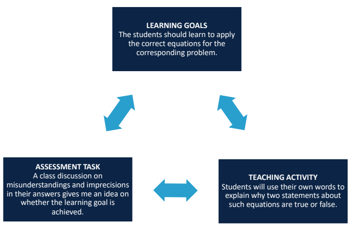


Figure 1: Constructive alignment

3. Trying it out in practice

The teaching activity was conducted at the end of a TE session, where we did some problems involving gauge transformations. I put the last 10 minutes aside for the activity The students were allowed to discuss with their neighbors, although I stressed that they should write their answer using their own words.

The following TE session started with a discussion of the answers. All students correctly identified that the two statements are false. However a few misconceptions arose in the answers of the second statement. The general arguments from the students were,

1. Poisson's equation is valid in the **Coulomb gauge.**
2. Poisson's equation is valid in **electrostatics**.

The first one is correct but incomplete, while the second one is correct in most cases. The full answer is that the equation $\frac{\partial}{\partial t}\nabla \cdot \boldsymbol{A} = 0$ must be fulfilled, which follows from Maxwell's equations. Although the students answers would suffice in many applications, the small inaccuracies sparked a very good discussion on gauge transformations and the origin of Poisson's equation in electrodynamics.

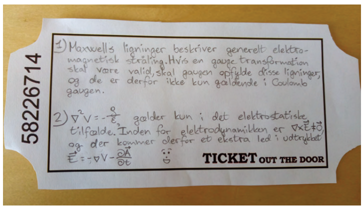
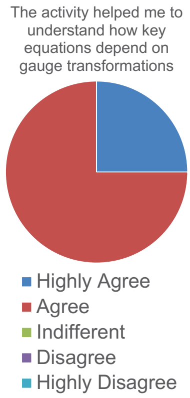


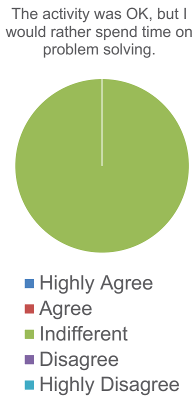
Figure 2: Example of a ticket out the door. Printed with permission from the author.

MAIN POINTS

1. **Main problem/challenge:** Identify how key equations are related to gauge transformations
2. **Teaching activity**: Ticket out the door
3. **How did it go?** The activity went well. It revealed some inaccuracies that were cleared up
4. **What to do next?** Plan similar teaching activities for next semester

The teaching activity was a success based on the discussion with the students. In particular one student said (translated): *"I really liked the activity, especially because I didn't know what a gauge transformation was before*". Below is the result of a small survey on whether the students liked the activity.





4. Looking forward

The teaching activity was a success. The students elevated their understanding of the topic and reported that they liked the activity. Though such an activity should not replace problem solving, all students agreed that it is a welcome alternative once in a while. I hope to teach electrodynamics next semester as well, where I plan to do similar activities. I will definitely suggest the lecturer to incorporate discussion questions in the next semester of electrodynamics.

Figure xx: **Constructive alignment**

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Henrik Lund Mortensen

Distinguishing Similar Topics

- A teaching activity about eukaryote and prokaryote transcription

Learning Lab

Abstract: It is often difficult for students to distinguish similar topics that are covered in different lectures without getting confused. Consequently, a teaching activity was used to provide an overview of the similarities and differences of eukaryote and prokaryote transcription in a TØ-session connected to the course General Molecular Biology and Biochemistry. The evaluating questionnaire revealed that this type of teaching activity increased understanding and could potentially be expanded to include other topics.

COURSE FACTS

- **Course name**: General Molecular Biology and Biochemisry
- **Level**: Bachelor
- **ECTS credits**: 10 ECTS
- **Language**: Danish
- **Number of students**: 166
- **Your role**: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

Usually, the lectures follow the chapters in the book chosen for the course and the TØ-sessions follow the lectures. This alignment sometimes makes it **hard for the students to relate and distinguish the different topics to each other** and especially when the contents of the topics are similar the students tend to confuse the topics.

2. Planning a teaching activity

To solve the above-described issue, I designed a teaching activity (TA) that will help the students to obtain an overview of the similarities and differences of given topics.

The TA should help the students **distinguish** the eukaryote transcription and prokaryote transcription from each other and **provide a tool** for the students to use in their future studies.

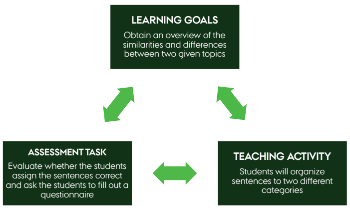


Figure 1: Constructive alignment of teaching activity

I chose to work with the two topics *Eukaryote transcription* and *Prokaryote transcription* since these topics are both very similar and very different, which often confuses the students.

3. Trying it out in practice

The TA was **performed in TØ** after the lectures covering the chosen topics; *Eukaryote transcription* and *Prokaryote transcription*. The students were paired in **small groups** (2-3 pers.) and handed a set of sentences. The students were asked to **organise these sentence according to the two main categories**. The sentences were true for either one or both of the main categories and a few sentences were completely false. To evaluate, the students were in plenum asked to say a sentence and say which category it belongs to. I acted as a writer at the board and the were allowed to **discuss in plenum**.

Figure 2: Students while performing the teaching activity

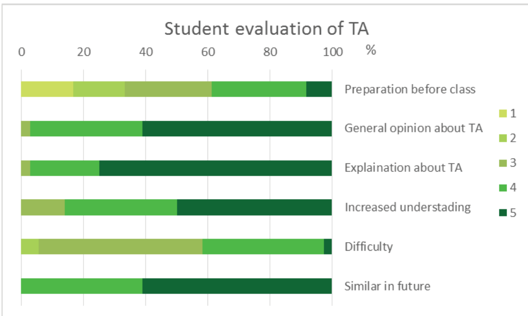


Figure 3: Student evaluation of teaching activity (TA). The students were asked in a questionnaire to evaluate the TA – on a scale from 1 to 5 with 5 being the most positive. In total of 36 students evaluated the TA.

MAIN POINTS

1. **Main problem/challenge:** To relate similar topics presented in different lectures.
2. **Teaching activity**: Organising sentences according to topic.
3. **How did it go?** Very well. The students were very engaged and motivated during the TA. The plenum discussion helped them get the right answers.
4. **What to do next?** Include similar TAs for other topics.

The students responded very positively when evaluating the TA in a questionnaire and the majority found that it **increased their understanding** of the chosen topics (fig. 3). Notably, this was regardless of how well the students were prepared for the TØ-session. Furthermore, even though the students found the TA challenging they after the plenum discussion got the right answers. Additionally, the majority answered that this type of TA would be **useful for them in the future**.

4. Looking forward

Overall, the TA worked as planned by providing the students with a good and valuable tool to gain the necessary overview of similar topics. An improvement to the TA could be to add something visual, since most students remember pictures rather than text. However, the majority felt that the TA increased their understanding and would like something similar in the future. Therefore, the next step will be to use this kind of TA for other topics during the whole course as well as expand something similar to other courses.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Michelle Møhlenberg
Main supervisor Rune Hartmann
Department of Molecular Biology and Genetics

Understanding Nitrogen cycling

- Using strip sequence and mind maps as learning tools

Learning Lab

Abstract: I addressed the problem of difficulty in understanding and remembering nitrogen cycling in soil systems through a strip sequence activity. The activity was made more interesting by asking the students to draw nitrogen cycle using the strip sequence on a magic paper. Assessment of student understanding was done by using a small quiz in menti.com. Using menti helped in maintaining anonymity and increasing student participation. Students were asked to give feedback on the TA to find out scope for improvement in the future.

COURSE FACTS

- Course name: Soil biology and fertility
- Level: Masters
- ECTS credits : 5
- Language: English
- Number of students: 5
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

The students have different level of understanding and knowledge about Nitrogen dynamics in soil and remembering the steps in Nitrogen cycle can be quite challenging for students. Also, introducing a completely new topic (Nitrification inhibitors) can make it even more difficult to understand if the students have poor understanding of Nitrogen cycle.

2. Planning a teaching activity

The teaching activity will help students first get an overview of the topic and then performing a small activity will help them recollect and cohere the elements of the topic. A small quiz in the end will help students apply the knowledge.

Strip sequence

Students will be divided into two groups, each group gets the events in nitrogen cycle as shuffled strips. Students have to arrange the processes in a coherent way and draw nitrogen cycle

Manure addition
NH4
Conversion of NH3 to nitrite
Conversion of nitrite to nitrate
Nitrous oxide emission
Nitrate leaching
Nitrate to nitrous oxide
Nitrogen
Nitrification inhibitors
Nitrification
Denitrification

Figure 1 : Image of the strip sequence used.

Learning goal: Explain, describe and arrange events in nitrogen cycle and understand nitrous oxide mitigation using nitrification inhibitors.

3. Trying it out in practice

The teaching materials were uploaded two days before on blackboard. On the day of teaching, I started with explaining the importance of nitrogen losses in soil systems and then explained nitrogen cycle using a comprehensive figure. This was followed by an activity wherein the class was divided into groups and each group was given a jumbled sequence of events in nitrogen cycle, and were asked to draw nitrogen cycle on a magic paper.

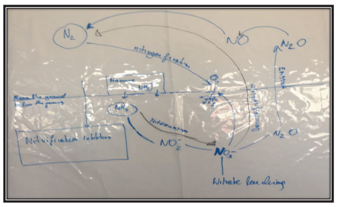


Figure 2: Students discussing in groups, the strip sequence to come up with drawing nitrogen cycle

I walked around and listened to the discussions and also helped the students in case of need. This was followed by continuation of the lecture which included my own PhD study as an example. This was followed by a small quiz in menti.com with applied level questions to test student understanding. Most students fared well in the menti quiz.

MAIN POINTS

1. **Main problem/challenge:** Understanding and remembering steps in nitrogen cycle is difficult for students
2. **Teaching activity**: Drawing nitrogen cycle using strip sequence and small applied level quiz.
3. **How did it go?** The TA was very successful, since learning objectives were met and students were happy as well.
4. **What to do next?** Field visit to show quantification of nitrogen losses in soil systems.

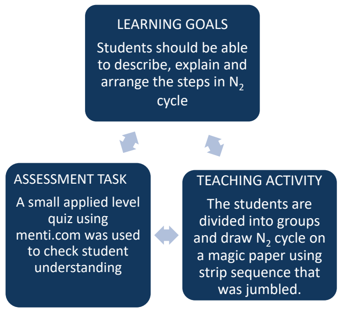


Figure 3: **Constructive alignment**

5. Students feedback

The students really liked the teaching activity and they were excited to try out the magic paper. Their feedback included a comment that I am a good teacher. And that I could improve a bit in delivering the lecture by speeding down my pace

4. Looking forward

Overall, the TA was successful since the students really liked the activities and they said that the TA was a very easy was to understand and remember the N2 cycle. I will improve in time management as a teaching assistant in my future classes. Practical demonstration of quantifying Nitrogen losses would further help students gain in-depth knowledge of Nitrogen cycling in agricultural systems.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Soil Fertility
Department of Agroecology

Theoretical exercises

- How to boost problem solving?

Learning Lab

Abstract: When a student starts analyzing a problem, he/she often use and loose a lot of time on looking for relevant formulae and input. Since analyzing problems and structuring solutions are of high priority in basic first year courses, I here describe the implementation of a teaching activity that seeks to let the students train these important skills. The activity is structured as a think-pair-share activity where the students structure a solution to the problem given based on a handed out scheme. In turn this is used to analyze the success of the activity. The analysis indicates that the students benefit significantly from the teaching activity in analyzing the problem.

COURSE FACTS

- Course name: Elektromagnetisme, bølger og optik
- Level: 1st year
- ECTS credits : 10
- Language: Danish
- Number of students: ca. 150
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

When the students face a theoretical exercise they often come to halt in the initial process of analyzing the problem and structuring a solution. Since **problem solving** and **arguing** for steps in a solution is a part of the learning goals of the course, this issue is truly at the core of the student learning. I have therefore decided to address the following question: how can we boost the problem solving process such that the students are more structured and efficient?

2. Planning a teaching activity

The students should be able to **analyze** a problem. They should be able to **identify** the relevant formulae and **structure** a solution for the problem. To train these skills I constructed a table they fill out for a chosen problem. The teaching activity is similar to a think-pair-share activity.

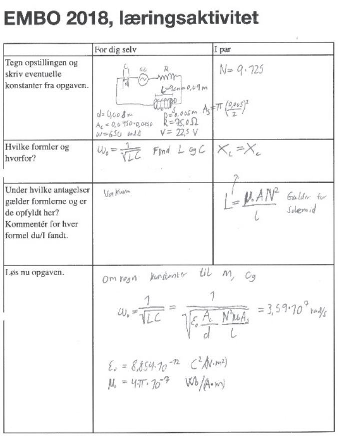

Figure 1: Table for problem solving. The activity is split in 2 parts. Part A: top 3 boxes. Part B: Bottom box.

3. Trying it out in practice

The teaching activity is structured in two major parts:

A. Structure the problem

1. Identify: sketch the setup. Note relevant constants.
2. Analyze: find and write down important formulae.
3. Perspectives: under what assumptions do the formulae apply?

B. Solve the problem

Part A is structured as a think-pair-share activity. First the students have a few minutes to **think** on how to structure the problem by themselves. They then **share** this in pairs for around 10 min. Finally, they **discuss** and **share** each others methods on class level. The activity is deliberately short. This is meant to push the students to get only the relevant information for solving the exercise.

At the end of class the students are asked to fill out a **minute-paper** for feedback on the activity.

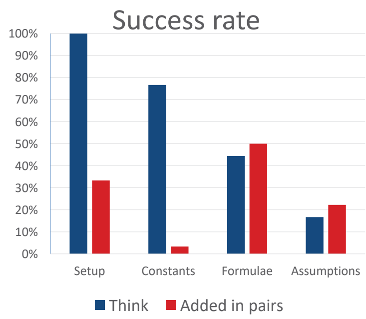

Figure 2: Part A success rate. I calculate this by correcting the filled out tables (Fig. 1) and assess to what degree they have completed each point. Think: individual success. Added in pairs: additional success in pairs.

MAIN POINTS

1. **Main problem/challenge:** Quickly analyze a problem and structure a solution
2. **Teaching activity**: Think-pair-share like activity, where the students analyze the problem by following a handed out table.
3. **How did it go?** Successful TA for standard exam problems. Not efficient for too simple or too phenomenological exercises.
4. **What to do next?** Use TA in combination with a "what is the principle?" type of activity.

4. Evaluation

I correct the filled out tables, Fig. 1. In the point "Setup" I assess whether each student's sketch is adequate. In the rest I count the number of relevant constants, formulae and assumptions there are and calculate what fraction the student have put down. I then take an average over all the students. This is divided into the points **think** (**blue**) and **pair** (**red**). In the pair column only the *additional* success in the pairs is shown.

We notice the following pattern. The students are perfectly capable of **identifying** the setup of the problem and noting the relevant constants. Here they benefit little from interacting with each other. However, when it comes to **analyzing** the setup, i.e. finding the relevant formulae, they benefit greatly from the pair part. Finally, they have a hard time putting the problem into a **perspective**, i.e. formulating whether the setup fulfills the assumptions for the formulae. This last step I consider beyond the intended scope of the activity and also beyond the learning goals of the course.

During the activity and in the minute-paper the students responded very well to the teaching activity. They liked that the activity helped them **structure** the problem and most felt that they solved the exercise more **quickly**.

5. Looking forward

The teaching activity was repeated over the course of several weeks based on a new exercise each time. From this and the minute-papers it is apparent that the students benefit the most, when the exercise is much like a **standard exam problem** in the course: an **unknown** but simple setup, only a few equations and a clear-cut benefit from being **faster** and more **efficient.** The activity does **not** work well for exercises that are too **simple** or too **phenomenological**, i.e. where they might as well do the exercise by themselves or where they benefit greatly from having more time to contemplate on the exercise.

I would propose to use the activity for **relevant exam-like problems** and combine this with a **"what is the principle"** type of activity for more phenomenological exercises.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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maQma
Department of Physics and Astronomy

Soil erosion

- Learn the important factors

Learning Lab

Abstract:

Erosion has been identified as the most important soil degradation process and it poses a substantial threat to sustainable agricultural farmland. For the module "Soil erosion and land management" I selected the teaching activity "Give one – Get one", to assess the students prior knowledge and to let them share their knowledge with each other. The teaching activity ranked from extremely useful to somewhat useful between the students.

COURSE FACTS

- Course name: Environmental management at Farm level Module: Soil erosion and land management
- Level: Master
- ECTS credits : 5
- Language: English
- Number of students:15
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

Even though most people know about soil erosion, it is only understood to a certain degree. Soil erosion is a very complex process with a lot of factors involved. For erosion modelling those factors have to be defined. In the beginning it is quite easy to lose overview of the different factors involved and eventually important ones are even left out of the equation.

2. Planning a teaching activity

The Intention of my activity was to help students access and recall their prior knowledge about soil erosion. In particular the different factors steering the erosion processes. It is based on the assumption that everyone has a small idea what parameters or factors could influence erosion. The activity will be implemented in the beginning of the teaching and it should help the students to share and learn from each other. This should be especially helpful if the students come from different disciplines or countries. Also, the students have a chance to get to know each other and socialize over the activity. In addition, this activity gives me a good overview of the knowledge from the different students.

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Montanarella, L., Pennock, D. J., McKenzie, N., Badraoui, M., Chude, V., Baptista, I., & Young Hong, S. (2016). World's soils are under threat. Soil, 2(1), 79-82.

3. Trying it out in practice

My selected teaching activity is "Give one – Get one". I handed out a piece of paper with the task and two columns written on it. "Give one" in the left column and "Get one" in the right column. Afterwards, students are asked to brainstorm a list of all factors influencing soil erosion and write the items down in the Give one - column. Therefore, they have to recall their own prior knowledge. After making the list, students find a partner. Each person should "give one" of their ideas by saying it out loud. Partners take turns sharing. Students write down any new information they get from these discussions in the "Get one" column. After the first round the students rotate and switch partners to get additional input.

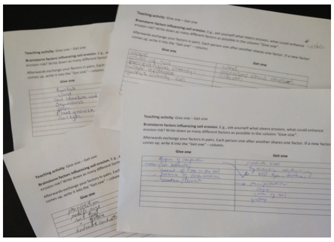


Fig. 1: Handout examples for "Give one – Get one"

Fig. 2: Students discussing their factors

MAIN POINTS

1. **Main problem/challenge:** Amount of different factors steering soil erosion
2. **Teaching activity**: Give one – Get one
3. **How did it go?** Good sharing of knowledge. Students found it "very useful"
4. **What to do next?** E.g. Parameterize the factors

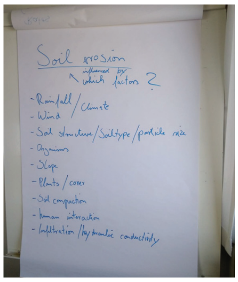


Fig. 3: Gathered factors from students

When the teaching activity is finished, the different factors were gathered and discussed shortly. I assessed the learning of the students by collecting the handouts and evaluated with a short evaluation paper containing three questions about the teaching activity.

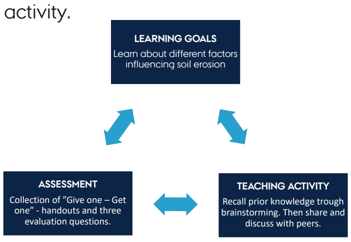


Fig. 4: Constructive alignment

4. Looking forward

Overall the discussions between the students worked well and the peers were able to exchange their prior knowledge.
A reasonable next step would be to put factors into a ranked order of importance for future parameterizing and modelling. Another possibility would be to discuss more the issues connected to soil erosion factors (e.g. climate change, population growth).

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Nils Onnen
Soil Physics
Agroecology

Repetition quiz

- Recalling the important points from a precious lecture

Learning Lab

Abstract: During a bachelor course two lectures about animal manure was given a week apart. A teaching activity was carried out to help students recall important parts of the first lecture before starting the second. Students were asked to make a question based on the first lecture and based on these, a quiz was made which initiated the second lecture. Students generally did well on the quiz and found it usefull.

COURSE FACTS

- Course name: Planteernæring (Plant nutrition)
- Level: Bachelor
- ECTS credits : 5
- Language: Danish
- Number of students: 5
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

Tow lectures on the same topic is given a week apart. The second lecture builds on the information given in the first lecture. It is important that the students recall the main points form the previous lecture in order to have something to build the new learning upon. This can be challenging.

2. Planning a teaching activity

At the beginning of the first lecture all students were asked to formulate a question (and answer) based on the main points from lecture. The questions were handed in at the end of the lecture. I added a few and combined them to a quiz covering most of the main points of the lecture.
The second lecture was initiated with this quiz using Mentimeter.
The activity gives the students an overview of important take home messages and show them the importance of repetition. Furthermore it gives the lecturer an idea of the level of understanding from the previous lecture.
The activity is evaluated with a small "Ticket out the door".

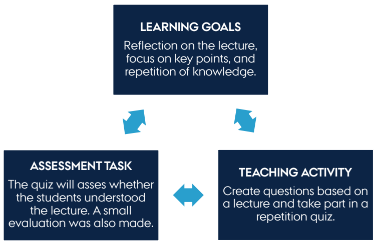


Figure 2: **Constructive alignment**

3. Trying it out in practice

All students handed in a question at the end of lecture one and most were relevant. It was my impression that most questions were made at the end of the lecture and there were a few repetitions among them.
At the second lecture the quiz were carried out. Almost all students were engaged and enjoyed the competition aspect.

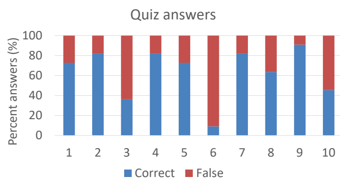


Figure 1: Percentage of correct and false answers to the 10 questions in the quiz.

Generally the students did well with a correct answer percentage close to 80 % in most questions. Question 3 and 6 were tricky and it is no surprise that many failed these. It is my impression that many students were focused on answering the last question very fast as this gives extra points in Mentimeter.

MAIN POINTS

1. **Main problem/challenge:** Repetition between two coherent lectures.
2. **Teaching activity**: Repetition quiz
3. **How did it go?** The students enjoyed the activity and found it useful.
4. **What to do next?** Develop other tools for repetition.

		Do you find it difficult to remember lectures from week to week?				
		Not at all	A little	Neither/or	Some	Very
Do you think it was a usefull activity?	Not at all					
	A little					
	Neither/or				1	
	Some	1	1	1	2	
	Very		2	1	1	

The quiz however also showed that some students had misunderstood very basic things. Hopefully the quiz helped clear these misunderstandings and serve as inspiration for further revision by the students them selves.
The answer to all questions was discussed in class by asking questions like "Why is it so?". Students were actively participating and arguing for their answers.

The "Ticket out the door" showed that the students feel the need to revise differently from (horizontal question in figure 3). However all except 1 found the activity usefull (vertical question in figure 3).

4. Looking forward

The activity generally worked well and there was a good atmosphere. The Mentimeter quiz gives a time bonus for being the first to answer, which promotes competition instead of reflection. This is not optimal. Furthermore, the scoreboard shows the score of all students and if students have not chosen an "anonymous" name they may feel exposed. I would try to find a different quiz tool if doing this again. An other improvement could be done in the first lecture. I think reminding the students that they have to make a question a few times during the lecture could stimulate the process. Another way of using this type of reflection could be to make the quiz on blackboard instead. This would make it possible to shape the following lecture around knowledge gaps and give more well prepared feedback.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Betina Nørgaard Pedersen
Soil fertility
Agroecology

Laboratory work vs. industry

- Relevance of the laboratory exercises for the students future work as chemical engineers

Learning Lab

Abstract: During the laboratory course *Chemical unit operations* the students often find it hard or forget to link the small laboratory exercises with applicability in the industry. A small think-pair-share activity will help the students to connect the laboratory experiments with future applicability. The activity takes a couple of minutes in the beginning and the evaluating talk with the teaching assistant can be included whenever there is waiting time during the laboratory work. This results in an activity with high learning outcome without taking time from the students main work during the laboratory classes. Furthermore, the activity is design so it can be included in all the different laboratory exercises in the course. The activity can successfully be implemented in the future.

COURSE FACTS

- Course name: Chemical unitoperations
- Level: 2nd semester bachelor
- ECTS credits : 5
- Language: English/Danish
- Number of students: 41
- My role: Assisting the students with their the laboratory work, helping with calculations, correcting reports and giving written feedback on these.

TEACHING IN PRACTICE

1. Identifying a problem

The goal of the course is to give students a broad knowledge about unit operations, how these are used in the chemical process plants and how to dimension them correctly. During the laboratory exercises the students tend to follow their protocol without thinking about what they are learning, and why.

2. Planning a teaching activity

The teaching activity is meant to force the students to think critically about the unit operations, learning outcomes, and how these learning outcomes can be applied in their future field of work before and during the laboratory work. As the activity is a think-pair-share it allows all the students, including the ones that usually are shy or have not prepared properly by reading and understanding the laboratory protocol, to think about answers and share them in a safe environment for discussion in their small laboratory groups (Figure 1).

3. Trying it out in practice

At the beginning of the laboratory class the students are reminded of the learning outcomes of the class. Thereafter, they are asked to answer the following question by themselves; *Based on the group's exercise for today, what is the unit operation used for in 'real life' and why is it important to make the relevant calculations (dimensions, heat transfer, efficiency, masses, etc.) correct?* After 1-2 minutes they are asked to discuss their answers in the groups and write down key-points. Then they begin their laboratory work. During the laboratory work, when there is natural break or waiting time, the teaching assistant go to the group and discuss their answers. If the group is missing out major or essential point the teaching assistant help them to get to these by asking questions and facilitating a dialogue.

The learning goals were assessed with 5 yes-no questions on a ticket-out-the-door. This allowed students to give anonymous answers that did not take much time from their laboratory work.

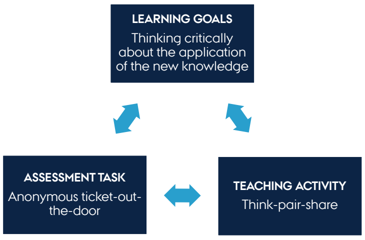
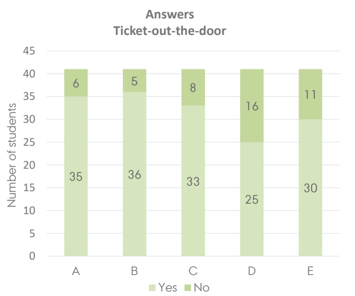


Figure 1: **Constructive alignment**
Illustration of the connection between the assessment task, learning goals and teaching activity.

Overall the students gave good feedback on the teaching activity (Figure 2), where 80% reports that they learned something new. A little less, 60% reports that the exercise gave them a new perspective of the relevance of the course for their future work. It could be beneficial to evaluate weather the questions should have a different wording to increase this.

MAIN POINTS

1. **Main problem/challenge:** Awareness from the students of the applicability of the learning outcomes from the laboratory in the industry. **Teaching activity**: Think-pair-share
2. **How did it go?** Well as a majority of the students report that they gained new knowledge and perspective and the exercise does not interfere with the laboratory work.
3. **What to do next?** Evaluate whether to implement the teaching activity as a permanent part of the laboratory work.



A: Was the exercise well described?
B: Was the purpose of the exercise easy to understand?
C: Did you learn anything new from the exercise?
D: Did the exercise give you a new perspective on the relevance of the course for your future work?
E: Did you prepare before lab (read the protocol)?

Figure 2: **Evaluation of the teaching activity**
Answers of ticket-out-the-door.

4. Looking forward

Overall the exercise worked well. All the students got engaged in the discussions due to the safe environment and most gave a positive feed back on the teaching activity.
As the students were doing 6 different laboratory experiments during the laboratory day of the teaching activity it shows that the activity is generally applicable and therefore easily can be implemented. It would be beneficial to fine-tune the questions, preferably in collaboration with some students to ensure that the target-audience understands the questions as intended.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Johanna Maria Pedersen
Air Quality Engineering
Department of Engineering

Exploring European GHG mitigation reports in China:

Synthesizing 2000 page English reports via cooperative group reading

Abstract: Although English is the universal language in science, it can be very challenging for students from non-native English speaking countries to understand the complexities of large scale greenhouse gas mitigation (GHG) reports. Furthermore, an additional challenge is the adaptation to the different learning styles within China, whereby asking questions during a lecture is minimal. Therefore, by providing the students with a modified jigsaw reading assignment that allows the students to focus on subsections and then present within the group promotes higher cognitive learning. While concurrently helping in English proficiency and allows cooperative learning among their peers to facilitate learning in a safe environment. It is clear based on the pros and cons hand-ins, that the students were able to comprehend relevant information from all of the reports regardless of not having to read each of them individually. I would suggest this strategy be implemented in all journal clubs irrespective if English is the non-native language.

COURSE FACTS

- Course name: Global Change
- Level: Masters
- ECTS credits : 10
- Language: English
- Number of students: 20
- Your role: Lecturer and Journal club

TEACHING IN PRACTICE

1. Identifying a problem (s)

(1) Can be a challenge for Chinese students to ask questions directly to the teacher during the lecture and as such prefer presentations with smaller group discussions.
(2) Developing reading comprehension and English oral presentation skills on a vast subject such as climate change mitigation.

2. Planning a teaching activity

- ❖ This task completely targets the learning framework the Chinese students are comfortable with regarding learning styles.

Learning goals for the teaching activity:

- ❖ Give students practice with oral presentations in English within a safe environment.
- ❖ Give students thorough reading comprehension.
- ❖ A practical solution to understand large scale greenhouse gas mitigation strategies and policies that are relevant, but challenging to understand individually.
- ❖ Involves continuous feedback among students and teacher while simultaneously providing an active learning situation where the students become the teachers.

An economic assessment of GHG mitigation policy options for EU agriculture

EcAMPA

An economic assessment of GHG mitigation policy options for EU agriculture

EcAMPA 2

Figure 1. ***EcAMPA* repots used for the teaching activity.**

3. Trying it out in practice

The teaching activity: Modified jigsaw reading

- ❖ Prior to the Modified jigsaw reading, I spent time with each group to assure the students were focusing on the relevant information and that the expectations were clear. As well, during this period, any uncertainties by the students were answered, and that each student was required to present within their respective group.
- ❖ Questions were provided beforehand to cover a comparison of measures for reducing greenhouse gas emissions from agriculture with respect to the pros and cons of each measure including the accounting of possible side effects on nature and the environment.

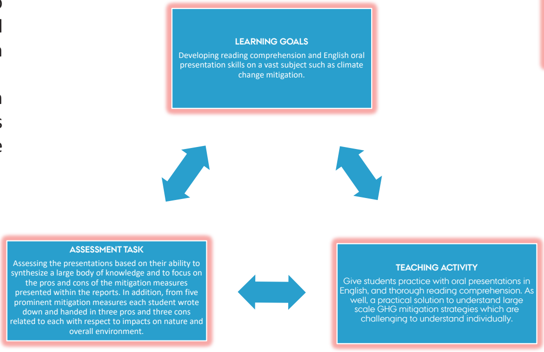


Figure 2. **Constructive alignment**

1. Each expert group (1,2,3,4) gave a 10 minute presentation of their respective assigned chapters from European agricultural GHG emissions called *EcAMPA* and *EcAMPA2* (Figure 1).
2. While group 1 were presenting, group 2, 3 and 4 had to fill out assigned questions for group 1, which will be asked in group A, B, C and D.
3. The expert groups split into letter groups, and the letter groups contained experts from different topics.
4. The letter groups had a 10 minute discussion to bring together all the concepts.
5. I walked around during the discussions and classroom participation points were used as an incentive for participation.
6. Following group 1, the expert group 2 presented, and this continued until all expert groups had presented.

4. Looking forward

Overall, the modified jigsaw reading was a success whereby the students concurrently improved their oral presentation skills and reading comprehension of GHG mitigation reports. However, based on the hand-ins regarding the pros and cons, students were challenged by providing more than one answer. I would suggest this a reflection not in relation to the large reports, but the time that was given for in-group discussions. Next time, I would increase the time the letter groups and the experts can discuss. In addition, to having myself join the groups to help aid in the discussion as opposed to just walking around.

MAIN POINTS

1. **Main problem/challenge:** Reading comprehension, and oral presentation skills in English for Chinese students.
2. **Teaching activity**: Modified jigsaw reading of large reports on climate change mitigation.
3. **How did it go?** Was very successful, and both myself and the Chinese students ended up learning a vast amount of information.
4. **What to do next?** See how I can implement this style of learning for other non-native speakers with different learning styles than Chinese students.

Assessing learning goals:

- ❖ Assessing the presentations is based on their ability to synthesize a large body of knowledge and to focus on the pros and cons of the mitigation measures presented within the reports. In addition, I randomly selected five prominent mitigation measures and asked each student to write down and individually hand in three pros and three cons related to each with respect to impacts on nature and overall environment.

Did the students learn?

- ❖ Each group did a great job of providing an overview of their assigned sections within 10 minutes. In addition, each group focused on the pros and cons of the GHG mitigation measures within their section.
- ❖ Based on the individual hand-ins regarding the pros and cons from the five mitigation measures, the majority of students were able to provide at least one pro and con, but the majority had trouble providing three for each (Figure 3).

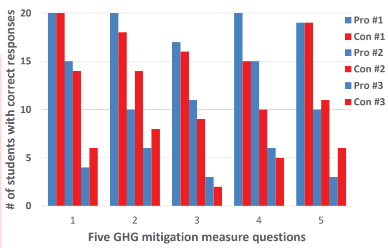


Figure 3. **Results from the individual hand-ins regarding the pros and cons of five GHG mitigation measure questions.**

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Leanne Peixoto
Supervisor: Jørgen Olesen
Department of Agroecoloy

introduction to basic knowledge of remote sensing

Learning Lab

Abstract: This teaching activity was conducted under the journal club in Climate and water section, department of Agroecology. The participants were the post doctors and PhD students in my section. This time I recommended the participants pretend the Bachelor students and I practiced the teaching activity as a main lecturer. The topic was introduction to basic knowledge of remote sensing. The teaching activity contained several procedures, like introduction, discussion, presentation, questionnaire and revision. After the teaching activity, the participants gave some feedbacks and improving suggestions to me. Overall, in my opinion, it was a successful activity.

COURSE FACTS

- Course name: introduction to basic knowledge of remote sensing
- Level: Bachelor
- ECTS credits : 2
- Language: English
- Number of students: 7
- Your role: main lecturer

TEACHING IN PRACTICE

1. Identifying a problem

Several challenges I met:

- My oral English expression ability, can the students understand what I said
- The students were fake students, their knowledge level was much higher than the bachelor students.
- Another, almost no one's background was remote sensing or geoscience, therefore I am not sure they can understand the basic concepts of remote sensing and how it works.

2. Planning a teaching activity

The teaching material

- The teaching powerpoint, books, useful images and animations from website
- Menti would be used in the evaluation

Several goals for students were set before the teaching activity:

- Can understand what is remote sensing, explain some basic concepts like electromagnetic radiation, spectrum, wavelength.
- Can download some famous satellite images.

Evaluation

- The assessment would be the questionnaire, which will contain some basic ideas of remote sensing by using the menti.

References

Fundamentals of remote sensing, Canada center for remote sensing tutorial

3. Trying it out in practice

The course will be 40 minutes adding 30 minutes homework. There will be several steps as following:

- Step 1(2 minutes) introduction of the course, myself (teacher).
- Step 2(3 minutes) introductions from the students (students).
- Step 3(5 minutes) students discussion about what is remote sensing and let some volunteers to talk about their ideas to all of us (students).
- Step 4 (20 minutes) presentation, what is remote sensing, remote sensing types, electromagnetic radiation, some basic equations, wavelength, satellite images downloading, the using examples of the remote sensing and so on(teacher).
- Step 5(5 minutes) answer the questions from the students and do the assessment by using menti questionnaire (students, teacher).
- Step 6(5 minutes) students' revision and quiz with the teacher's reply. Also, welcome the suggestions and comments about the teaching content, manner and so on (students, teacher).
- Step 7(30 minutes) Home Work. Downloading the satellite images.

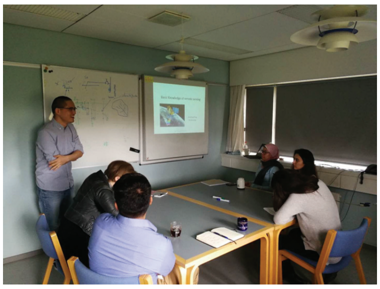


Figure1: Teaching activity

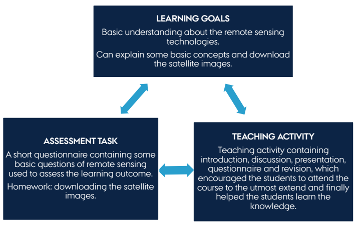


Figure 2: Constructive alignment

MAIN POINTS

1. Main problem/challenge
lecturer's oral English expression ability; match of teaching contents and the students' background knowledge level
2. Teaching activity:
Teaching was conducted by oral lectures, discussion and questionnaire.
3. How did it go?
It went well. Good preparation can help the lecturer relax and confident. My oral English was not a very big problem. Assessment in the end of the course showed that the learning of the students was good.
4. What to do next?
I received some useful feedbacks from the participants. That contained the presentation of the powerpoint, the teaching contents and so on. I will use them in my following possible teaching activities.

4. Looking forward

In my teaching practice, the very good point was that I let students discussed with each other and communicated with them about their ideas, which is very important and helpful. After talking with the participants and assessment, they can understand some basic concepts of remote sensing and how it works.
In the future, I will adopt some useful feedbacks from the participants, like add some motivations to let students understand the concepts easier, set some specific learning goals to replace 'so on' in the end of the learning goals, and try some brain storms in the beginning of the courses. I hope the experience from this course can be helpful in my following teaching activities.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Junxiang Peng
Climate and Water
Department of Agroecology

Ídentifying knowledge gaps
- The fishbowl and group discussions

Learning Lab

Abstract: identifying what parts of a new subject a student doesn't know can be very challenging, and is a huge step in order to learn something new. Once the students realize what parts of the curriculum they struggle with, they can address it and improve their learning and their learning experience. In order to identify difficult parts of a subject the fishbowl activity can be very usefull. In this case we combine it with group discussions and an online test to make sure the students identify and learn the difficult parts of the curriculum. In the process they also learn how to "talk bout science", which is a very good practice for the oral exam.

COURSE FACTS

- Course name: Fundamental geophysics
- Level: Bachelor (2. semester)
- ECTS credits : 10 ECTS
- Language: Danish
- Number of students: 15
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

As this course presents some difficult theory and is placed early in the bachelor programme, the students sometimes find the nomenclature and definitions difficult. They tend to over complicate the theory and spend too much time on details that are not important for the understanding of the subjects. Some students also feel "stupid" if they don't understand the basics, and therefor don't ask questions in class

2. Planning a teaching activity

The problem of students not asking questions can be solved using the fishbowl activity. Through being "forced" to ask questions and doing it anonymously, the students can figure out what they find difficult and more easily find the answer to their questions.
The answers to their questions will be available online as a "cheat sheet"

3. Trying it out in practice

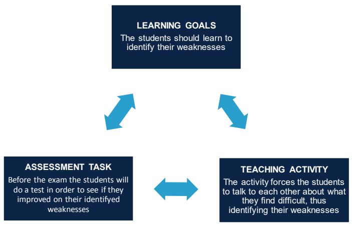
The fishbowl activity was implemented during the last exercise. The students were asked to ask a question about one specific topic (gravity and gravity anomalies), which is usually difficult to understand. They discussed the subject in groups and talked about how to apply the theory in practice. They also answered a lot of eachothers questions during the process. Finally they all put a note in the fishbowl.

Upon reading the notes I realized that the discussion had been really fruitfull, and the questions were more or less the same, leaving only five different questions to be answered. This will be uploaded to their blackboard page. And a quiz will assess the subject when they get closer to the exam.

www.venstre.no

MAIN POINTS

1. **Main problem/challenge:** identifying what is difficult for the students. Getting students to reflect and ask questions
2. **Teaching activity**: Fishbowl
3. **How did it go?** The students had some really good discussions that turned out to be more fruitfull than the actual fishbowl activity
4. **What to do next?** Give the students the Cheat sheet and the test before the exam in order to let them reassess their knowledge gaps



4. Looking forward

This activity could be implemented as an end of subject exercise in all the subjects in the course during the semester, and then the test could be implemented shortly before the oral exam so the students quickly figure out where their knowledge gaps are.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Lasse Krogsgaard Prins
Group 8
Department of Geoscience

Biochemical identification of microorganisms.

Lab protocol:

Abstract:
To identify bacteria, we must rely heavily on biochemical testing. Before performing, understanding of the basic principle and correct interpretation of results are very important. In order to make them clear and understandable activities like group investigation and visual lists preparations are being done. These activities clearly shows the high interest and enthusiasm of the participants as compare to previous methods which involves the demonstration of the protocol and then straight to lab and working independently.

COURSE FACTS

- Course name: Microbiological techniques
- Level: Masters
- ECTS credits : 3
- Language: English
- Number of students: 12
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

The students participating in the given course come from different schools and thus have different theoretical and practical background. My major concern here is to make sure that every participant can understand what is the mechanism behind every step and how to report it.
Mostly students just follow the protocol without knowing the principle.

2. Planning a teaching activity

In order to make students able to fully understand the theory behind each step. Firstly they would be divided into 4 groups each of three students, each group will be given different tests to perform. Firstly they would do the **group investigation** then afterwards they were asked to make **visual lists** based on their tests. In this way each group discuss their results with other participants.

Figure 1: Group investigation provoke every participant.

3. Trying it out in practice

The **group investigation** activity is carried out on the first day of the lab. This helps them in planning and organizing of the lab protocol for the following days. While the **visual lists** were made on the last day of the course so that groups knows each other activities. However in the end they were assessed by **writing one sentence summary** and **pros-con grid** for each test. In this way they can better analyze the results. As a last effort, the students will be asked to evaluate the TA by asking different questions handed out for feedback.

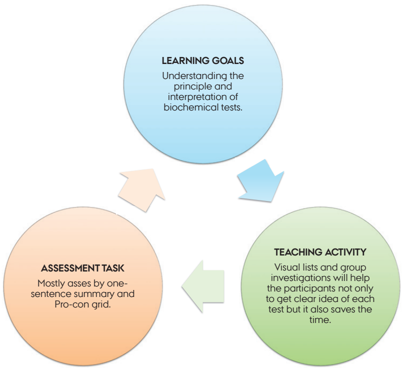


Figure 2: Constructive alignment

MAIN POINTS

1. **Main problem/challenge**
   - Differenciation between each method principle and purpose
   - Results interpretation
2. **Teaching activity**:
   - Group investigation
   - visual lists
3. **How did it go?**
   - Group investigations goes smoothly and according to the plan.
   - Students proactively participate in visual lists
4. **What to do next?**
   - Introduction of more activities like "say something" should be included to ensure the active participation of all students.

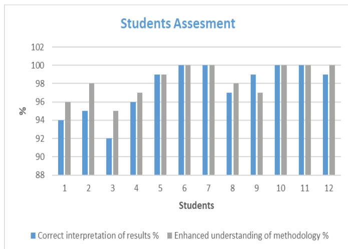


Figure 3: Showing the effectiveness of the teaching activity on students.

4. Looking forward

The participants were activated by this teaching activity. It works as planned, students get better understanding of the underlying principle of each step. However by linking the theory with practical work and group discussion enhances student learning. In the end the use of visual lists increases their analytical capabilities. This activity gets very nice feedback from the students.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Sundas Rani
Immunology and Microbiology
Department of Animal Sciences

From Integrated Circuit Design to its Physical Implementation

Learning Lab

Abstract:

Design of Integrated Circuits (IC) is a very challenging path that starts with functional design of circuits using the models of integrated device (schematic design in the CAD tool) and ends with the physical layout of devices that can be used in the chip fabrication foundries (layout design in the CAD tool). The intention of this activity is to build the students' perception on how their designed integrated circuits will be built in the foundry. For this purpose a combination of paper strips, LEGOs, and CAD tools are employed.

COURSE FACTS

- Course name: Analog and digital integrated circuits
- Level: Master
- ECTS credits : 10
- Language: English
- Number of students: 13
- Your role: Teacher Assistant

TEACHING IN PRACTICE

1. Identifying a problem

For fabrication of integrated circuits it is required that the designer draw the physical layout of the integrated devices in an appropriate CAD tool which will be used by the foundry to build the devices on a silicon substrate. It is usually hard for students to relate the physical layout with the designed circuit and then with the actual device after fabrication. Lack of deep understanding of these concepts may force the student/designer to redo the circuit design or ends up with a non-efficient circuit/layout design.

2. Planning a teaching activity

In order to help the students to deeply understand the relations between the circuit, layout and physical implementation which is the main learning goal of this activity, 3 steps are designed.

1- Making of paper strips of steps of IC physical implementation in the foundry from the main supervisor's lecture and discuss about them. It helps the students to recall their prior knowledge.

2- Asking the students to Draw a sample layout in the CAD tool and discuss the output results. It helps the students to engage in the layout design and understand its relations with the circuit schematic.

3-Asking the students to make a 3D model of an inverter (the simplest integrated circuit) using LEGOs. It help the students to think about the structure that they are building and help their better understanding of actual physical implementation.

3. Trying it out in practice

For this activity, the students were divided into the groups of 3 persons and each group was given a bunch of LEGOs and paper strips.

First off, I asked the students to recall one the main supervisor's lectures about the fabrication process of the integrated circuits, with sorting the paper strips. Then, we discussed in the class the technology dependent steps and the steps that an IC designer designs them with layout drawing.

For the second step, I had a mini lecture on how the students can do the layout design in the CAD tool. Then I asked them to do the layout of an inverter circuit (the simplest IC block) and discuss in the group that how the layout design can effect the circuit functionality. Meanwhile, I was walking among them to help them with the principals and answer their questions. Next we discussed the same question in the class.

Finally I asked the students to build the 3D model of the circuit of an inverter using LEGOs. While they were making their models I was walking among them to help them with the principals and answering their questions. Then I asked each of the groups to present their model for another group and get feedback from their peers about it.

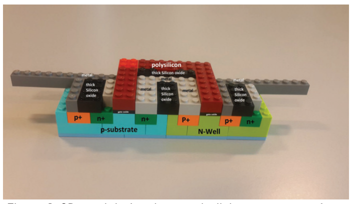


Figure 1: 3D model of an inverter built by one group of students with added comments on the paint

MAIN POINTS

1. **Main problem/challenge:** It is hard for the students to relate the circuit schematic, its physical layout and its physical implementation.
2. **Teaching activity**: using paper strips to recall the layout basics, CAD tool to engage the students in drawing a layout and LEGOs for simulating the physical implementation
3. **How did it go?** The students where able to analyze and relate the intended materials.
4. **What to do next?** A field trip to a foundry to see the actual process for making the integrated circuits.

Figure 1 shows the 3D model of an inverter that one group of students made using LEGOs. Based on the outputs of students in successful drawing of the layout and making the 3D models as well as class discussions, the teaching activity was successful. Figure 2 illustrates the constructive alignment of the designed activity.

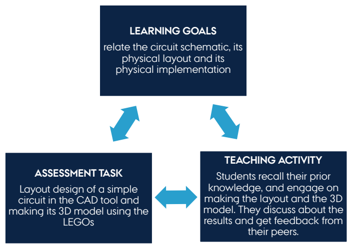


Figure 2: Constructive alignment

4. Looking forward

All the groups of students were successful in building a 3D model of the transistor and most of them were engaged in the class discussions that shows the effectiveness of the teaching activity. The next step can be a field trip to a chip fabrication foundry to let the students observe the actual physical implementation and the consideration that should be made in the foundries.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Amin Rashidi
Integrated Circuit & Electronics Laboratory (ICE LAB)
Department of Electrical Engineering

Have fun making nanostructures

- Learning by visualization.

Learning Lab

Abstract: At the begging, the fabrication of nanostructures at the nanoscale is a challenge due to the lack of experience, sometimes can be difficult to understand what is happening at each stage of the process. In order to the students have a deep understanding of how nanostructures are created, I have realized a schematic representation of the stages, selecting the activity called "strip sequence". My main objective guides to the students to the comprehension of key points for nanostructures fabrication at the same time that they are having fun.

COURSE FACTS

- Course name: Cleanroom-based Micro and Nano Fabrication
- Level: Master Course
- ECTS credits : 5
- Language: English
- Number of students: 20
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

The fabrication of nanostructures requires of practice, but in this course, the students will have only one chance to fabricate one type of nanostructure. They must be conscious how to do it in the best way.

The difficult part is can imagine what is happening in the fabrication process, and anticipate the possible issues to make a specific nanostructure successfully.

2. Planning a teaching activity

I have chosen the activity called strip sequence because I consider that is an easy tactic to get a deep understanding of protocols. As the final project, the students should follow a protocol in the correct way to fabricate nanostructures by hole-mask colloidal lithography (HMCL). The goal is that the students get a deep understanding of the standard protocol before going to the laboratory session. I have added some schematic drawings due to the difficulty of visualization of the process at the nanoscale by the naked eye. The purpose is to activate them to participate consciously in nanostructures fabrication.

3. Trying it out in practice

I will give them an explanation of what we will do in the laboratory session in order to create nanostructures by means of HMCL. The explanation includes schematic drawings and a video of each stage of the process (https://www.youtube.com/watch?v=CiQbtoJjWo&feature=youtu.be). Afterward, I will implement the activity called "strip sequence", strips with the names of the steps in HMCL, where the students in small groups will discuss the correct order of the steps to fabricate nanostructures using HMCL and write a brief description of each step. I will observe their answers and give them feedback.

MAIN POINTS

1. **Main problem/challenge:** Deep understanding of how create nanostructures by HMCL
2. **Teaching activity**: Strip Sequence
3. **How did it go?** The activity has been not realized yet, until next period.
4. **What to do next?** Implement it in the course.

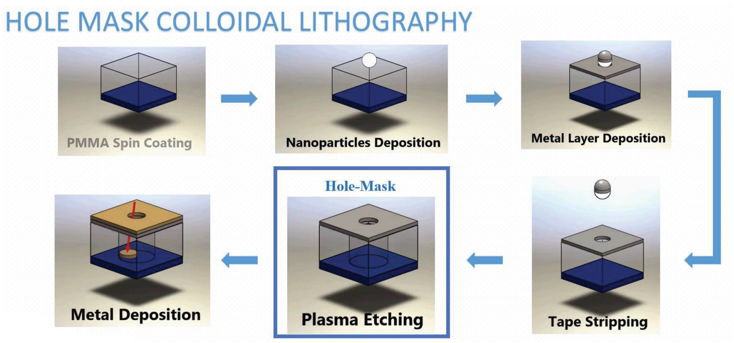


Figure 1: **Schematic representation of HMCL step by step**

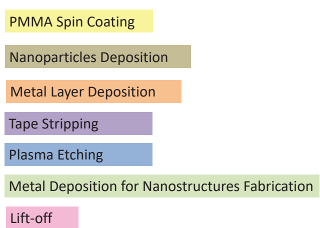


Figure 2: **Strip sequence**

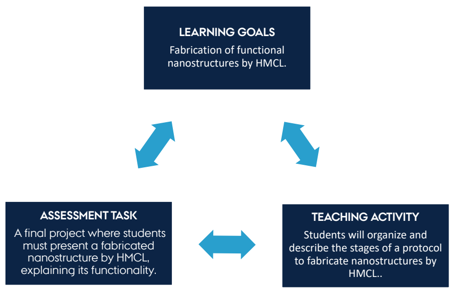


Figure 3: **Constructive alignment**

4. Looking forward

I hope the students participate actively in the course with this teaching activity and others. I want to give to all of them the opportunity to have a deep understanding of basic concepts, at the same time that they are having fun learning through videos and effective laboratory sessions.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Maria Guadalupe del Rocio Herrera Salazar
Biointerfaces group
Nanoscience Department

Lab work!

Doesn't have to be boring!

Learning Lab

Abstract: This course aims to provide a hands-on experience of advanced methods and techniques in plant science and biotechnology. As a summer course, students from diverse streams of plant science with variable theoretical knowledge and experience are accepted, which cause difficulty for some students to achieve overall learning goals. Most of them just follow the protocol without understanding the theoretical aspects. Therefore, A teaching activity utilizing strip sequence of various steps of protocol and thus providing general background information can be used to promote student learning by promoting active participation and motivation, resulting achievement of learning goals among majority of students.

COURSE FACTS

- Course name: Hands-on Advanced Methods and Techniques in Plant Science and Biotechnology
- Level: Master
- ECTS credits : 5
- Language: English
- Number of students: 12+
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

Specialized courses accepting students from diverse theoretical backgrounds often run into problems with achieving learning outcomes for all students. This could be lack of background knowledge, experience, fear/shyness or motivation among students. As a result, many students just perform the experiments without reasoning the protocol. A teaching activity providing an overview of the protocol and theoretical information in an interesting way, promoting active participation can help students better understand and actually learn the techniques, rather then just following the protocol to obtain results for the assessment report.

2. Planning a teaching activity

This teaching activity utilizes combined strips sequences to provide necessary knowledge required to perform the lab exercise. The students should be able to explain each step of the transformation protocol by ordering strips into correct order and matching to the correct theoretical reasoning on the corresponding strips. The aim is to start a discussion among students to promote active learning.

3. Trying it out in practice

The students will be provided with the detailed protocol and background information prior to the lab exercise and the teaching activity will be performed on the first day. The teaching activity is intended to help students in planning, organizing and understanding the lab exercises of the upcoming days. The student will work in pairs, perform the lab experiments and discuss the results in the end. The correct answers will be provided in the discussion by TA. At the end of the lab exercise, the students will be asked to evaluate the teaching activity and provide feedback using online tools anonymously.

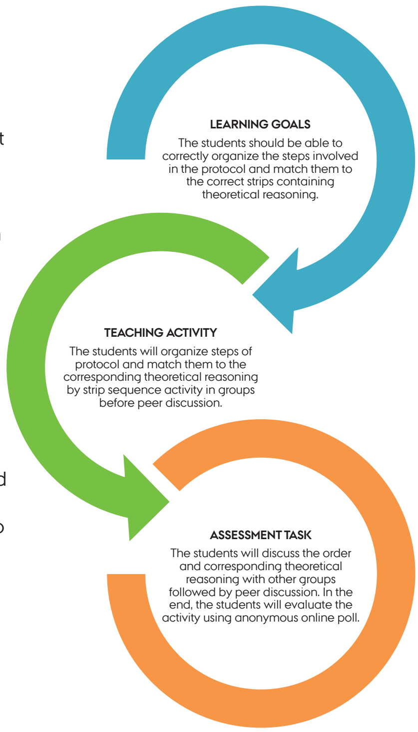


Figure 1: **Constructive alignment**

MAIN POINTS

1. **Main problem/challenge:** Some students lack the overview of the Lab exercise which impede in achieving learning goals.
2. **Teaching activity**: Students will organize steps of protocol in correct order and relate them to the correct theoretical reasoning.
3. **How did it go?** The activity is expected to increase active learning and motivation, yielding better success rate in achieving learning goals.
4. **What to do next?** This activity can be applied to all lab exercises as a standard procedure to improve student learning and participation.

4. Looking forward

I gained an opportunity of active learning by interacting with peers and tutors on course day 1, by participating in similar strip sequence activity. The feedback was encouraging and I certainly felt more motivated. These activities appear to be beneficial in encouraging peer interaction providing a trigger for discussion and learning for all students. Conducting similar activity with my students should help them understand and actively participate in the course. Moreover, it is easy to implement and should be a standard procedure for all Lab oriented exercises.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Shrikant Sharma
Supervisor: Prof. Henrik Brinch-Pedersen
Molecular Biology and Genetics

Geometry in linear algebra
- How linear algebra is the first step towards geometry

Learning Lab

Abstract: Linear algebra is a very basic subject if you want to study mathematics. I wanted to give the students a very concrete way in thinking what linear algebra is using the shape of the letter F.

COURSE FACTS

- Course name: Linear Algebra
- Level: Undergraduate
- ECTS credits : 10
- Language: English
- Number of students: 16
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

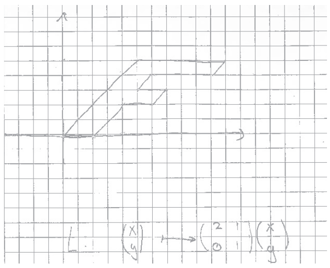
During my time teaching as a TA I noticed that first year student tend to think about mathematics as something very abstract. The way linear algebra is presented is very algebraic, and I see students trying to present exercise in the most formal and abstract way instead of (whenever was possible) approaching the problem in a more concrete way. I think finding a way to think about math in the most concrete way is a very useful tool to have.

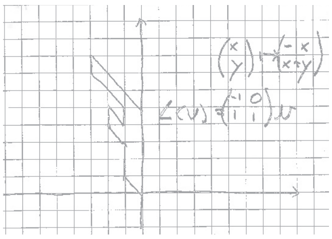
2. Planning a teaching activity

I wanted to find something that would have been very easy if they understood the concepts but a bit hard if they had some confusion in their mind. Also, of course, I wanted the teaching activity to be as fun as a math exercise can be. So I decided that the best way would be something related to shapes on the plane. Since the main topic of the course is linear transformation I tried to give them a way to think about linear transformation in a very "practical" way. So I thought that the best thing is to give them a "before" and "after linear transformation" picture of the same object. The problem was "what shape would fit best?". Using a square or rectangle would have been too easy, so I used the letter F, because it gives a lot of information and distract a lot from where you should actually look.

3. Trying it out in practice

I carried out the teaching activity in the following way: I draw the letter F on the Cartesian plane at the blackboard and then subdivided the class in 5 groups of 3 people each (one student was absent). To each group I gave a piece of paper where there was a drawing of a transformed F (see the pictures below). Each group had a different picture.





The pictures show the drawing of the F made by me and the solution the students gave.

The students has then be given 15 minutes to reflect on the problem and write the solution and hand me the piece of paper I gave them with the solution written on it. .

As expected the best students finished the task very quickly while for the rest of them it took a bit longer. Anyhow they all finished in the assigned period of time

I noticed that they all liked this new type of exercise and even the students that usually are less involved in the discussion where very engaged in the discussion among themselves. Some of those who finished before the 15 minutes mark were also trying to solve the exercises of other groups. In the end they all handed me the piece of paper with the correct solution.

MAIN POINTS

1. **Main problem/challenge:** think about linear algebra in a more concrete and geometric way.
2. **Teaching activity**: Figuring out out the exact linear transformation that transform a shape into another.
3. **How did it go?** It went very well as all student managed t give the right solution to the problem.
4. **What to do next?** This teaching activity could be improved by adding some consideration about the change of the area in correlation with the determinant.

4. Looking forward

I think the teaching activity worked pretty well. All the students arrived at the right answer in the prescribed time. This activity could be improved by adding more considerations. For example, one could add some remarks about the change of the area and its relation with the determinant.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Simone Siclari

Department of mathematics

Electromagnetic experiment

- enhancing deep learning and intuition

Learning Lab

Abstract: Courses focusing on student learning through problem solving may sometimes leave students with a fragmented understanding of the content and lacking intuition with simple experiments. It is therefore desirable to design a teaching activity, including hypothesizing and reflecting on a mini-experiment, that will help students challenge the connections of their current knowledge. If combined with the creation of concept-maps in groups focusing on creativity and discussion, this could inspire deeper learning of the course content and physical intuition. The teaching activity seems to have a positive effect and helps students remember more concepts compared to a control class and a more balanced fraction of theoretical- and experimental variables as well.

COURSE FACTS

- **Course name:** Electromagnetism, Waves and Optics
- **Level:** First-year Bachelor
- **ECTS credits :** 10
- **Language:** Danish
- **Number of students:** 11
- **Your role:** Instructor

TEACHING IN PRACTICE

1. Identifying a problem

When first-year students strive to grasp course content by problem solving the connections between concepts can sometimes be undermined, as I have personally experienced. A good intuition is all about these connections and often requires knowledge of the experimental variables involved. It will empower the students to reflect upon their solutions – do they actually make physical sense? It is therefore imperative to have the students train this intuition.

2. Planning the teaching activity

The teaching activity is designed with focus on prediction, connecting known knowledge and group discussion. After the teaching activity the students should be able to describe a simple electromagnetic experiment and list and relate all the relevant theoretical- and experimental variables.

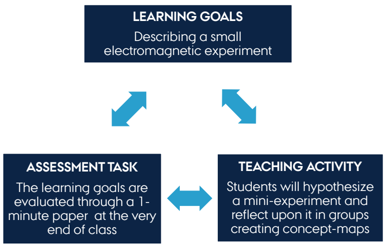


Figure 1: **Constructive alignment**
The alignment between 1) learning goals 2) student assessment and 3) the teaching activity

3. Trying it out in practice

The core of the teaching activity is a small YouTube-video of a working electromagnet. The setup is viewed and the students do a Think-Pair-Share resulting in plenum hypothesizing what will happen. Afterwards, the result is discussed and the students create concept-maps relating all the variables and physical laws involved.

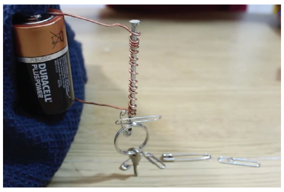


Figure 2: **The mini-experiment**
An electromagnet attracting paper clips. From https://www.youtube.com/watch?v=wX9QBwJBI_Y&t

At the very end of class the students recap the teaching activity by listing all remembered variables in a 1-minute paper, thus combining learning and assessment. This is repeated two weeks later to test the lasting effect of the activity. Finally, a second class is given the same 1-minute paper. Their answers will work as a control group.

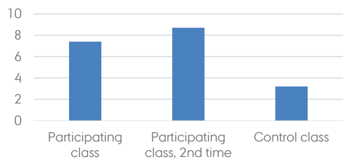


Figure 3: **Average number of concepts mentioned**
From left the average number of concepts listed in the 1-minute paper from all in the participating class is shown next to the class answers two weeks later. Finally, the average from the control class is shown which is lower than for participating students.

MAIN POINTS

1. **Main problem/challenge:** Enhancing deep learning and physical intuition
2. **Teaching activity**: Mini-experiment and concept-maps
3. **How did it go?** The teaching activity successfully satisfies its criteria
4. **What to do next?** Try with new material

4. Outcome of teaching activity

From figure 3 it is clear that the class participating in the teaching activity is more successful in listing concepts associated with an electromagnet. Two weeks after the activity the effect is still prominent. The class also shows a more balanced variety of mentioned variables as seen in figure 4. Combined, these results may indicate that the students develop a deeper learning of the concepts and their connections. This will hopefully empower the students with a better intuition when reflecting on their solutions in problem solving exercises and at the exam.

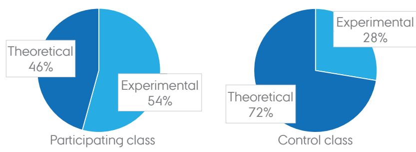


Figure 4: **Concepts categorized**
Left: The fraction of theoretical- (dark blue) and experimental (light blue) concepts mentioned by the class participating in the teaching activity. Right: The fractions of the control class.

5. Looking forward

Making the students hypothesize the experiment with a Think-Pair-Share works well and creates a plenum understanding of the setup. Furthermore, the concept-maps are engaging all of the students – however, more time could be spend discussing the concept-maps as a whole class.
Finally, the teaching activity could well be tried with new material. It only requires video of a simple experiment connecting a variety of concepts.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Magnus Graf Skou
Ultracold quantum gasses group
Department of Physics and Astronomy

Matrix Groups in Geometry

- A way to structure teaching sessions

Learning Lab

Abstract: We try out a "new" approach to exercise classes centered on more student to student interaction and less lecturing. We find that this works in some regards; more of the weaker students are engaged and actively participating, but it also has its downsides; the number of exercises covered each session is less. Important insights are routinely missed and less curriculum is covered.

COURSE FACTS

- Course name: Geometry
- Level: Bachelor, 4th semester
- ECTS credits : 10
- Language: Danish
- Number of students: ~18
- Your role: Teaching exercise classes

TEACHING IN PRACTICE

1. Identifying a problem

It is difficult to diversify the teaching. Students in the course have all more or less taken the same classes previously. Even then the skill level among the students is very varied. The level to which the individual student has internalized and understood concepts from previous classes, and is now able to mobilize and apply them in the current course differ a lot.

Going through material on the blackboard thus faces the challenge of finding the right "level" of explanation. Some students will be bored with details while others are they struggling to follow the argument!

2. Planning a teaching activity

Students are divided into groups and tasked with solving assigned exercises. Then after a set time, at which point they are all finished, the students go into new groups; now in turn they present the exercise they have solved to their new group. The new groups ideally consists of one person from each of the previous groups.

By forcing the students to explain their solutions themselves the level is automatically adjusted to that of their own. Still, since the level among the students differ, it will not be fit for everyone. However, the smaller groups make for a relaxed environment where it is easier to ask questions. Thus more students will be able to follow the presentation.

3. Trying it out in practice

Over the course of the semester we have tried out different variations of the matrix group approach to teaching an exercise class. Below we summarize the main challenges and lessons learned from these experiences.

At the beginning of the lesson the students are divided into groups. The groups consist of 3-4 students, depending on the number of students present. Sometimes students were late and then joined existing groups which resulted in groups of 5 students as well, which is not to be desired.

In the beginning of the semester it was a challenge to make the right groups. Not knowing the students or their mathematical ability lead to sessions with groups made up of students whom usually worked together, and groups with students working at different speeds, either due to a different level of preparation or due to different skill levels - sometimes both.

Later on it became apparent that good balanced groups was not enough to make efficient use of the time. In the worst case a group of students spent most of the session in discussion without making much progress; the problem they were facing was out of their reach and too difficult for them to do at that point. At the same time other groups were functioning very well. So it is also important to consider which problems to present to which groups.

MAIN POINTS

1. **Main problem/challenge:** To teach effectively.
2. **Teaching activity**: Students solving problems in matrix groups, and then presenting them to their piers.
3. **How did it go?** Fine. I am not convinced this is always the best way of teaching, however, sometimes it is good.
4. **What to do next?** Modify the method in a way that the teaching is not dumbed down as much and more material is covered.

About halfway through the semester some students stopped showing up for the sessions. They were still active students, some of them even quite talented. We suspect that they were less engaged with this new way of teaching as opposed to the more traditional approach with presentations at the blackboard.

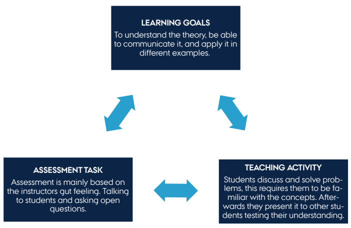


Figure: **Constructive alignment**

4. Looking forward

Adopting this new method of teaching was initially very simple. Then came all the adjustments, and although it appeared to be working well there are issues. Firstly, more preparation is required from the TA. Secondly and most notably, less exercises were covered in class. Students were not always prepared and very few groups were able to do more than one exercise in the alloted time. Often the harder more conceptual exercises were left out. And so the level of the class was lower than what it would have been. On the other hand the method seemed very suited to engage with weaker and less prepared students.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Andreas Skovbakke, PhD-student
Dep. of Mathematics

Vegetable enzymes

- Supporting introverted students by jigsaw exercise

Learning Lab

Abstract:

It can be a challenge to encourage introverted students to be actively involved in the plenum discussions. Often only few students are participating. As an effort to motivate and support the students a jigsaw exercise was developed and implemented as a teaching activity. This activity was evaluated by Mentimeter questions related to the learning outcome from each of the three segments of the activity (peer discussions, presentation and examination/peer feedback). From the assessment all students responded that they felt more comfortable by the examination after the jigsaw exercise than they felt at the previous lecture without the exercise.

COURSE FACTS

- **Course name:** Food Structure and Enzymes
- **Level:** Master level
- **ECTS credits:** 10 ECTS
- **Language:** English
- **Number of students:** 20
- **Your role:** Giving lecture about specific enzymes, problem solving and teaching activity (TA)

TEACHING IN PRACTICE

1. Identifying a problem

From my experience as a teaching assistant one of the most challenging things is to motivate the most introverted and uncomfortable students to **1.** participate orally in the plenum discussions, and **2.** often when students are going to present in front of other students they are too focused on their own task so they forget to listen and are not open to learn from the peer students presentations.

2. Planning a teaching activity

The goal with this TA was to support students learning through a jigsaw exercise. This TA should make the students more comfortable in presenting and learn from peer students in a "group examination". Thus, making the students more susceptible to learn and deeply understand the theory. In the examination section peer feedback were implemented, to help the students reflect.

3. Trying it out in practice

Students were divided into four groups with different categories. Each group was given 10 min to discuss questions covering the given topic. In this phase of the exercise students will have the chance to learn from each other and use all the ideas in the next phase. In this next phase they were divided into new groups consisting of students given different topics in the first phase. Now they were given 15 min for individual presentations/examinations, where the rest of the group should be open to lean from the presentation, give feedback and ask questions to the presenter.

Figure 2: Master students working in groups in the first part of the TA

The jigsaw activity was based on questions about the food related enzyme lipoxygenase (LOX). The previous lecture focusing on the enzyme polyphenol oxidase (PPO) was used for comparison, here no TA was used before a common plenum discussion. A clear difference in the level of participation were observed and everybody seemed to be very confident in their presentation after the TA.

MAIN POINTS

1. **Main problem/challenge:** To activate all students and support learning from peer presentations
2. **Teaching activity**: A jigsaw exercise
3. **How did it go?** The students felt more comfortable and were more open to learn
4. **What to do next?** I will definitely use this TA again next time

4. Results

This activity was evaluated by Mentimeter questions related to the learning outcome from each of the three segments of the activity. The students responded that they liked the combination of peer discussion and individual presentations. Further, all students felt that they were more open to learn from the peer presentations after the TA compared to the previous lecture without the TA.

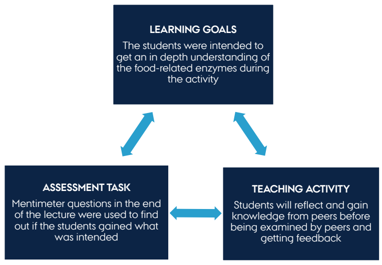


Figure 3: Constructive alignment

Preparation

1: **Lipoxygenase: The significance of lipoxygenase in foods**	2: **Lipoxygenase: Characteristics of the enzymes**	**3. Lipoxygenase: Mechanisms**	**4. Lipoxygenase: Prevention strategies**
Student 1.1	Student 2.1	Student 3.1	Student 4.1
Student 1.2	Student 2.2	Student 3.2	Student 4.2
Student 1.3	Student 2.3	Student 3.3	Student 4.3
Student 1.4	Student 2.4	Student 3.4	Student 4.4

Prepare for 7 – 10 minutes

'Examination'

Group 1	**Group 2**	**Group 1**	**Group 2**
Student 1.1 – Question 1	Student 1.2 – Question 1	Student 1.1 – Question 1	Student 1.2 – Question 1
Student 2.1 – Question 2	Student 2.2 – Question 2	Student 2.1 – Question 2	Student 2.2 – Question 2
Student 3.1 – Question 3	Student 3.2 – Question 3	Student 3.1 – Question 3	Student 3.2 – Question 3
Student 4.1 – Question 4	Student 4.2 – Question 4	Student 4.1 – Question 4	Student 4.2 – Question 4

Spend 10-15 minutes on each examination

Figure 1: The jigsaw exercise, containing discussion groups and presentation/ examination groups

4. Looking forward

Everybody felt more comfortable by presenting after discussing in groups. Further, most of the students felt that they were more open to take in new informations from peer presentations while they felt well prepared themselves. Based on my experience with this TA I will definitely use it in future lectures, and will consider to use a quiz as evaluation.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Anne Vuholm Sunds
Food Chemistry and Technology
Department of Food Science

Student Presentation Exercise

- encouraging active student participation

Learning Lab

Abstract

A significant challenge encountered as a teaching assistant is the problem of having students voluntarily present solutions to problems on the white board. This might be due to students not having confidence in the correctness of their solutions or their ability to present. For this exercise the students were instructed to select specific exercises to solve and then afterwards present them to each other in pairs or small groups before presenting in front of the class. Overall the students participated more actively in solving and presenting the exercises and the exercise was evaluated as a good way of improving student learning.

COURSE FACTS

- Course name: Optimization
- Level: Bachelor
- ECTS credits : 10
- Language: English
- Number of students: 28
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

The students in my course are evaluated by an oral exam at the end of the semester. In order to prepare the students for the exam, they are given weekly problems at the TA sessions that at the end of the session is presented by students or the instructor. I have chosen to address the problem of students being reluctant to present their solutions in front of the entire class.

2. Planning a teaching activity

The students should be able to solve the exercises for the TA session and argue for correctness of their solutions. The teaching activity will address the challenge of getting students to present problems on the white board. The students will often doubt their solutions to problems or their presentation skills and therefore do not wish to present their solution to the entire class.

By letting students assign them selves to specific exercises and letting them present their solutions to each other in smaller groups before hand they will get an opportunity to practice their solution and also spot mistakes.

3. Trying it out in practice

A list of exercises were given to the students beforehand allowing them to get an overview of the exercises before the TA session. At the TA session the exercises were listed on the board and each exercise given a difficulty rating. The students will individuality or in pairs assign themselves to an exercise and spend 30 minutes attempting to solve the exercise. Afterwards they will discuss their solutions with other groups for a short period. The rest of the TA session is spend presenting the exercises at the white board. The presentations are done by the students who want to present or by the teaching assistant.

Figure 1: Students discussing their solutions

The students responded very well to the exercise. The amount of exercises presented by students on the white board increased significantly. Only two exercises were left unpresented by students.

MAIN POINTS

1. **Main problem/challenge:** Students are reluctant to present their solutions for the class
2. **Teaching activity**: Presentations of solutions in smaller groups
3. **How did it go?** Great - The exercise was very successful in having students present at the black board.
4. **What to do next?** More formally evaluate student learning and test on larger groups

The students were asked to evaluate the exercise by handing out a series of questions for feedback. When the students were asked to evaluate whether the exercise improved their understanding many argued that being assigned to an exercise and discussing the solutions helped them in solving the exercise.

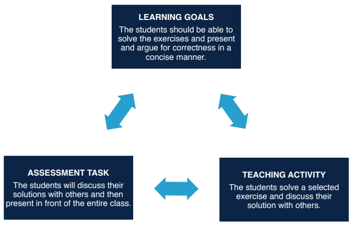


Figure 2: **Constructive alignment**

4. Looking forward

The exercise worked very well as a way of making the students participate more actively in the exercises. The students were very engaged in solving the exercises and also in discussion during the presentations.

In order to improve further on the exercise I would like to try it with a bigger class of students. Unfortunately not many students showed up to class - probably due to the nice weather. This will also allow for more than one group of students to be assigned to an exercise.

Another possible improvement on the exercise would be to more formally evaluate the learning of the students and give them feedback. This, however, could potentially discourage students from presenting.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Quaternary Field Geology

- why we do fieldwork and how to process samples and interpret the results

Learning Lab

Abstract: As a student you have very little field and laboratory experience, which often makes it difficult to see the end goal and see the connection between fieldwork, laboratory work, theory and interpretations, which for a geologist is very important. As an attempt to make the students more aware of the connection between the different elements in this course I made them do a mind map, having them reflect on the connection and links between the different elements. It worked out very well, and gave them a broader understanding of the connections between field work, laboratory processing of samples and theory.

COURSE FACTS

- Course name: Quaternary Field Geology
- Level: Bachelor
- ECTS credits : 5
- Language: Danish
- Number of students: 40
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

From my experience students often have a problem connecting the samples we get in the field and the way of processing them in the lab with what the results can tell us. They are often focused on specific procedures and not the overall picture of why we do what we do and what that can end up telling us.

2. Planning a teaching activity

A mind map first and foremost makes the students discuss and make them set forward arguments for what they think are the connection between different elements. This makes them consider what the end goal of the task is and what the results can tell us.

The learning goal for my teaching activity was to:

- **Make the students reflect on the end goal of the course/assignment, and try and see the connection between field-work, lab-work and processing results**
- **Make the students aware of different methods and why we use them**
- **Make the students argue and discuss which hopefully can make them evolve their understanding of the processes**

3. Trying it out in practice

I chose to make the students do a mind map, where they should connect elements from the field and lab, some results and interpretations. I gave a short description of what the end goal of this course is and then walked through the different elements they could arrange on the mind map. I gave them 15 minutes to discuss, where after I had them change half the team with another group to do 5 minutes of discussion on the results. After that, we had a 15 min discussion on the class where we talked through the different possibilities and how samples and lab work could be connected with the end goal of telling the geological history of the field-area.

MAIN POINTS

1. **Main problem/challenge:** Having a broader understanding and overview of several processes and why they are carried out.
2. **Teaching activity**: Mind Map
3. **How did it go?** It went well, the discussion between students clarified many questions, and made them realize things they had not thought about.
4. **What to do next?** Next up I will make an evaluation on how well the students feel they have had an overview and understanding of the processes during the entire course.

There was a good discussion on class and while I was walking among the different groups I was more observing than engaging in the discussions and only very few questions were asked.

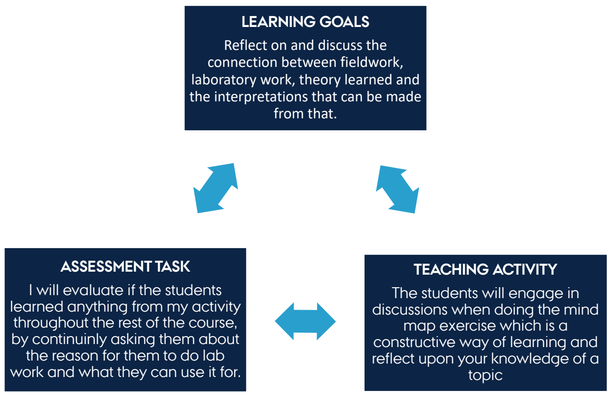

Figure 1: **Constructive alignment**

4. Looking forward

The discussion amongst the students worked very well and had them reflect and think about why we do what we do and what the different samples can tell us in the end. The next step will be to follow up on the things we discussed while they carry out lab work and write the report where they put together the geological history of the area. Next year it would be nice to have even more time to carry out an activity like this, so the students get well prepared for the field and lab work.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Anne Sofie Søndergaard
Quaternary Geology
Department for Geoscience

Student Summary of Lectures

- Summary of previous lectures at the beginning and summary of current lecture at the end of lecture

Learning Lab

Abstract:

During a course, there are a lot of information for the students to learn. It is hard to keep track of all information and see a bigger picture. By using Think-Pair-Share, the students reflect on their own learning at the beginning and end of each lecture. These repetitions and summaries should help the student learning and create a red line through the lectures.
The students reported that the summaries helped them remember, reflect, reassess and identify key elements of the teaching from each lecture.

COURSE FACTS

- Course name: BT4FEM
- Level: Bachelor
- ECTS credits : 5
- Language: Danish
- Number of students: 89
- Your role: Teacher

TEACHING IN PRACTICE

1. Identifying a problem

I am a first-time teacher on a *Finite Element Theory* course with almost 90 students and I am responsible for 3 lectures about discs. We know from previous years that the students often find this part of the course hard. We need to set up a mathematical model for a disc, use this model to set up a Finite Element Model and introduce the students to applications of the Finite Elements in practice. In order to get the necessary tools to do this, we need to take some steps backwards and learn the underlying theory.

The main challenge is to maximize their learning outcome from the teaching. It is also important that the students see a red line through the lectures so they know why we need to take "detours".

2. Planning a teaching activity

I want to help the students to transfer new information from their working memory to the long-term memory. The teaching activity should enable the students to reflect on the lectures and identify key elements. By repeating this process of summarizing the teaching, it can help the student learning.

I also want a clear red line throughout the lectures to help the students. The teaching activity will help them to connect knowledge from the last lecture to the new lecture. By starting the lectures with known information and expanding on this through the lectures, we increase the student learning.

3. Trying it out in practice

The students did a Think-Pair-Share at the end of each lecture. Here they reflected, summarized and identified the key points of the teaching in pairs while I walked around the classroom. Since an active discussion was difficult to establish due to the large number of students then they instead uploaded 3 key words to Mentimeter and I went through the word cloud.

Then again at the beginning of the next lecture, we did the same but they tried to remember - without looking at their notes - what they learnt last time and upload 3 keywords to Menti. Then I went through the word cloud and summarized what we did the last time and how we are doing to use this in this lecture.

Figure 1: **Teaching about the mathematic model**
Picture from the first lecture

The teaching activity did not go entirely as planned. In the beginning, the students looked in their notes, which was not the intent. The students in the front of the classroom were engaged in the activity while those in the back talked about other things. When I pass by they changed the subject and talked superficial about the teaching. Furthermore, some students were a bit immature and wrote "funny" words on Menti while others used the platform as evaluation of the individual lectures.

MAIN POINTS

1. **Main problem/challenge:** Identify key points of teaching and see a red line through the lectures
2. **Teaching activity**: Think-Pair Share at begin and end of lecture to remember, summarize and identify key points of the last/current lecture
3. **How did it go?** Overall it went well but there are room for improvements.
4. **What to do next?** Spell out what I want the students to do. Emphasize that is not an evaluation of the lectures

At the end of the 3rd lecture, the students evaluated the teaching activity along with the teaching, as seen in figure 2.

The student were generally positive about this teaching activity. They reported that the summaries helped them remember, reflect, reassess and identify key elements of the teaching from each lecture.

Figure 2: **Evaluation of Teaching Activity**
The evaluation of the teaching activity (in Danish)

4. Looking forward

Overall the teaching activity worked well and the students reported a general satisfaction with the activity.

It is simple teaching activity that can be implemented in almost any teaching without taking too much time. If a teacher wants to implement this into his/her teaching, there are things to consider. It will work better with fewer students so active discussions are a possibility and this would enable the teacher to access the understanding of the keywords. And he/she will need to say that the summaries are not an evaluation of the lecture.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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The use of GIS-analysis

- And how to make you remember

Learning Lab

Abstract: In this teaching activity students will be asked to use GIS to analyze a small dataset. During the exercise they must reflect upon what they are doing in order to store the knowledge they obtain and remember it for the next time. The students should then recall this knowledge and organize the steps in the exercise using a strip sequence. This teaching activity is intended to make the students reflect more about what they are doing in computer exercises.

COURSE FACTS

- Course name: The hydrogeochemical cycle
- Level: Master
- ECTS credits : 10
- Language: English
- Number of students: 12
- Your role: Teaching Assistent

MAIN POINTS

1. **Main problem/challenge:** Understanding and reflecting upon the use of a computer program.
2. **Teaching activity**: Written exercise and strip sequence.
3. **How did it go?** The students where better at recalling how to use the program.
4. **What to do next?** Implement more group work and discussion about the exercise.

TEACHING IN PRACTICE

1. Identifying a problem

When working on computer exercises where the learning goal is to be able to use a specific program such as GIS, a big issue is to get the students to remember and understand how the program works instead of just clicking randomly until the exercise is done. When doing so, the students do not reflect on what they are doing, and the next time they have to work with the program, they often can not remember how to operate it, thus, they have not learned how to use the program and the learning goal is not fulfilled.

2. Planning a teaching activity

This activity will involve two parts: First, a computer exercise in GIS where the students are asked to reflect about what they are doing, and secondly a strip sequence in which they are asked to recall what they did in GIS.
It is the intention to get the student to remember the different functions in the program, and more important, try to incorporate this approach to exercises in the future.

The learning goal of this exercise is to give the students a fundamental understanding of how GIS works, instead of just being able to use the program.

3. Trying it out in practice

The students are asked to make a simple GIS exercise. During the exercise they should write down exactly what they are doing in GIS in the different parts of the exercise: What buttons do they click and what will this do to the data? These answers should then be handed in together with screenshots of their work. The next time in class we will do a strip sequence, in

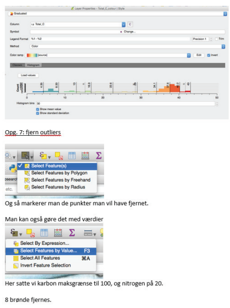

Figure 1: The students are asked to hand in a small report on what they were doing in the data analysis. This includes small explanations of how the different GIS-functions works on the data.

which the students are asked to recall what they worked with and arrange the steps from the computer exercise in the correct order. The strip sequence contains both the different steps from the exercise, but also explanations on what this will do to the data.

The activity will be evaluated on the result of the strip sequence – does the students remember what they did and how GIS works? Furthermore, the students outcome of the activity will be evaluated based on an anonymous questionnaire, where they are asked to rank this activity.

This teaching activity resulted in a better understanding and reflection upon how to use GIS. By writing down what the program does, the students seemed to remember it better. The following strip sequence made them recall the most important functions and what these do to a dataset.

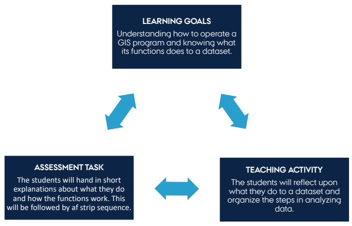

Figure 2: Constructive alignment

4. Looking forward

It went well getting the students to consider a bit more what they were clicking and why. The next step might be to involve the students more in the exercise. This could for instance be with group work, where the students are either asked to discuss the exercise or explain to each other what they are doing. In this way, they will be forced to put their own words on the exercise, which might improve the learning.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Quiz Your Knowledge

- Revision for Atomic and Molecular Physics

Abstract: It was almost the end of the Atomic and Molecular Physics course and upon conducting a mentimeter survey we found that students were finding certain topics like Zeeman effect, quantum numbers and the notation difficult to understand. They also asked for an overview of the course topics. Hence, we designed a quiz with two rounds – one round for the quantum numbers, term symbols and Zeeman effect, and another for the rest of the course topics. We included peer review, plenary session and group discussion. The activity was successful as the students had fun and at the same time met their learning goals. Feedback was taken in the form of a mentimeter survey and also by direct observation of the students during the activity. The next step will be to improve the activity using the students feedback and implement it the following year again.

Learning Lab

COURSE FACTS

- Course name: Atomic and Molecular Physics
- Level: 2nd year Physics
- ECTS credits : 5
- Language: English
- Number of students: 22 (x3)
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

We thought that the best way to find out what the students found difficult was to ask them directly. A mentimeter survey was a good tool. Through the survey we identified that most students found certain topics like **the notation**, **the different quantum numbers** and **Zeeman effect** difficult to follow. Some students mentioned that they wanted a **quick overview** as the course was almost complete. We decided to tackle both these aspects in the activity that we designed.

2. Planning a teaching activity

We organized a quiz with two rounds. The first round was aimed at **identifying** the different quantum numbers, **calculating** them and using it **to explain** fine and hyperfine splitting of energy levels for a simple atom. It also included Zeeman effect. The second round was in pop-quiz style with 10 questions covering all the topics taught in the course. We included some questions that the students themselves had asked during the earlier TØ sessions.

Learning Goals:

- **Identify** the different quantum numbers
- **Calculate** the various quantum numbers for a simple system
- **Explain** fine and hyperfine splitting of energy levels
- **Reflect** on the various topics taught during the course and find a connection between them

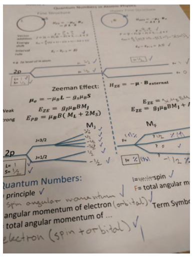

Figure 1: Example of a filled in "Round 1" sheet with student corrections

3. Trying it out in practice

The students were asked to form groups of about 4. First, the rules of the quiz were explained. The first round consisted of a summary sheet (Figure 1), in which some quantum numbers, energy levels and simple formulae were left out for the students to fill in. They were given 5 minutes to work together on it and were allowed to refer to their notes and the text book. Then the groups were asked to exchange the sheets for peer review. To review, the answers were discussed by the TA with the whole class.

In round 2, the questions were projected on a screen and students had to fill in the right answers in the sheet that was handed to them. Again, they worked in groups. There were 10 questions from various topics covered during the course, several of which were questions asked by the students to the TA during earlier sessions. The groups were asked to exchange their sheets again for peer review. The answers were discussed and clarified by the TA with the whole class.

The scores were totaled and the winning team got a bag of chocolates which they shared with the rest of the class.

MAIN POINTS

1. **Main problem/challenge:** Understanding quantum numbers and notation
2. **Teaching activity**: revision "pub" quiz
3. **How did it go?** The students were all engaged and they said they found it useful
4. **What to do next?** Implement activity during revision session before the exam

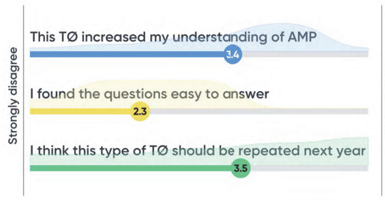

Figure 2: Evaluation results on mentimeter. Sixteen students participated in the evaluation.

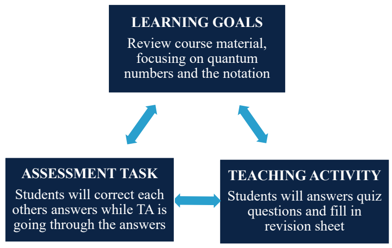

Figure 3: Constructive alignment. The students will learn about the course material by doing a quiz and checking each others answers.

4. Looking forward

Overall the teaching activity was a success. The students were engaged throughout the quiz and asked questions during the discussion session. The evaluation is shown in Figure 2 and from this it is clear that the students found it useful. However when repeating the exercise we will make some questions easier to answer to boost their confidence. In conclusion, positive feedback such as "the group quiz worked really well" and "It was great as repitition!" make it clear that this exercise should be repeated in following years.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Klara Volckaert and Rijutha Jaganathan
Hofmann group and Hornekær group
Department of Physics and Astronomy

Obtain the overview of spectroscopies in Organic Chemistry I - An extended strip sequence

Learning Lab

Abstract:

Organic chemistry is a major field with many basic concepts that need to be learned in a short period of time to merely scratch at the surface. Many students therefore find it hard to obtain the overview that enables them to solve a given problem where multiple concepts are needed. In my teaching activity, I focused on one of the major course learning goals, spectroscopies, to help the students obtain the necessary overview of the steps that are involved in spectra interpretation.

COURSE FACTS

- Course name: Organic Chemistry I
- Level: 1st year chemistry
- ECTS credits : 10
- Language: Danish
- Number of students: >300 total
- Your role: TA for two smaller classes of ~24 students each

Planning a teaching activity

Constructive alignment[1] is essential for teaching to be successful. In planning my teaching activity, I thus strived to first identify what I intended the students to learn (leaning goals) and the challenges that I expected the students to encounter. I then designed a teaching activity that targeted the identified challenges. Finally, I developed a Mentimeter poll to evaluate the teaching activity and assess student learning.

1. Learning goals

I chose to focus on one of the major course learning goals, namely interpretation of spectra. With my teaching activity, the students were intended to learn how to (1) interpret simple experimental spectra obtained from mass spectroscopy, infrared spectroscopy, ^{13}C NMR and ^{1}H NMR, and (2) combine information from more than one spectroscopic technique to extract possible molecular structures that match all given spectra.

2. Challenges

A key challenge for my students in order to meet the established learning goals was lack of overview needed to attack a given set of spectra in a systematic way.

3. Teaching activity

In order to meet the learning goals, it was thus necessary to develop a teaching activity that helped the students create an overview of the steps involved in spectra interpretation. My solution was an extended strip sequence (Figure 1) designed to increase the students' understanding of the information that each type of spectrum provides, as well as create overview of the order in which a spectrum can be interpreted systematically. By discussing the procedures in groups, all students are activated, they get peer-feedback, and storage in the long-term memory is promoted.

4. Evaluation and assessment

In order to evaluate the teaching activity and assess student learning, I created a Mentimeter poll (Figure 2) to be used in the week following the teaching activity.

Technique	Information	Steps
Mass spectroscopy (MS)	**A.** Molecular formula **K.** Degree of unsaturation **D.** Molecular fragments	**g.** Identify M⁺
		c. Determine possible molecular formulas
		f. Calculate degree of unsaturation
		a. Identify other clear m/z peaks and determine possible molecular fragments
Infrared spectroscopy (IR)	**J.** Functional groups	**i.** Use absorption peaks to identify possible functional groups
^{13}C NMR	**G.** Non-equivalent carbons **F.** Carbon hybridization **C.** Functional groups	**h.** Identify chemical shifts and thus number of non-equivalent carbons
		m. Use chemical shifts to determine likely carbon hybridizations
^{1}H NMR	**E.** Non-equivalent protons and number of each **I.** Chemical environment near protons **B.** Number of protons on neighboring carbons	**l.** Identify chemical shifts and thus non-equivalent protons
		d. Relate relative intensities to the molecular formula to determine number of protons contributing to each chemical shift
		b. If possible, note the multiplicity of each chemical shift to determine number of protons on neighboring carbons
		j. Use chemical shifts to determine the chemical environment of all protons
		e. Combine information about each proton's chemical environment, number of contributors and neighbors to propose structure of molecular fragments
Combination	**H.** Structure	**k.** Propose structures that match all the obtained information

Figure 1: **Extended strip sequence**
Strip sequence with three levels to help my students obtain an overview of spectroscopies in organic chemistry and the steps involved in spectra interpretation.

Teaching in practice

In the first week with spectra interpretation, I presented a way to attack a set of spectra in a systematic way. The teaching activity was carried out in the following week, thus giving the students a chance to practice. During the activity, the students discussed each level of the strip sequence (Figure 1) in small groups. First, they matched the techniques (column 1) with the information that may be obtained (column 2). Next, they matched the techniques with the steps required to obtain that information (column 3). Finally, they ordered the steps. By switching groups 2-and-2 they gave/received peer-feedback. The activity was concluded with a short class discussion, and everyone was given an uncut strip sequence to use as a guide in the future. The strip sequence was placed instead of two spectra exercises, but the students were encouraged to give them another try after the activity.

MAIN POINTS

1. **Main problem/challenge:** Obtaining the overview in spectra interpretation
2. **Teaching activity**: Extended strip sequence
3. **How did it go?** All students were activated and after the activity they felt that spectra interpretation was easier
4. **What to do next?** Implement more teaching activities

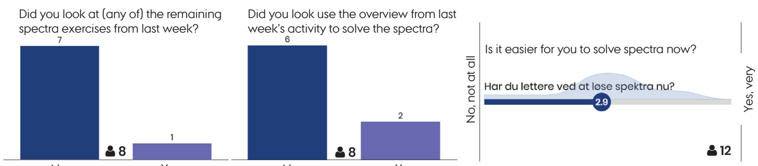

Figure 2: **Mentimeter poll**
Mentimeter poll used in the following week to evaluate the success of the teaching activity and assess student learning.

Looking forward

As I walked around during the activity, I noticed that many of the students that were normally not active were engaged in discussion and that various misunderstandings were straightened out. A Mentimeter poll (Figure 2) in the following week was used for evaluation, but unfortunately very few students looked at the exercises after the activity, making it difficult to assess the student learning. However, the students that did look at the exercises also made use of the strip sequence, and in general the students felt that it was somewhat easier to interpret spectra after the activity, which was the main learning goal. Looking forward, I intend to make use of similar, but less elaborate, teaching activities to help create overview for my students.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

References
1. Teaching Teaching & Understanding Understanding: www.daimi.au.dk/~brabrand/short-film/

Nina Kølln Wittig
Biological and bioinspired materials
Department of Chemistry and iNANO

Flow chart drawing exercise

- Increased experience through an exercise

Learning Lab

Abstract:

Obviously, for first year undergraduates, it could be tough and unfamiliar to start real laboratory chemical experiment. So making a flow chart on what to do step by step in real exercise will be useful and helpful for them. So in the class, I will help students to get experience on how to make a brief flow chart for real exercise. After this class, students will be able to do that for their own laboratory exercise and execute the exercise more efficiently.

COURSE FACTS

- Course name: Laboratory Organic Chemistry
- Level: Bachelor
- ECTS credits : 10
- Language: English
- Number of students: 20
- Your role: Instructor

TEACHING IN PRACTICE

1. Identifying a problem

There is no doubt that first-year undergraduates have different and practical background. In addition , based on my own experience as a first-year undergraduate, I realized that it could be tough and unfamiliar for them to start real laboratory chemical experiment.

2. Planning a teaching activity

In the class, there will be mainly three parts:
1).For the first part, I will show all the students how to draw a brief and useful experimental operation flow chart for one laboratory exercise;
2).After that, I will choose a second laboratory exercise and provide some sequences of different steps to do that exercise and ask students to order the sequence with their lab partners;
3).Finally, I will arrange a peer discussion session.

Filtrate the organic phase and concentrate it on the rotary evaporator	Wash the collected ether phase throughly with 2x15 ml sodium carbonate solution and dry it in Erlenmeyer flask with $MgSO_4$
Collect the final product in a pre-weighed flask and calculate the yield percentage	Add 0.5 ml concentrated H_2SO_4 with a plastic pipette
Reflux the solution at 120°C for one hour	Mix 12.5 ml EtOH and 6.5 ml 2-methylpropanoic acid in a 50 ml round-bottom flask
Determine the refractive index of the final product	Distill the remainder at normal pressure and note the boiling point during distillation
Extract the water phase with 2x25 ml Et_2O	Cool the reaction flask in an ice bath and add 25 ml crushed ice through a powder funnel

Figure 1: The strip sequence made for students to order.

3. Trying it out in practice

I will use the manual for the laboratory exercise for the course. Definitely, there is detailed description of every exercise, but a convenient and intuitive flow chart like that shown below will be very useful for students to execute the exercxise more efficiently.

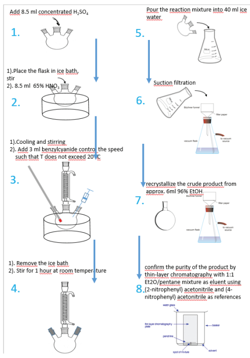

Figure 2: The drawn flow chart to help students acquire experience on arranging sequence for a laboratory exercise.

Based on their strip sequence ordering results, I will know how well students experience the teaching activity. In the end, I will also make an annonymous survey for all students and get the feedback from them on the teaching activity.

The questionnaire: :

1. Did you understand and get most points the TA taught in the class?
   A. Yes B. No
2. Did you get the right order for the exercise the TA showed in the class?
   A. Yes B. No
3. Do you think it is necessary to draw the experimental operation flow chart and prepare well for the laboratory exercise before every excerise?
   A. Yes B. No
4. Do you think it is too difficult to draw the experimental operation flow chart before every exercise?
   A. Yes B. No
5. Will you draw the experimental operation flow chart before every exercise?
   A. Yes B. No
6. Do you have any other new method that could help students to prepare well for the laboratory exercise every time?
7. Do you have anything else that you want to tell the TA?

Figure 3: Questionnaire for students to give feedback.

MAIN POINTS

1. **Main problem/challenge:** Lack of experience of carrying out laboratory experiment.
2. **Teaching activity**: Strip sequence on main steps of one specific laboratory exercise.
3. **How did it go?** Not executed yet.
4. **What to do next?** Looking forward to execute it in the coming semester.

Feedback from students		
	Right	Wrong
Strip sequence results	xx%	xx%
Questionnaire feedback		
	Yes	No
Q1.	xx%	xx%
Q2.	xx%	xx%
Q3.	xx%	xx%
Q4.	xx%	xx%
Q5.	xx%	xx%

Table 1: Percentage students answering correctly on the strip sequence and the questionnaire feedback.

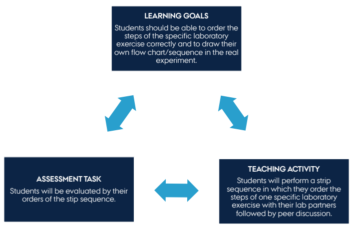

Figure 4: **Constructive alignment**
Alignment between learning goals, assessment and teaching activity.

4. Looking forward

Hopefully, this designed teaching activity will help students to be well prepared for the real lab experiment work.
As a next step, I think it would also be a great idea not only to ask students to draw their own flow charts before every exercise but also to ask them to display them by their lab bench every time. In this way, they could revisit the chart when needed during the lab work and the TA could also address any misunderstandings in the chart during the experiment.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Presentations in groups

Learning Lab

Abstract: I have attempted to mix the classical, blackboard-based exercise session format with a more group-oriented model, where students solve exercises collectively and make joint presentations. The hope has been to eliminate the issues of inactive students and get a broader participation level. The attempt was a success, based both on student feedback and from my observation as a TA.

COURSE FACTS

- Course name: Geometry
- Level: Bachelor, 4th sem.
- ECTS credits : 10
- Language: Dansh
- Number of students: 9
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

Mathematical communication is famously blackboard-centered, and there seems to be no clear alternative to this format. It hence easily develops into one-way communication. At exercise sessions, it tends to be the same few students always presenting, the others feeling too insecure to participate. The challenge is to cope with this issue while sticking to the blackboard model.

2. Planning a teaching activity

While ultimately maintaining the blackboard model, the hope was that putting people in groups and assigning them a specific collection of exercises in advance, and asking them to present them together at the blackboard instead of individually, you would be able to break the barrier they had against active participation. Some prior planning was necessary. Since the model would clearly be more time-consuming than the classical one, the TA had to single out the relevant exercises in advance and decide on a natural division of these amongst the groups.

3. Trying it out in practice

The students were asked to divide themselves into groups, a process they more or less controlled themselves. The TA wrote a series of collections of exercises on the blackboard, describing their level of difficulty and abstraction, and asked the groups to volunteer for them. In the end, however, the TA found himself suggesting to individual groups which exercises they could take. At first, most students spent some time individually reflecting on the exercises before commencing with the discussions. The TA tried not to participate too much for the first twenty minutes or so, instead walking around between the tables, listening and trying to look ready to answer questions.

After this initial time period, he would walk over and ask about their approach and progress, commenting, giving hints or feedback if necessary. After this, he would periodically visit each table and measure their progress, occasionally asking them to come to the blackboard to explain something to them. In the end, all groups had managed to solve (most of) their exercises.

After about ninety minutes, he would ask them to start planning a joint presentation, with focus on dividing the exercise as evenly as possible amongst the students. The TA would usually discuss the format of the presentations with each group beforehand, giving pedagogical suggestions.

MAIN POINTS

1. **Main problem/challenge:** Inactive students
2. **Teaching activity**: Group-based problem solving with presentations
3. **How did it go?** Very well, based on both student feedback and the TA's impression
4. **What to do next?** I will probably use this model in the future.

The presentations would begin once all groups felt sufficiently ready. At the blackboard, the students in general were good at making sure everybody said something. Occasionally, like with classical exercise sessions, it was necessary for the TA to interrupt, make suggestions for the presentation, correct, make additional points, or present alternative approaches or solutions. Care was taken in order to do this in a way, and to an extend, that would not make the students feel unnecessarily uneasy. This part would usually take about 75 minutes.

In the end, the TA asked the students to comment on the learning outcome of this compared to classical exercise sessions. There was universal agreement that the group-based model was better. This was in accordance with the TA's impression.

4. Looking forward

The experiment worked out well beyond expectations. Both my own impression, as well as the feedback from the students, suggested that the learning outcomes were much better than before, as was individual progress with the exercises. This model will probably be the basis of my future TA sessions.

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Department

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