PROCEEDINGS: TEACHING@NAT-TECH SPRING 2020

18 JUNE 2020

AARHUS UNIVERSITY
SCIENCE AND TECHNOLOGY LEARNING LAB

SOLIDUM PETIT IN PROFUNDIS · UNIVERSITAS ARHUSIENSIS

Learning Lab

Teaching@Nat-Tech celebrates the end of the Teacher Training programme and the Science Teaching programme with a mini-conference at the Faculty of Natural Sciences and the Faculty of Technical Sciences. The purpose of the conference is to inspire exceptional teaching.

The spring semester this year was a bit different as the COVID-19 pandemic rendered face-to-face teaching at campus impossible.

The conference is held by ST Learning Lab, the educational development centre of the Faculty of Natural Sciences and the Faculty of Technical Sciences, Aarhus University.

For more information visit: stll.au.dk

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KEYNOTE BY GERTH STØLTING BRODAL, PROFESSOR

Gerth will, among other things, talk about his first teaching experience as a teaching assistant in a programming course at Aarhus University in the fall of 1992, only equipped with a weekend course on how to be a teaching assistant. Since then, he has taught and advised at the BSc, MSc, and PhD levels at Aarhus University. Currently, he is responsible for two BSc courses with more than 150 students and numerous teaching assistants.

In his keynote, he will reflect on his experiences over the years, going from blackboards through whiteboards to Blackboard; from handwritten plastic slides and overhead projectors to PowerPoint, YouTube, and Discord; and from small-class teaching to establishing a major BSc course from scratch. He will talk about what has been the challenges and how new ideas were gradually incorporated into courses.

TEACHER TRAINING PROGRAMME POSTERS BY ASSISTANT PROFESSORS

Learning design/ theme	Lectures	Group work* (theoretical exercises/ TØ)	Supervision
Flipped Classroom	Martin Markvard Knudsen Aktiveret undervisning, p ----------- Michael Dahl Knudsen Flipped classroom for simulation software instructions, p. ----------- Mads Dyrmann Using Flipped Class-Room to Extend Exercise Time in Digital Image Processing, p.	Anne Kruse Hollensen Assignment in molecular biology and biochemistry, p.	Stine Winther Kristensen Introduction to teaching at ENG, p.
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*Also referred to as 'small-class teaching'

Risiko vurdering/(maskin)direktiver

Lars J Brandt
Underviser

Keywords: small class lecturing, STREAM, gruppe arbejde, individuelt arbejde, Peer feedback, opsummering.

Pedagogical challenge/purpose

Give a short description of the pedagogical challenge you are addressing in your learning design?

Den største udfordring var at forstå hvor svært det var for de studerende at forstår budskabet omkring DRA. Hvilken ingangsvinkel der skulle bruges for at motivere og igangsætte de studerende. Det er meget forskel på om det er 5 studerende eller 50 studerende som skal undervises. Ved større grupper er det nemmere for de studerende at hjælpe hianden. I små grupper skal der hjælpes en del mere.

Context/course facts

Give a short description of the course context (number of students, level, ECTS, etc.)

Implementering af grundlæggende Risiko vurdering for Maskindirektivet
Projekt 1(1. semester), Projekt 2 (2. semester) og Projekt 3 (3. semester)
Maskinkonstruktion, sikkerheds forståelse
Bachelor
Dette skal gennemgås med 3 klasser, hvor der er henholdsvis 5 elever, 45 elever og 50 elever
5 ECTS

Learning outcomes and purpose of learning design

Which learning outcomes are you pursuing with your learning design and the use of educational-IT? Why did you choose to focus on the challenge/problem/idea? What type of activity/activities are you addressing/ planning to address in your learning design (e. g. lectures, lab, theoretical exercises, supervision, etc.)?

. Jeg forventer med denne undervisning, at give forståelse for brugen af risiko vurdering til elevernes arbejde. Det være sig omkring sikkerhed for personer, som for miljøet. Jeg har arbejdet med maskindirektivet I mange år og ved hvilken indflydelse det har, hvis man har forståelse for risiko vurderingen som hører til, for at kunne lave en CE mærkning af sit udstyr. (hvis udstyret skal CE mærkes).

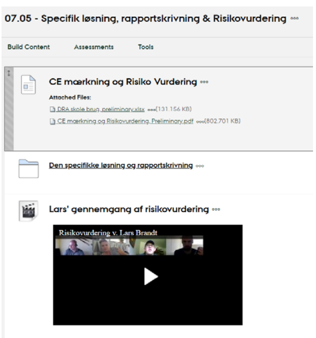

Figure X: *Digital learning materials such as screen dumps of learning paths, webcasts etc.*

Her har jeg forsøgt at lave in class og out of class undervisning. I in class har jeg lavet nogle templets, hvor den ene kan bruges direkte I deres projekter. Den anden er en vejledning I hvordan templeten skal udfyldes og vurderes. Derudover har jeg lave en 90min video hvor jeg fortæller hvordan sammenhængen er mellem masindirektivet, ISO12100 og risiko vurdering. Derudover er der I videoen fortalt hvordan DRA templeten skal udfyldes og hvilke risiko der er ved ikke at tage de korekte forholdsregler. Eleverne laver nu out of class opgaver med brugen af DRA. Her imellem er der peer feedback fra mig som underviser. Derefter laves der peer Feedback mellem de studerendes opgaver, hvor de giver hianden kommentar og forslag. Jeg har lavet et setup med Kahoot hvor de væsenlige emner er lavet som spørgsmål.

Indicators of impact

Describe how you monitored/assessed/evaluated your students learning outcomes during the activities.

Da dette er en længere process, er det svært at se en direkte læring af denne undervisning. Der skal laves risiko vurdering en del gange før at der kan ses resultater af denne forståelse. Hver gang der laves en risiko vurdering på en given opgave eller project , vil det være muligt at se en udvikling af dybten for evaluering af de konkrete spørgsmål som de studerende responderer over. De vil kunne gennemskuge hvorfor det er vigtigt at spørge why 5 gange til den fare der arbejdes med. De studerend vil med tiden kunne vurderes farens farlighed og konkret beslutte hvilken konsekvens det har.

Indikakator som billed er ikke muligt på nuværende tid

Resources	Tasks	Supports
	Forberedelse, uden for klassen	
Arbejdstilsynets Hjemmeside *(DRA) Eller søgning på DRA	Se/læs om forskellige DRA	Medstuderende
	Undervisning i Klassen, 1 Sem	
DRA matriks, billeder, emner	Gennemgang af DRA Brugen af DRA Opsætning af DRA	
Skitse/billed	Opgave (Billede) Udfyld første afd. af DRA	Underviser/medstuderende
mentimeter/kahoot	Kontrol/test af forståelse for DRA	Tilbage melding fra underviser
	DRA bruges i Projekt 1 opgaven	

Figure Y. *LDTool representation of learning design used In Learning design*

Learning design and Educational-IT

Describe if the learning design is supporting the teaching experiment performed during module 2 of the teacher training programme. Describe the alignment between in class and out-of-class activities in your learning design. Give a short description of the activity and how you used the learning material and tools that you developed. Include links or screenshots of the learning material that you developed as well as relevant learning design model.

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)? Der er lavet en DRA templet, hvor alle muligheder er lagt ind for at kunne udfører risiko vurderingen på en god made, samt har jeg lavet en video som forklarer hvordan templeten skal udfyldes.

Lessons learned and looking forward

Describe briefly the main lessons learned and future plans for the use of educational technology and development of the teaching practice.

Efter at have undervist I faget 3 gange, en gang med mine remedier og to gange hvor de studerende havde et konkret problem, er min umildbare reaktion, at fremførelsen af emnet DRA til en CE mærkning måske, mere skal foregå i de individuelle hold med deres respektive problem, end som et overordnet undervisningsforløb, første gang at de studerende introduceres for dette abstrakte emne
Jeg skal lave et klasse undervisning af emnet DRA til CE mærkning d. 7 maj efter det første koncept, som jeg have forberedt. Når det er gennemført vil jeg lave en endelig vurdering, omkring hvilken fremlæggelse/undervisnings form jeg føler er den bedst egnet fremadrettet.
Herefter vil jeg bedre kunne give feedback, til hvilken aktivitet der kan foretages af anden underviser og hvilke resultater der kan forventes, af undervisnings forløbet.

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Using Flipped Class-Room to Extend Exercise Time in Digital Image Processing

Mads Dyrmann
Assistant Professor

Keywords: *Electronic engineering; Digital Image Processing; lecture; exercises; feedback;*

Pedagogical challenge/purpose

Application of the learned algorithms is important for the course. This learning design provides students with support and feedback during exercises by flipping the class romm.

Context/course facts

An elective course at 6th semester, bachelor in engineering, 30-50 students, 5 ECTS

Digital Image Processing (DIP) is an elective course for bachelor students, who are studying either Electronic Engineering, Software Technology, or Healthcare Technology.
The course focuses on 2D signal processing and assumes that students have passed the courses in *Digital Signal Processing* and *Linear Algebra.* After completing the course the students should be able to explain and apply fundamental 2D Signal Processing techniques for image filtering. This includes filters for image enhancement, morphological filters, segmentation and pattern recognition.

Learning outcomes and purpose of learning design

Applying algorithms is essential in the course.
Therefore the students work on completing a programming exercise for each lecture, which this learning design seeks to support.

Lessons are currently structured as follows:
1. Preparation (reading) (out of class)
2. Lecture (in class)
3. Exercises (out of class)

Today, there is time to get started working on the exercises in class, but not completed during the four-lesson block devoted to the course each week. The students are therefore expected to work independently with the exercises after the lessons. This learning design moves parts of the lecture to the preparation phase, thereby leaving more time for exercises and support in class.

Learning design and Educational-IT

By moving the main parts of the lecture to the preparation phase, the course is transformed into a **flipped classroom** course. Small video lectures will be available, which combine screencasts and pencasts. Screencasts can be used for slides and graphic presentations, which today are presented using Powerpoint slides, while pencasts can replace algorithms on the black-board. Fortunately, transforming these parts of the lecture to videos can easily be done, as this course is an algorithmic and programming course where the content is mostly digital.

The students must see a clear benefit by preparing for the lesson. Small quizzes for each lesson will tell the students if they understand today's topic. If not, the in-class lecture will build upon the quiz answers. An example of such a quiz is shown in Figure 1.
As for the exercises, a server has been set-up, where students can upload their processed images, and the server will tell if the image is processed correctly.

The quizzes in the preparation phase maps as an individual and active activity in Canole's 'Pedagogy framework for mapping tools-in-use' (Canole *et. Al*, 2004). The students will most often solve the exercises on their own computer, but discuss the process in pairs or small groups. This helps the students also get feedback from fellow students, making exercise solving an active and partly social activity according to Conole's Pedagogy framework. Finally, a chat server like Discord or Riot will be set-up, where students can collaborate, discuss, and get feedback on their exercise work after class.

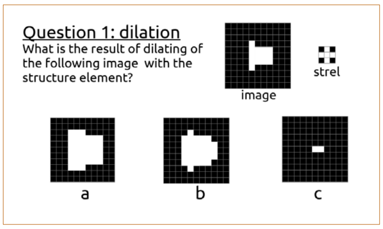

Figure 1. *Example of quiz that accompanies student's preparation*

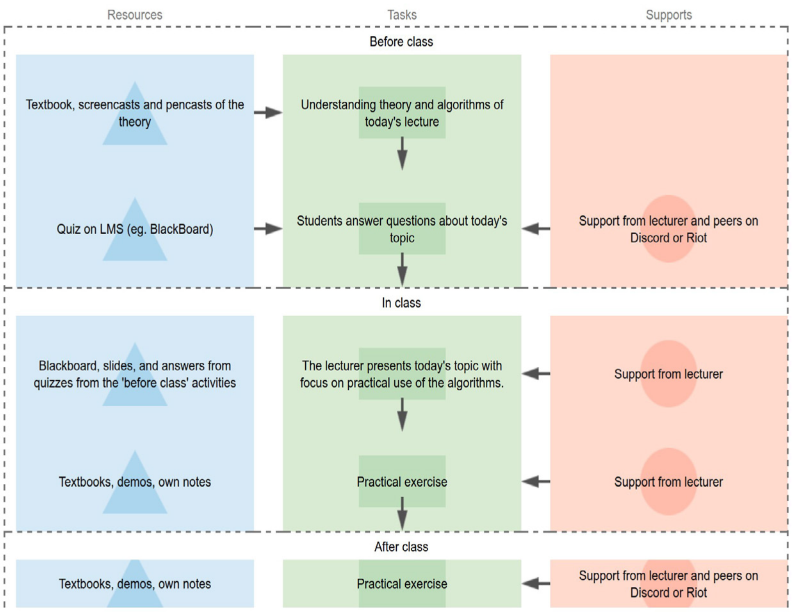

Figure 2. Learning design for a DIP lecture followed by exercises

Indicators of impact

The exercises help to show the students learning: If students can solve the day's practice, they have also understood the topic.
Some students will first find that they have not fully understood the topic when working with the exercises. With this learning design, the teacher is present during the work with the exercises. It is thus possible to clear up misunderstandings quickly so that the exercise can be continued. The teacher is also allowed to monitor the students' learning based on the students' ability to solve the exercises.

EDU-IT role and benefits

EDU-IT will be used throughout the course in the form of videos and quizzes on Blackboard before class, exercises accessable through Gitlab, and Discord discussions. The material on Blackboard will replace parts of the lecture, giving more practice time in class. By distributing the exercises through Git, it is possible to update the exercises on an ongoing basis, as well as allowing the students to contribute to the exercise description. Discord discussions allow quick and unformal feedback from the teacher and fellow students outside the class.

Lessons learned and looking forward

The teacher training programmed has contributed to further reflection in the structure of a course, ensuring consistency between learning objectives and course structure. In particular, I see a gain from educational technology in activities outside of lectures, as this can support learning and discussion.

References
Conole, G., Dyke, M., Oliver, M. and Seale, J. (2004). 'Mapping pedagogy and tools for effective learning design', Computers and Education.Volume 43, Issues 1-2, August-September 2004, Pages 17-33.

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Assignment in molecular biology and biochemistry

Anne Kruse Hollensen
Postdoc

Keywords*: Molecular biology and biochemistry; small class teaching; assessment; SAMR, Flipped Classroom, JiTT, STREAM*

Pedagogical challenge/purpose

1) To assist the students in revising the curriculum without the stress experienced by some students in connection with an assignment carried out in class.
2) To reduce time spent by teaching assistants giving feedback on assignments.

Context/course facts

Course in General Molecular Biology and Biochemistry (10 ECTS) for approximately 170 Bachelor's students at non-molecular biological study programs. The teaching methods are lectures and theoretical exercises (small class teaching). The exam is written. All aids except internet are allowed for the exam. Participation in the exam requires approval of three assignments/tests carried out in class in connection with the theoretical exercises.

Learning outcomes and purpose of learning design

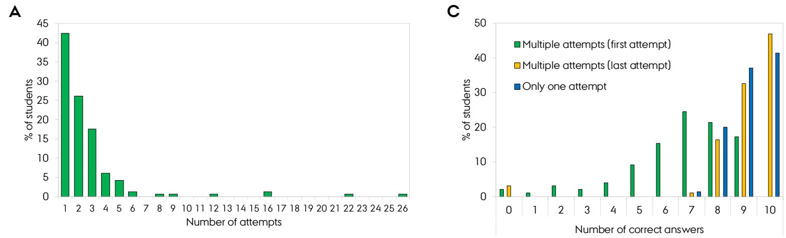
Previously, assignments only consisting of essay-like questions were carried individually by the students in class. However, to reduce time spent by the teaching assistants providing the students feedback on the assignments some of the assignments have previously been exchanged with multiple-choice quizzes still answered by the students individually in class. Notably, due to too many questions in the multiple-choice quizzes the students were stressed by the pressure of time. Hence the purpose of this learning design is 1) to assist the students in revising the curriculum regularly during the course without the stress experienced by some students in connection with assignments and tests carried out in-class and 2) to reduce time spent by the teaching assistants out-of-class giving feedback on assignments consisting of essay-like exercises.

Learning design and Educational-IT

The students were asked to answer a multiple-choice quiz consisting of ten questions in Blackboard. Hence, this learning design is based on the SAMR model for integration of technology in teaching. In addition to traditional multiple-choice questions the assignment also consisted of the question types 'multiple answers', 'fill in the blank', 'multiple fill in the blank', 'matching', and 'ordering'. Hence, all possible types of multiple-choice questions that the students can meet at the exam were present. To promote revision of the curriculum the students were allowed to answer the questions as many times as they wanted to. However, only the last attempt was counting. Moreover, the students were beforehand informed that approval of the assignment required eight out of ten correct answers. After each attempt to answer the entire assignment, the students were provided feedback consisting of references to chapters in the text book describing the correct answers. For each new attempt to answer the questions the possible answers were shown in a new random order. The quiz was made available for the students for 24 hours and they were allowed to do the quiz at home either alone or together with peers. During this period of time the main lecturer and one teaching assistant were available for one hour for students having difficulties understanding or answering one or more questions. Within the first week after completion of the assignment two times 45 min of theoretical exercises were allocated questions to the assignment and the curriculum in general. Thereby, this learning design is connecting the assignment done out-of-class with follow up in-class activities according to the ideas of Flipped Classroom, 'Science and Technology Rethinking education through Educational IT towards Augmentation and Modification' (STREAM), and 'Just-in-Time Teaching' (JiTT). A schematic representation of the learning design is shown in Figure 1.

Indicators of impact

To evaluate the outcome of the learning activity, data was extracted from Blackboard. 41.7% of the in total 168 students only did the assignment one time (Figure 2A) and 98.6% of theses obtained an approved result (Figure 2B). Of the students accessing the assignment more times (2-26 times) (Figure 2A), 61% percent of these students did not obtain eight or more correctly answered questions in first attempt (Figure 2B). However, 95.9% of these students ended up getting their assignment approved. Finally, the data shows that only 72.1% and 83.6% of the students ended up correctly answering question 1 and 9, respectively, whereas more than 90% of the students were able to answer the remaining questions correctly (Figure 2C). Hence, the subjects in the curriculum covered by these two questions are obvious candidates for further revision at the theoretical exercises allocated for this purpose. The students stated that they liked the format of the assignment which had made them aware of the specific parts of the curriculum they needed to study further. Moreover, one of the teaching assistants experienced at theoretical exercise allocated for follow up that the students primarily had questions regarding question 1 and notably, did not requested further in class time for revision of the curriculum.



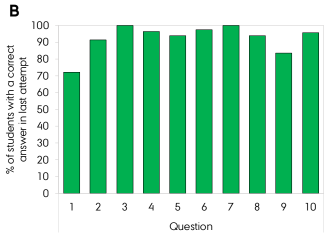


Figure 2. Data extracted from Blackboard. A: Number of times the students answered the assignment. B: Number of correct answered questions the students obtained in their first and last attempts. The graph also shows the number of correct answers for the students using only one attempt to answer the assignment. C: Percentage of students answering the individual questions correctly in their last attempt.

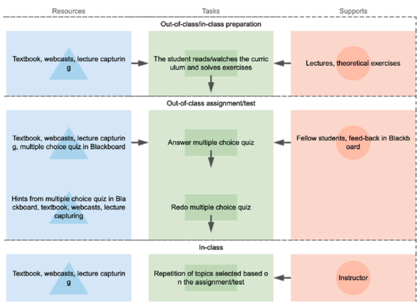


Figure 1. *LDTool representation of the learning design.*

Lessons learned and looking forward

In conclusion, this learning design has assisted students in revising the curriculum. Notably, this was obtained despite a significant reduction in time spent by teaching assistants providing feedback on assignments out of class which hopefully in the future will result in more in class time with the students. However, for future use I would include one or two essay-like questions that of cause requires manual feedback to the students from the teaching assistants but will make the assignment more exam-like. Moreover, I would include other kinds of material than the text book as hints. This could be links to webcasts based on for example parts of recorded lectures. Notably, the assignment could also be included as a part of the exam.

References

Biggs, J. (2012). What the student does: teaching for enhanced learning. *Higher Education Research & Development, 31*(1), 39-55. doi:10.1080/07294360.2012.642839
Godsk, M. (2013). STREAM: a flexible model for transforming higher science education into blended and online learning. *E-Learn 2013.*
Novak, G., & Patterson, E. T. (2010). An Introduction to Just-in-Time Teaching (JiTT). *Just-in-Time Teaching: Across the Disciplines, and Across the Academy. Simkins, S. P., & Maier, M. H. (Eds.). Stylus Publishing, LLC.*
Puentedura, R. (2010). SAMR and TPCK: intro to advanced practice. *http://hippasus.com/rrpweblog/ rubenrp@hippasus.com.*

EDU-IT role and benefits
In the learning design various kinds of multiple choice questions available in Blackboard were used. Moreover, the ideas of Flipped Classroom, STREAM, and JiTT were implemented.

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Aktiveret undervisning

Martin Markvard Knudsen
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Nøgleord:
Screencast, mentimeter, test, flipped classroom, just in time teaching

Om kurset

Kurset organisk kemi og biokemi er et 2. semesters kursus for bioteknologistuderende på Ingeniørhøjskolen. Kurset vægter 10 ECTS. Kurset består af 2x4 timers moduler pr. uge fordelt over 14 uger. Der er to undervisere tilknyttet kurset, en som dækker biokemi og en som dækker organisk kemi.

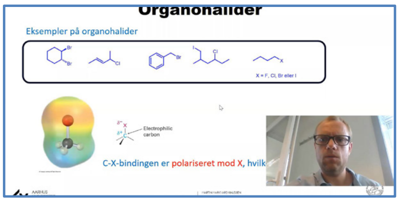
Learning IT

Brugen af IT er en integreret del af kurset. Her følger nogle eksempler på IT i undervisningen:

Screencast:
På blackboard ligger der screencast, der understøtter undervisningen. Screencasts er præoptagede videoer, som de studerende kan tilgå, når det passer dem. Følgende emner er dækket med screencast:

- Gennemgang af vigtige opgaver
- Repetition af tidligere undervisning
- Defenition af nøglebegreber

Screencast opfylder ønsket om fleksibilitet i tid, sted og hastighed. De studerende kan selv bestemme, hvor, hvornår og hvor hurtigt materialet skal gennemgås.



Mentimeter:
Mentimeter bruges til forskellige ting i undervisningen:

- Quizzer i løbet af undervisningen

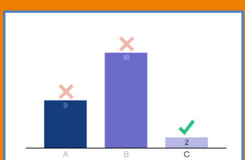
For at aktivere de studerende lægges der en del mentimeterquizzer ind i undervisningen. Quizzerne understøtter de studerendes læring ved at skulle tænke selv, og de giver mulighed for think-pair-share.

- Test af de studerende før undervisning

For at få en ide om, hvad de studerende har forstået eller finder svært, er der lavet mentimeterquizzer i pensum. Ud fra testresultaterne kan man som underviser se, hvad der er svært og let for de studerende og tilrettelægge undervisningen efter dette. Dette fører over i just in time teaching.

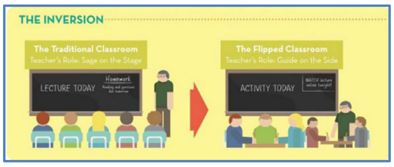
Just in time teaching

Som en del af forberedelsen skal de studerende tage en quiz i pensummet til undervisningsgangen. Ud fra resultaterne kan underviseren se, hvad de studerende har let og svært ved og derved tilrettelægge undervisningen, så der lægges mere fokus på de emner, de studerende har syntes var svært.



Fliped classroom og træning i mundtlig eksamen

I undervisningen stilles der opgaver, som de studerende skal løse individuelt eller i grupper. Efterfølgende skal de gennemgå opgaven samt løsningen på tavle for andre studerende. Dette lægger sig op af flipped classroom, hvor de studerende selv skal forklare indholdet i pensum. Desuden understøtter det også de studerendes forberedelse til eksamen, idet eksamen er en mundtlig eksamen

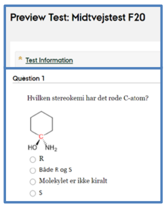


Pædogiske udfordringer

De studerende skal til mundtlig eksamen. Dette er en udfordring, da de ikke i væsentlig grad har været til mundtlig eksamen før på universitetet. Derfor er en væsentlig del af opgaveregningen lagt over til gruppearbejde, hvor de studerende skal fremlægge opgaverne mundtligt for hinanden. Derved trænes den mundtlige fremlæggelse, der skal bruges til eksamen

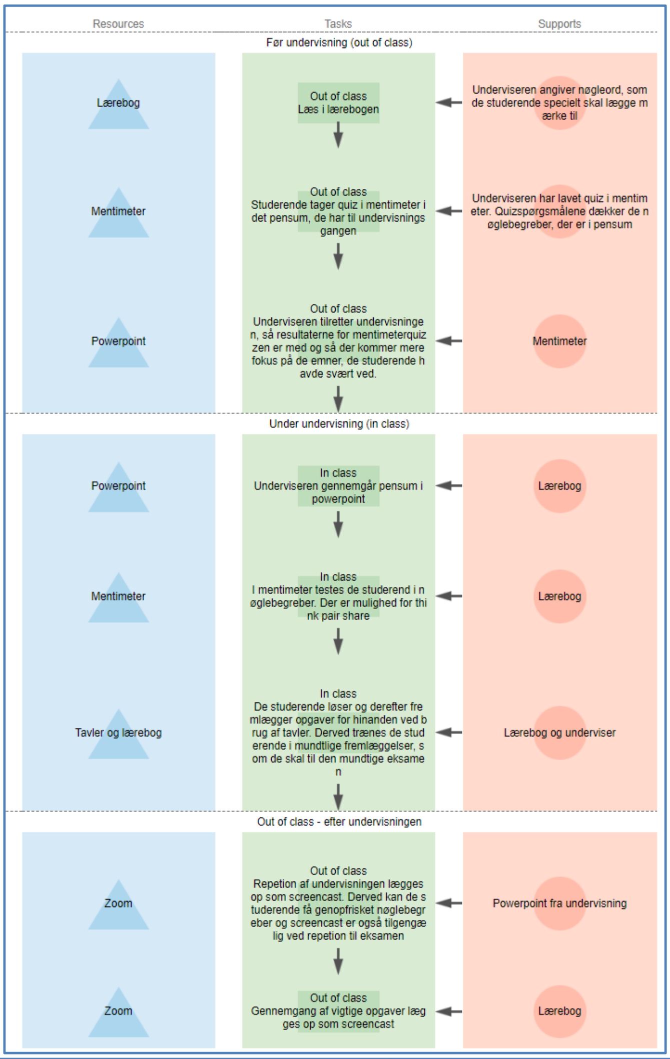
Midtvejstest

Halvvejs i kurset ligger der en multiple choice midtvejstest. Testen har til formål at træne de studerende i pensum og sikre, at de får repeteret allerede gennemgået pensum.



Aktiviteter i og omkring undervisningen

De forskellige aktiviteter beskrevet på denne poster er alle med til at støtte op om de studeredes læring. Nedenstående figur viser, hvilke resource, der skal til for at understøtte aktiviteterne. Figuren viser også, at en del af aktiviteterne foregår out of class.



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Flipped classroom for simulation software instructions

Michael Dahl Knudsen
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Keywords*: Simulation software; Lectures; Flipped classroom; Screencasts; Multiple-choice quiz; Discussion forum*

Context

Education: *Civil and Architectural Engineering*
Course title: *Simulation of Building Energy Systems*
Workload: *5 ECTS*
Level: *Master*
Class size: *10-20 students*

This course has previously been taught as traditional class room lectures. However, some of these lectures are better taught using a flipped classroom strategy and the presented learning design is intended for those lectures.

Learning outcomes and purpose of learning design

This learning design is intended to be used for seven lectures on the building simulation software EnergyPlus. Each lecture is identical in structure, but focus on different topics. For instance, one topic is Ideal Loads Air Systems (ILAS) which is used as example in this presentation. The learning outcomes of the lecture are then:

- Learn **basic theory** behind ILAS
- Learn **how to** model an ILAS in EnergyPlus

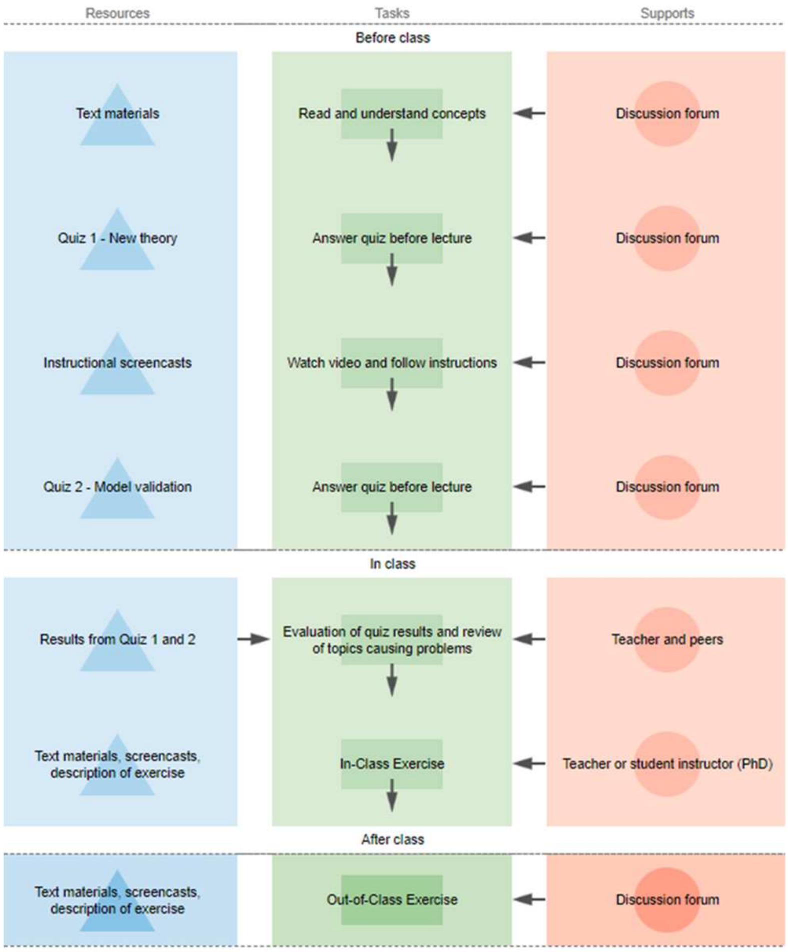

Figure 1. LDTool representation of the learning design

EDU-IT role and benefits

The flipped classroom strategy will be supported by instructional screencasts and tests/quizzes before class and a discussion forum after class.

Pedagogical challenge/purpose

This course teach how to use a simulation software tool. It is challenging to give instructional guidance in class because:

1. The pace is different for each student.
2. It is difficult to take notes

Flipped classroom and before class screencasts solves these challenges.

Learning design and Educational-IT

Figure 1 show the learning design which is based on the flipped classroom strategy. Readings as well as theoretical lecturing and software instructions are before class activities. This is facilitated by recording webcasts of theory and screencasts of software instructions. Quizzes and tests are then used to provide immediate feedback to the students and insights to the teacher on trouble spots.

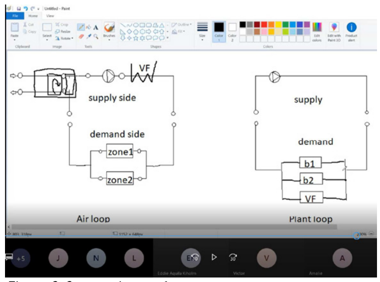

Figure 2: Screen dump of screencast.

In class activities are mainly dedicated to exercises where the teachers role is to guide students on individual problems.
After class activities will be relatively small exercises that extends In-class exercises and they will be released a few days after class. The purpose is to get the students to review/refresh the topic after class.

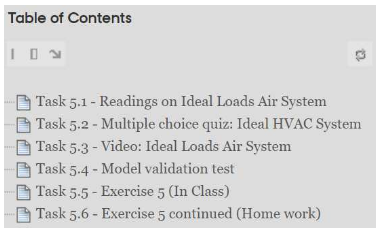

Figure 3: Screen dump of blackboard content.

Lessons learned and looking forward

At first it was difficult to make students engage in the discussion forum. Therefore, it was necessary to make it an explicit exercise to post at least one question as well as answer or comment at least one question every week. It is important to make this mandatory from day one to obtain an active forum.

Introduction to teaching at ENG

Stine Kristensen, PhD
Study planner

Keywords: *supervision, educational system*

Pedagogical challenge/purpose

As a newly employed assistant professor your often facing a lot of challenges, both on how to start or continue your research carrier in a new country but also how to teach in a new place, where the tradition and regulations differs from what you are familiar with. This workshop aims for lowering the barrier for starting teaching and should give the attendants a good fundament for starting a balanced research and teaching carrier at AU.

Context/course facts

Department of Engineering is expanding and hence several new researchers are constantly being hired. Many of those comes from abroad and is not familiar with the Danish educational system and comes with different experience with teaching. In order to give the newly researcher a good start with teaching and make sure they are aware of the Danish regulations, this new course is being developed. The course is composed of a small series of meetings designed for newly employees at ENG. It is expected that min. 5 employees will follow the workshop each year.

Learning outcomes and purpose of learning design

The purpose of the course is to give a basic introduction to teaching at a Danish university and the different regulations but also to make the teachers reflect on different teaching methods.

Learning outcome:
- Understands the Danish education system and the different relevant regulations
- Obtaining an overview of different teaching methods
- Reflection of the different teaching methods
- Understanding of how different digital learning materials can support the learning environment.

Learning design and Educational-IT

The learning design is using both in-class and out-of-class activities. The out-of-class activities contains different materials such as videos, legal documents and materials about the study program. The in-class modules are individual face-to-face meetings, where the new teachers are asked to reflect over the out-of-class activities. We will also go through al the different documents and webpages relevant for their teaching.

Learning design

The overall structure of the learning design is depicted in figure 1

1. The newly employed will view a few videos on the Danish education system, roles and regulations.
2. The newly employee will answer a small survey about the Danish educational system and their teaching experience. The survey will establish the basis for the first meeting.
3. The newly employee will watch different videos on educational-IT and talk with other teachers about pros and cons with teaching methods. He/she will reflect on this and how it can be incorporated in the appointed teaching
4. Meeting, where we will discuss the different teaching methods and figure out where the need of assistance would be.

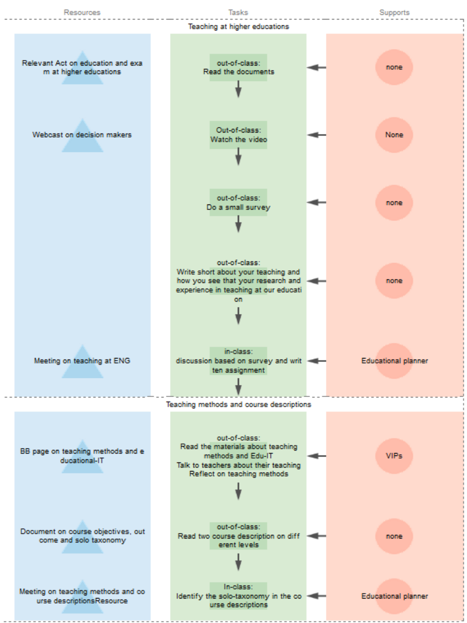

Figure 1. *LDTool representation of learning design*

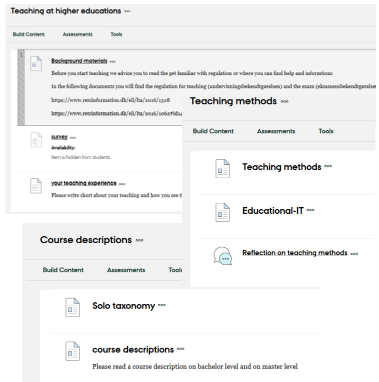

Figure 2. *screen shoot from the Black board page*

Indicators of impact

Due to Covid-19 it has not been possible to execute the introduction to new teachers. The purpose is to have a discussing after each semester, where we will talk about how the teaching have been, which information was missing and if this course has been helpful. Before the final meeting the teachers will be ask to reflect on the following questions:

1) Has this course been beneficial
2) Has you implemented new teaching methods based on the knowledge from this course?
3) Which elements were missing

Lessons learned and looking forward

Due to the fact that the course has not been possible to run due to Covid-19 it is not possible to describe the lessons learn, but the hope is that teacher will fell more comfortable starting teaching as they will get a basic understanding of teaching at ENG and know who to contact whenever they have any questions. I expect that the course will undergo a continuous development as I learn the teachers challenges.

References

https://needle.uow.edu.au/ldt/ld/tiMzpMC1

EDU-IT role and benefits

The digital learning materials that will be used in this course will be webcast and Black Board surveys. The webcast is a flexible way of learning whereas the surveys will be used as a fundament for the face-to-face meetings as it will give me understanding about persons previous teaching experience and knowledge about the Danish educational system.

Learning Biochemistry by use of guidance questions

Morten Krog Larsen
Assistant Professor, Aarhus School of Engineering, Aarhus University

Keywords: *Biochemistry ; lecture/theoretical exercises ; Virtual learning design ; STREAM based working model.*

BI2-OBK - Course facts

Background:
The introductory course in organic chemistry and biochemistry (OBK) was born out of limitations in the study plan for the biotechnology students. In particular, the maximum number of exams a student can be faced with at the end of a semester did not accommodate introduction to the disciplines early enough in the education. This was a significant decision-maker for merging the two disciplines.
The hybrid course OBK covers 10 ECTS point and has a diverse curriculum. Both the organic chemistry and biochemistry curriculum cover the basic topics of the disciplines. A number of common grounds of concepts argues for a rationale to merge the two courses and merging the topics solved the problems described above.

Learning outcomes and purpose of learning design

I took over the course for the first time in 2020 and to be fair the semester did not develop in the intended manner. Mainly due to outside circumstances which forced the small class teaching to be conducted via Zoom. Although, overall a success, a number of didactic choices had to made a long the way of the course.
Overall aim is to build a foundation in organic and biochemistry. In addition, ideally to bridge the two disciplines in relevant focal points, thereby cross-fertilising the conceptual understanding. One such example, is the emphasis on being able to describe the shape of biomolecules by addressing the hybridisation of the carbon atoms. This has allowed the students to see the biochemistry in the light of organic chemistry and connecting the two subject areas.
The feedback states that it has been well-received albeit we need to address the order in which the topics are organised to maximise the cross-fertilisation.

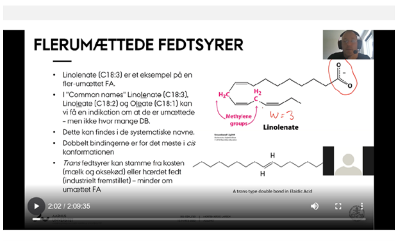

Figure 1. *Screendump from topic lecture in Biochemistry via Zoom*

The first learning design was simply to adapt the findings described in Bligh DA, of Bassey 1968 in which testing of material described in a lecture effects the students ability to recall the information given.
However, with the change of format the approach was less meaningful and a second learning design was developed based on the STREAM model (Godsk, M.) . The inspiration was to make sure the students were sufficiently activated during the sessions, as the "dosing-off" effect was more pronounced by the remote lecturing. This was solved by minimum amount of lecturing and emphasis on group work based on problem solving.

Learning design and Educational-IT

In figure 2 the first learning design is depicted. As mentioned above the design proven less meaningful to conduct as small class teaching activies turned to be conducted in an on-line environment.
In short, the scheme address via multiple choice test (MCQ) how well the student recalls the previous lecture topic and thus guide the student to evaluate his/her standpoint during the course.

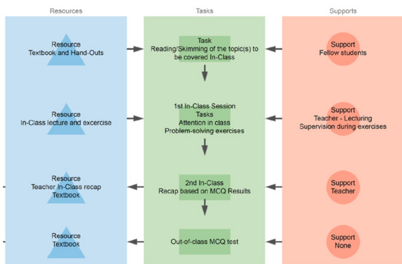

Figure 2. *LDTool representation of learning design 1 inspired by Bassey 1968 https://needle.uow.edu.au/ldt/ld/PlNyJzkK*

Design 2 was the design of choice when face-to-face small class teaching was affected. The out-of-class activities prior to small class teaching remained fairly the same, as in normal reading of textbook chapters.
In class, however, a more constant activity level was maintained through-out the 3-4 hours as approximately 70-80 % of the time was spent working a series of guidance question aiming to nuture the understanding of the topic at hand.
The group work was organized as 3-4 person group allocated to their own break-out room in Zoom. I could then visit each room to support their progress and embark in discussion and chats around the subject. The set-up proved very useful indeed.

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, the tools provided for on-line teaching were well organized and adequate during the lock-down period. I am pleased that we had the EDU-IT course fresh in mind as the adaptation more augmented IT based teaching environment appeared smooth.

Pedagogical challenge/purpose

Give a short description of the pedagogical challenge you are addressing in your learning design?
The challenge has been multiple during the Spring Semester of 2020 due to COVID-19. A different learning-design, from that initially intended, was implemented based on supervisor assisted group work. This allowed students to work through the curriculum at the pace of their group, yet maintaining weekly routines by offering fixed meeting times with peers and supervisor.

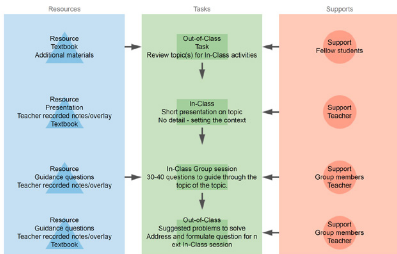

Figure 3. *LDTool representation of learning design 2 adapting the STREAM model https://needle.uow.edu.au/ldt/ld/83k0lg81*

Indicators of impact

Describe how you monitored/assessed/evaluated your students learning outcomes during the activities.

Admittedly, I underestimated the efforts needed to get good solid metrics from the students and so the feedback was their more or less sporadic written chats in Zoom. However, it was clear that the conceptual design was working as intended with the intended outcome.
Feedback stated that for further improvement one would need to prepare full written answers to the guidance question as the students in general do not trust their own judgement.

Lessons learned and looking forward

Describe briefly the main lessons learned and future plans for the use of educational technology and development of the teaching practice.
As stated above the organization worked reasonably well to continue the scheme. However, a written guide to the guidance questions is needed.
In addition, the two learning designs could in principle be combined for potential additive effects on the learning outcome.

References
Bligh DA, (1998), What´s the use of Lectures?, Intellect Books, p. 46f
Godsk, M. 2013. STREAM: a Flexible Model for Transforming Higher Science Education into Blended and Online Learning. ELearn 722-728

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Transforming a Teaching Module Consisting of Lectures and Associated Exercises Using the STREAM Model

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Blue Man MSO, PhD, Team Leader, Academic Employee
Department of Molecular Biology and Genetics, Aarhus University

Keywords: *Molecular Biology; RNA; lectures; theoretical exercises; STREAM; Mentimeter; Blackboard; Pencast*

Pedagogical Challenge and Purpose

Restructuring the introductory module for the course 'RNA molecular biology'

The introductory module serves the purpose of introducing a technology that is used in the majority of contemporary scientific articles. The pedagogical challenge is to make the content more easily digestible for the students, such that they actually understand the technology before they start reading articles where it is used.

Course Facts and Context

'RNA Molecular Biology' is a 10 ECTS theoretical course dealing with the most recent advances in the field of RNA molecular biology. There are app. 24 students at Masters or PhD level.
The introductory module, which is under scrutiny here, has traditionally consisted of 5x45 min lessons (2x45 min lecture, 2x45 min theoretical exercises, 1x45 min student presentation).

Purpose of Learning Design

The purpose of this learning design is to transform an existing quite heavy, theoretical and passive lecture and exercise module on Next Generation Sequencing (NGS) technologies and their usage to study RNA into a much more active, almost-hands-on and learning-by-almost-doing learning experience.

Most contemporary scientific articles concerning RNA contain some variant of an NGS experiment, but the students have generally only obtained a peripheral knowledge about the technology during their studies. Thus, it is necessary to conduct a crash course on NGS technologies early on in this course.

Intended Learning Outcomes

- Describe and explain the underlying technologies behind the three main NGS platforms (SOLO taxonomy level 3)
- Design a strategy for construction of a DNA library, based on RNA as the starting material, that is compatible with sequencing on the Illumina NGS platform(s) (SOLO taxonomy level 4)
- Develop an RNA enrichment strategy based on the most common physico-chemical features of various RNA types (SOLO taxonomy level 5)

Learning Design and Educational-IT

The restructuring will concern the lecture and theoretical exercises, which will be merged into one 3x45 min session with increased out-of-class activities. In the long term, I wish to dedicate three modules (over three weeks), rather than only one, to this topic in order to enable the students to get a real understanding of these important technologies. Here, I will only describe the one module where I did start the restructuring process.

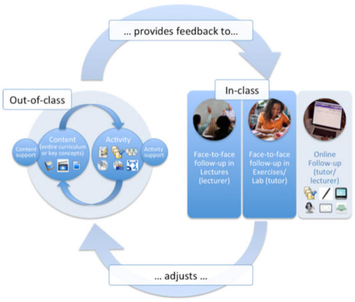

Figure 1. *The STREAM model (from Godsk, 2013)*

The design is based on the STREAM model (Godsk, 2013) **(Figure 1)**, which includes active learning and draws on models such as 'Flipped Classroom' and 'Just in time teaching', and is build up as follows:

(1) Most curriculum acquisition takes place out of class before the lecture by reading review articles and watching videos supported by various activities including multiple choice quizzes on Blackboard **(Figure 2)**.
(2) The classroom session falls in three parts: First, there is a short classical lecture including a thorough follow-up on the aforementioned quizzes. Next, there are group discussions related to a specific set of questions and finally the session is wrapped up by the groups producing a 'pencast' that describes a widely used procedure for sample preparation for next generation sequencing of RNA.
(3) After the lecture, there is a brief follow-up on the pencasts, and, subsequently, submission of group assignments that are first evaluated by peers and since by the lecturer.

During the full in-class session, the students can anonymously ask questions related to the topic via 'open-ended' in Mentimeter.

The detailed structure of the learning design is illustrated by use of the LDTool **(Figure 3)**.

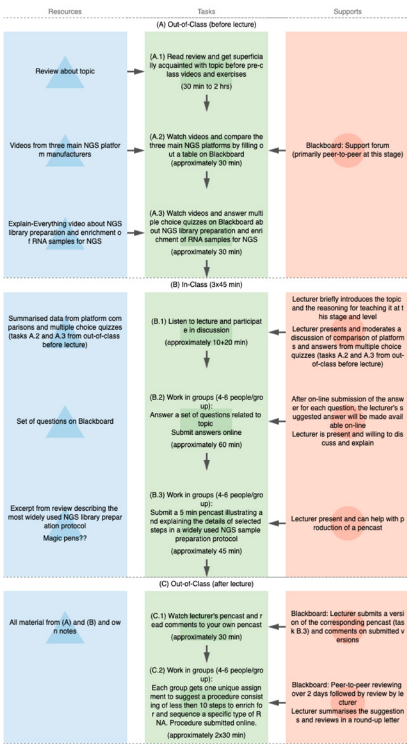

Figure 3. *LDTool representation of learning design*

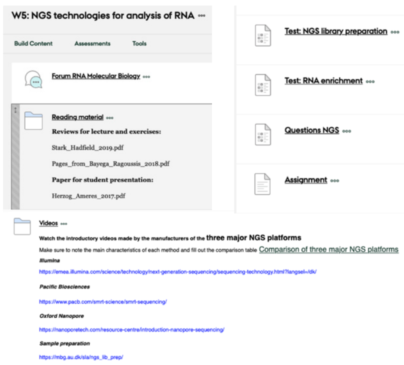

Figure 2. *Screen shots from the module's Blackboard page*

Indicators of Impact

The learning outcomes will be monitored by the following means:

(1) Pre-lecture activities on Blackboard (A.2-A.3)
(2) Discussions during lecture (B.1)
(3) On-line answers to questions fitting to ILOs (B.2)
(4) Pencasts (B.3 + C.1)
(5) Student assignment (C.2)
(6) Anonymous questions and assessments in Mentimeter **(Figure 4)**

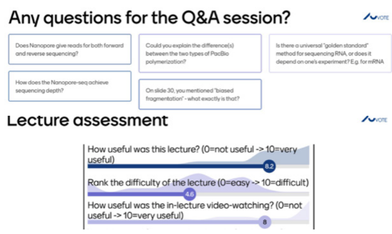

Figure 4. *Examples of usage of Mentimeter*

Lessons Learned and Looking Forward

My experiences from restructuring this module has been generally very good. I learned that breaking up the traditional lecture format was harmless and fairly easy to do. Moreover, allowing the students time to reflect, discuss and ask questions during and after the lecture proved very beneficial for both the students (as assessed by Menti-rating) and for me. In relation to that, Mentimeter turned out to be a very useful and easy-to-use tool. We realized that the possibility to be anonymous through 'open-ended' in Mentimeter improved both the quantity and quality of questions asked in class. Therefore, I will continue to use and develop on the mentioned elements in my future teaching activities.

EDU-IT: Role and Benefits

The learning design uses the following digital learning tools, which help to diversify the teaching experience and support better learning:
(1) Blackboard course page, discussion forum as well as various quizzes and questionnaires **(Figure 2)**
(2) On-line videos
(3) Mentimeter (word-cloud, open-ended, multiple-choice, scales, ranking, …) **(Figure 4)**
(4) Pencasts

Reference

Godsk, M. (2013). STREAM: a Flexible Model for Transforming Higher Science Education into Blended and Online Learning. In T. Bastiaens & G. Marks (eds.), Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2013, (pp. 722-728). Chesapeake, VA: AACE.

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Motivational activity for theoretical exercises

Eva Egelyng Sigsgaard
Postdoc, Department of Biology, AU

Keywords: *biology; theoretical exercises; educational IT; deep learning*

Pedagogical challenge/purpose

In today's larger and more diverse university classes, an important pedagogical challenge is to create a learning environment, where all students are likely to use higher order learning processes and thereby obtain deep learning (Biggs, 2012)

Context/course facts

This project concerned two theoretical exercise sessions out of a total of 15 such exercises in the course Genetics and Evolution. The course is a 10 ECTS, BSc level course and consists of lectures, theoretical exercises, lab exercises, and a small project. As an instructor, I taught four teams of 20-25 students per theoretical exercise.

Learning outcomes and purpose of learning design

Since the theoretical exercise sessions are three hours long and focus on a single type of activity (answering written exam-style questions), I hypothesized that a different type of activity halfway through a session might improve student motivation and learning. I specifically wanted to take advantage of the potential of educational technology to engage students in a variety of ways and develop student's abilities to link theoretical and practical aspects (Price & Kirkwood, 2011). My aim was to increase deep learning through an activity that i) had a clear objective, ii) improved motivation, iii) encouraged dialogue, and iv) provided freedom to focus on the task (see Biggs, 2012). I expected that the students would experience an improved motivation and understanding of the relevant topic, due to the more varied and practice-oriented learning approach.

Learning design and Educational-IT

The first activity consisted of a 15-min. simulation exercise about random genetic effects (Figure 1). I gave a short presentation explaining the learning goals and time frame of the activity, the details of the simulation itself, an overall question to consider during the activity ("How are small populations affected by random genetic effects compared to large populations?"), and some suggestions for what to try out in the simulation. By informing the students in advance of the time plan and by choosing an "explorative" activity, I hoped to provide an environment in which the students felt free to focus on the task without stress (see Biggs, 2012). To encourage collaboration and dialogue, I asked the students to perform the activity in groups of two or three, and I went around to the groups during the activity to help out or ask questions.

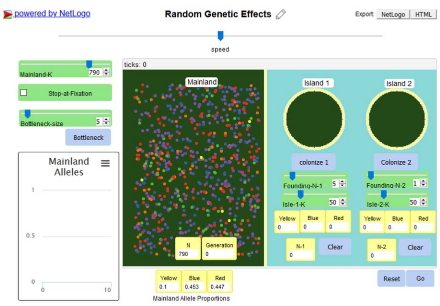

Figure 1. *Screenshot of the online simulation exercise.*

After 10 min., I asked the students to consider again the question posited in the beginning. This question was directly connected to the theoretical exercise questions that the students had been working on in- and out-of-class, and which they would be presenting after the activity. Thus, the students were able to rehearse the same theoretical concept immediately, which has been found to be much more effective than rehearsal after longer time periods (e.g. Bassey, 1968).

For the second activity, I did a 10-min. powerpoint presentation about my own research on environmental DNA (eDNA). I started the presentation by explaining the connection to the current course topic, and then explained the significance of my research field for current societal challenges and basic biological research. I then presented a specific challenge (design of eDNA metabarcodes), which we face repeatedly in my field, and asked the students to answer three Menti questions about this. Lastly, we discussed the Menti questions and I encouraged the students to ask any further questions. Due to the Covid-19 situation, the teaching sessions were conducted remotely for all except the first team of students in the first week. Thus, the online simulation activity was conducted out-of-class for three out of four teams, and the eDNA activity was conducted via the video meeting software Zoom.

I developed a learning design to support my teaching experiment (Figure 2).

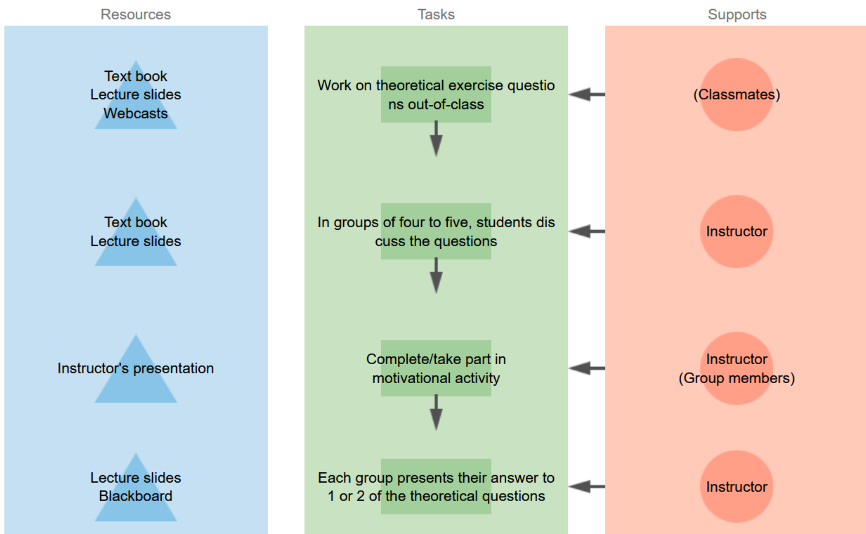

Figure 2. *LDTool representation of learning design used in motivational activity*

Indicators of impact

I asked the students to respond to a short Menti survey about each activity and also evaluated the results of weekly Blackboard quizzes organized by the course coordinators. A clear majority of the students experienced that the activities improved their motivation and understanding to some degree. Figure 3 shows the results of the survey for the first activity. The students performed well on relevant quiz questions.

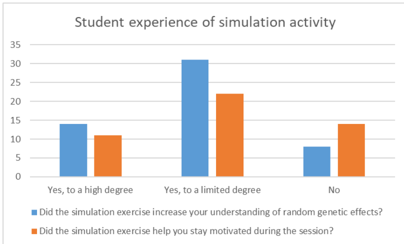

Figure 3. *Results of Menti survey on simulation activity*

Lessons learned and looking forward

Finding a short motivational activity that is appropriate both in content and academic level can be challenging. Importantly, the activity can be at a relatively basic academic level compared to the course level. In future, I will consider asking the students to form hypotheses for outcomes of the online simulation.

EDU-IT role and benefits

The simulation used in the project is an online interactive illustration of random genetic effects available for free from the educational resource Virtual Biology Lab at: http://virtualbiologylab.org/NetWebHTML_FilesJan2016/RandomEffectsModel.html

References

Bassey, Michael (1968). Learning methods in tertiary education. Nottingham Regional College of Technology, internal paper

Biggs, John (2012). What the student does: teaching for enhanced learning, Higher Education Research & Development, *31*:1, 39-55

Price, Linda and Kirkwood, Adrian (2011). *Enhancing professional learning and teaching through technology: a synthesis of evidence-based practice among teachers in higher education.* Higher Education Academy, York, UK

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SCIENCE TEACHING COURSE POSTERS BY PHD STUDENTS

Confidence and understanding

- How removing the computer from students might enhance their presentation skills and understanding

Learning Lab

Abstract:
Solving exercises and using the gained knowledge to reflect and understand broader scientific concepts are valuable skills for every student at Aarhus University. However a focus on the "perfect performance" sometimes prevents the students from a free reflection and use of their acquired skills. This teaching activity aims to enhance the student presentation and reflection skills by removing the computer they hold in front them. Students found this activity inspiring and fun, but I need a better way to assess the actual improvement.

COURSE FACTS

- Course name: Genetic and Evolution
- Level: Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 25
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

Every week students in groups are encourage to present the exercises they have solved, in front of their class. This often involves some persuasion and a lot of giggling from the performing students. Sometimes the students are so focused on giving the correct answer or calculation, resulting in the students holding their computer in front of them for "shelter", using the computer as a teleprompter. With the excuse that they cannot remember the exercise/answers. This often leads to a vague and locked performs without the students actually showing that they understand certain calculations, figures or key concepts. Its important to solve this problem because it helps the student to reflect on their learning and thereby improve their understanding.

2. Planning a teaching activity

This teaching activity aims to help the students apply their newly gained knowledge and show that they can reflect and use key concepts to understand a figure.
This activity is held when the students normally present their results from the prepared exercises. Removing the computer from the student presentation force them to stop reading and start thinking. The learning outcome of this activity should be for the student to make a presentation without their computer and

3. Trying it out in practice

This learning activity was tried in two out for four classes. Students were clustered in groups of 3-5 people. Working on and comparing the results for exercises. As a TA I walked around the class to help clarify issues regarding the exercises, I could then select a group that was representing the "mean" level of the class and I prepared them on what was coming. The group went to the blackboard and started to present their results all having their computer in front, but when they reached the selected figure they removed their computers and tried to explain the figure without looking into the computer for answers, I asked the questions needed to cover key concepts.

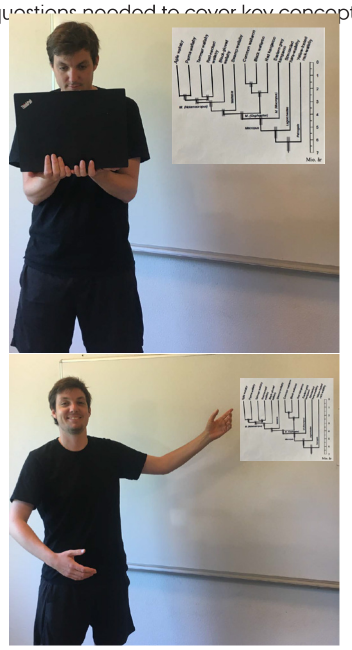

Figure 1: Two types of presentations the "common type" (top) and the "induced type" (bottom)

MAIN POINTS

1. **Main problem/challenge:** Bad presentation habit leads to a reduced reflection of key concepts and themes
2. **Teaching activity**: Students are forced to present a specific figure without their computer
3. **How did it go?** Students became more relaxed in front of the class and subjectively better at reflecting and using their acquired knowledge when reading a figure
4. **What to do next?** Do it again next year, and use a Menti-questionnaire to assess student learning outcome.

Evaluation

Unfortunately it was only two out of five of the presenting students that took the lead and became engaged in this teaching activity, the three others were standing passively.
Several classes were doing the same presentation two as the "common type" and two as the "induced type" (Figure 1). I could subjectively see a better performance from the students that was presenting the figure as the "induced type" compared to the "common type", further I asked the spectating part of the class and several answered that they got a better understanding of the figure and found the presentation more engaging. The presenting students felt some degree of insecurity doing the presentation, but felt that it was an interesting experience.

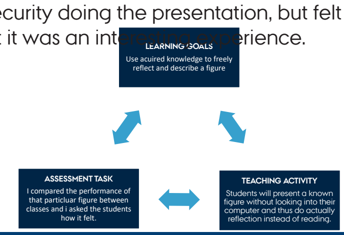

Figure 2: **Constructive alignment**
Illustrates the connection between learning goals, teaching activity and assessment task.

4. Looking forward

It was often the same type of student with a strong and secure knowledge that took the lead of the presentation, so I need to find a way where all students try to present.
Its extremely important that the student feel that it's a safe environment, and the TA is responsible for creating this atmosphere. This can be implemented as a part of TØ for many courses across disciplines. Future assessment will be done using a Menti-questionnaire.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Sune Agersnap
Department of Biology

Identifying and improving students' weakness points
- In practice

Learning Lab

Abstract:
One the first day of teaching I told the students that it is not an easy course, So you should practice a lot to be able to pass the exam. In this way, I pumped lots of enthusiasm toward them to help them take the course more seriously. But, in the middle of the semester, as the number of topics increased, I felt a panic among the students about their level of dominancy. So, I planned a teaching activity to help them retrieve their self confidence.

COURSE FACTS

- Course name: Electrodynamics
- Level: Bachelor
- ECTS credits : 10
- Language: English
- Number of students: 22
- Your role: Instructor

TEACHING IN PRACTICE

1. Identifying a problem

Electrodynamics is one of the heaviest courses that physics students take during their bachelor program. Students study and practice numerous topics during the semester and they usually feel quite unsure about their problem solving abilities at the end of semester.
In this paper I've reported my attempt to find the students' points of weakness and help them increase their self confidence when they face similar problems.

2. Planning a teaching activity

The activity is planned for two weeks as follows. At the beginning of the first week, I made an announcement and told the students that they have one week to review the materials that we covered previously. Then, I asked them to select some assignments that they find relatively hard or challenging to solve and post them as feedbacks through the blackboard system.
After that, I organized a meeting with the course's lecturer to analyze the feedbacks and identify the topics that are reported more by the students as a challenge.

3. Trying it out in practice

Knowing the points that students are struggling with, I could manage to select four problems that effectively cover the reported problems.
At the class, First I gave the students a short lecture using a presentation file to recap the critical points needed to solve the exercises. Then, I introduced the exercises, divided the class into four groups, and assigned an exercise to each one.
I used a jigsaw method to make sure that all the students have enough opportunity to discuss all aspects of the solution with me and the others.

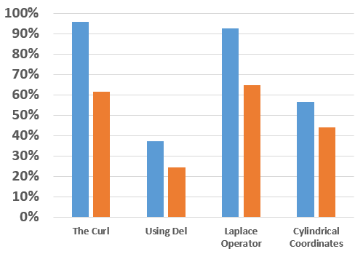

Figure 1: Students' answers to this question: "How sure are you that you can solve problems from this topic?", at the beginning of the session (orange), at the end of the session (blue)

3. Assessment

At the beginning of the session, before the lecture and also at the end of the session, I asked them to grade their level of dominancy on different topics. The survey was held anonymously. The results (Figure 1) showed that the activity helped them to increase their problem-solving ability by almost 30 percent.

MAIN POINTS

1. **Main problem/challenge:** Identifying and improving students' weakness points and increasing their self-confidence.
2. **Teaching activity**: An online survey about weaknesses, a short lecture, jigsaw problem-solving
3. **How did it go?** Students reported that they feel more dominant after the activity.
4. **What to do next?** Feedback the weaknesses to the next semester instructor to focus on more.

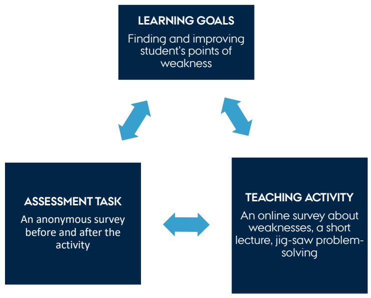

Figure 2: **Constructive alignment**

4. Looking forward

Reporting the weakness points to the instructor of the next semester can help him/her a lot to know which topics should be taken more seriously. This would lead to a stronger alignment between teaching methods and learning goals in the next semesters.

References

https://www.teachhub.com/jigsaw-method-teaching-strategy

https://www.sydney.edu.au/education_social_work/groupwork/docs/ConstructiveAlignment.pdf

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Lab exercises - Do students really read through the protocols? How prepared they come? A strip-sequence activity

Learning Lab

Abstract: When students have Laboratory Exercises in a practical course, they are given beforehand a protocol with some initial introduction of the experiment, the details of it and a list of to-be-answered questions for a further report. Most of the times, if the students read through the protocol before entering the lab, they don't do it thoroughly. This causes some drawbacks: a delay on the scheduled timetable, a reduced understanding of the experiments and unwanted errors. Here, a solution to these is presented. Before entering the lab, students will perform a *connect the statements/strip sequence* activity which will engage their learning and perform a better experiment.

COURSE FACTS

- Course name: Biofabrication
- Level: Master
- ECTS credits : 10
- Language: English
- Number of students: 15-20
- Your role: Laboratory TA in Laboratory Exercises

TEACHING IN PRACTICE

1. Identifying a problem

If you have been as a TA in any Laboratory exercises, you mostly have noticed that the students hardly read through the protocols that are given in advance. This causes a lack of background knowledge, delays on the laboratory schedule, increases experimental errors and reduces student learning and understanding. In addition, also may cause that not the whole class will follow all the experimental procedures. The aim of this teaching activity is to encourage students to read and understand experimental protocols before entering any research laboratory.

2. Planning a teaching activity

One of the learning goals of the course is to be able to argue methods from laboratory experiments. To complete it, is essential to know the scientific protocols used and the purpose of each step. Here, a teaching activity is presented, where students, in small laboratory groups, will have to decide the order of the scientific protocol of the day. Afterwards, they will have to pair it with the correct purpose of each step and the equipment needed. With this, and a further plenary discussion, the students will be able to perform the laboratory exercises having worked with the protocol in advance. In addition, the students will also learn how to plan experimental work, as they will need to actively think about the protocol used.

3. Trying it out in practice

In order to encourage students to read through the protocols, they will be told in advance, that an activity regarding the laboratory protocol will be done before starting the experiments.
The teaching activity will consist of a strip sequence followed by a connect the statements. Here, the students will be divided into small laboratory groups, in which they will work further on the course, and will be given a series of steps of the protocol they will have to order. After this, they will get two sets of strips more, containing the purpose and the material/chemical they need to use for each step. Figure 1A shows how the teaching material is going to be handed to the students, and once is solved by them (1B). After all groups have finished (5 min), the groups will be mixed, and students will have a short discussion and sharing their decisions (2-3 min). Finally the correct order of the protocol and connections will be discussed with the whole class.

When the students will be discussing the connect the statements / strip sequence activity of the protocol, the TA will be walking around the groups giving feedback. In addition, students will be able to get peer-feedback when they are mixed in between their groups and during plenary discussion.
The final plenary discussion evaluate the learning of the class. Furthermore, when there is waiting time during the laboratory exercises of the day, the TA will ask the students of their impressions on the activity.

MAIN POINTS

1. **Main problem/challenge:** Students don't really read through laboratory protocols before entering the lab
2. **Teaching activity**: Connect the statements/strip sequence with laboratory protocol for the specific experiment
3. **How did it go?** It has not been implemented yet.
4. **What to do next?** The teaching activity will be refined with the course coordinator and planned for Fall 2020 teaching.

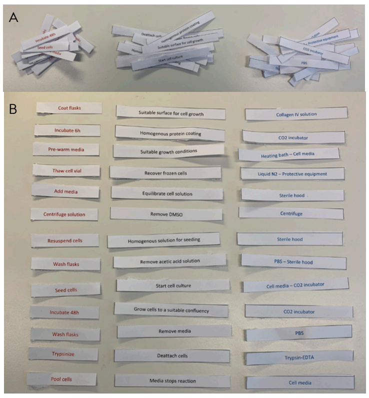

Figure 1: An example of the teaching activity: before and after. A) Teaching materials consisting of a strip sequence and connect the statements given to the students. B) Solution of the activity. If the students have read the protocol thoroughly, they should be able to place them in the correct order and correct groups.
Color code: Red: Process. **Black**: Purpose.
Blue: Equipment/Chemicals used.

4. Looking forward

Once the basic activity has been successfully implemented, there will be some modifications in order to improve students learning and transform from a one-day activity (one protocol) to a monthly activity. Some of these improvements may be mixing between the protocols as the course progresses, removing the color coding to increase its complexity, or leaving blank sequences to be filled. Moreover, in the case of getting poor or very few student feedback from the activities , an online quiz tool could be used (Kahoot, Mentimeter)

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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From theory to practice

- Encouraging understanding and participation

Abstract: A common issue in theoretical courses is the lack of motivation of students to participate actively in the lecture and the difficulty in finding an application of the concepts learned in class. The teaching activity consists in presenting simple exercises and ask each student to find a solution first individually and later through discussion with fellow students. The activity will be implemented in the next semester (Autumn 2020) and the feedbacks received will be used to improve it.

COURSE FACTS

- Course name: Mechanics, thermodynamics and Partial Differential Equations 1
- Level: Bachelor of Science
- ECTS credits : 5
- Language: English/Danish
- Number of students: 20
- Your role: Teaching assistant (lecturing and supervising the exercise sessions)

TEACHING IN PRACTICE

1. Identifying a problem

The learning objectives of the partial differential equation module of the course is that the students are able to find an analytical solution to equations applied to heat transfer problems. In reality, it is challenging to make complex mathematical topics understandable in only few lectures. The students read the theory without understanding in depth its meaning and its application, and without participating much in class. This becomes a problem for the students learning. The challenge is to facilitate the transition from the theory to the exercises and to encourage active participation.

2. Planning a teaching activity

The expected outcome of the teaching activity is to make the students develop both their own reflection skills and their ability to discuss their arguments with others. At the beginning, the students will solve exercises on their own, putting their knowledge into practice. Later, the discussion with colleagues will allow them to compare different approaches and learn from others. Finally, the presentation to the whole class will be an opportunity to practice oral communication and to get feedback. This will help solving the problems encountered with students learning.

3. Trying it out in practice

The teaching activity has not been performed yet. Instead, the plan for its implementation is described below.

1. The teacher introduces the activity. A list of short exercises is given to the students.
2. For 20 minutes the students think about the questions and write down a draft of the answers.
3. The students gather in groups of two or three people and compare and discuss their solutions for half an hour.
4. A group of students is called at the blackboard to show to the rest of the class how they came to their solution. The other groups of student interact if they have questions. For each question, a different group of student is called.
5. The teacher will show the correct solution correcting the mistakes of the students, if any.

MAIN POINTS

1. **Main problem/challenge:** Limited students participation and difficulties in applying the theoretical concepts
2. **Teaching activity**: Think-Pair-Share
3. **How did it go?** It will be implemented during the next semester

Evaluation

The students will be asked to evaluate the activity by answering to few questions anonymously. They will be asked to write comments about:

- the difficulty/length of the exercises
- the time given to small group and whole class discussion
- the feedback from the teacher
- general impressions and suggestions

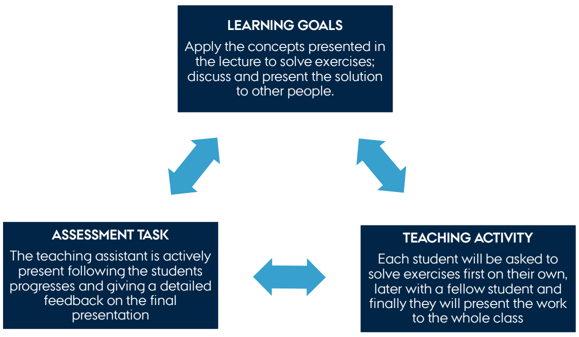

Figure 1: **Constructive alignment**

4. Looking forward

The answers given by the students during the exercise will give an indicator of what was more and less clear in the previous lectures. The quantity and the difficulty of the questions of the teaching activity will be calibrated according to how fast and how well the students answered. Moreover, the students evaluations will be taken into consideration for improving the teaching activity. Particular attention will be given to students that were not very active in class also during the activity.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Indoor Climate and Energy
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Excelling in the Laboratory

- Encouraging students to better understand their organic chemistry laboratory exercises

Learning Lab

Abstract: Because of elaborate laboratory manuals students tend to not fully understand the practical as well as the theoretical concepts related to the exercises at hand. By introducing the students to strip sequences based on simplified laboratory manuals they are challenged to reflect on the exercises and thus they are encouraged to better understand the exercises and the related organic chemistry concepts. Assessment is done as both peer assessment and by the TA through hand-ins. Unfortunately, it was not possible to introduce the teaching activity during the Science Teaching course.

COURSE FACTS

- Course name: Organic Chemistry I: Functional Groups and Reactions
- Level: Bachelor, 2nd semester
- ECTS credits : 10
- Language: Danish
- Number of students: 17
- Your role: Supervising the students and encouraging them to understand their lab exercises through dialog and teaching activities (LØ TA).

TEACHING IN PRACTICE

1. Identifying a problem

Students do not always obtain a deep understanding of their laboratory exercises due to the fact that they have to follow elaborate manuals. The lab manuals do not encourage the students to reflect on the individual steps of the exercises. Consequently, the students lack understanding of the concepts related to the exercises and they often spend more time in the lab than allocated. It is important to address this problem to make the students able to more easily grasp the work in the laboratory and to draw connections between general concepts in organic chemistry.

2. Planning a teaching activity

The teaching activity is based on strip sequences. By simplifying the lab manuals the students are forced to give more thought to the process of the laboratory exercises. Additionally, through peer feedback[1] the students will get an even better chance to grasp the practical work and the related theoretical organic chemistry concepts. Not only does this comply with the already described learning outcomes of the course, it also makes students able to draw connections between different organic chemistry concepts, and they will be better prepared to enter the lab and execute the exercises at hand.

3. Trying it out in practice

The teaching activity is based on "Strip Sequence". The laboratory manuals are elaborate, so to encourage the students to give more thought to the process, the manuals are simplified and divided into small strips. The strips are mixed and given to each group of students. Each group then has to sort the strips into the correct order. An extract from a strip sequence based on a lab manual is shown in table 1.

Table 1: Extract from a strip sequence based on a laboratory manual from Organic Chemistry I. The left column shows the strip sequence in the correct order and the right column shows the mixed strips sequence that the students have to solve.

Correct sequence	Mixed sequence
9-Fluorenone is added	Cover with tin foil
Test the purity by TLC	Poke holes in tin foil
Confirm if full conversion is obtained	NaBH4 is added
Cover with tin foil	Measure melting point
Filter mixture	Place product in preweighed test jar
Measure melting point	9-Fluorenone is added
Measure yield	Measure yield
NaBH4 is added	Filter mixture
Place product in preweighed test jar	Confirm if full conversion is obtained
Poke holes in tin foil	Test the purity by TLC

The students are informed about the teaching activity before class so that they can properly prepare for it. Additionally, they are given instructions about the activity as the first thing during the lecture. The students solve the strip sequences in their respective groups. Afterwards, two groups pair up to assess each others work. When the peer assessment is done each group fills out a table with their respective answers and starts their lab exercise. The table is collected by the TA during the lecture and used for assessment. The activity is expected to take no more than 10 min.

MAIN POINTS

1. **Main problem/challenge:** Students lack understanding of lab exercises and the related concepts.
2. **Teaching activity**: Strip sequences of lab manuals.
3. **How did it go?** It was not possible to implement the teaching activity during the Science Teaching course.
4. **What to do next?** Implementation of the teaching activity and improvement through student feedback.

Before the students leave, they are asked to spend two minutes on a minute paper, which the TA will also use for assessment.[2] After the lecture, an out-of-class activity is made for the students to evaluate the teaching activity in the form of a survey.

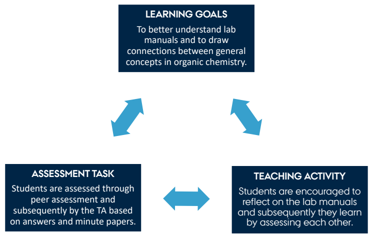

Figure 1: **Constructive alignment**

References

1. A. Axelsson (2005): Kan man lita på kamratgranskning?
2. T. A. Angelo and K. P. Cross (1993): Classroom Assessment Techniques: A Handbook for College Teachers, 2nd Ed.

4. Looking forward

Unfortunately, the teaching activity could not be implemented during the science teaching course. Therefore, the next step would be to implement the activity and to evaluate whether it is feasible to make it a permanent part of the laboratory exercises. The time spent on the activity has to be optimized as the students already tend to spend more time on the lab exercises than allocated. Consequently, the time available may also be the determining factor for the possible implementation of the teaching activity.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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How to make students quiz themselves

- A teaching activity for low taxonomic courses

Abstract: First-year students often struggle with the increased teaching tempo at the university. New concepts are rapidly introduced with accompanying new terminology. The best way to absorb a large amount of low-level taxonomic knowledge is through repetition. The teaching activity presented herein is a student-driven quiz based on multiple minor activities such as *muddiest point*, *ticket-out-the-door,* and *student quiz questions*. It was found that the activity allows for assessment on different levels.

Learning Lab

COURSE FACTS

- Course name: Basic Organic Chemistry
- Level: Bachelor, 1st year
- ECTS credits : 5
- Language: Danish
- Number of students: 22
- Your role: TA (2 hrs/week)

TEACHING IN PRACTICE

1. Identifying a problem

New students at the university struggle with the increased pace of teaching compared to high school. In the first-year course *Basic Organic Chemistry* students have to learn many new concepts and the terminology of the craft. This includes naming simple organic compounds, identifying functional groups, and distinguishing molecular isomers. These tasks are at a low taxonomic level but still very important for future education, as they form the basis for scientific communication within the field. The best way to learn such subjects is through repetition[1]. The primary issue with a teaching environment focused on repetition is that it is boring, thus failing to stimulate active learning. The teaching activity presented herein seeks to incorporate repetition through an alternative, student-driven method.

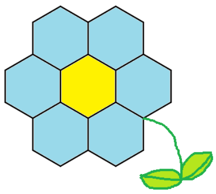
2. Planning a teaching activity

The teaching activity was planned so that students will repeat small chunks of information several time: At the end of a session, students are paired up and assigned to formulate two questions. The first question should be one they already know the answer to. Preferably, something they have learned in the current session. It should be asked as a multiple-choice style question with four different answers. The second should be a *muddiest point* style question, where they do not know the answer.

The first questions make the students repeat something they have learned and the second make them reflect about what they have not learned.
The two questions are then handed into the TA in a *ticket-out-the-door* fashion. In between sessions, the TA sorts through the questions and crafts a multiple-choice quiz using an online quiz tool, like Kahoot. The students are then quizzed on their own questions in the beginning of the next session.
Through the quiz, the students once again delve into a repetitive task on the course material, which is the main learning goal.

3. Trying it out in practice

The students were very active during the question formulation part. They had engaging discussions about the course material and they were very creative on the second question. An example is seen below.



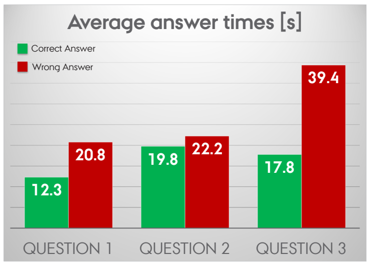
What is the name of this molecule?

During the quiz, the classroom was completely silent, which indicates that the students were concentrating. The quiz results were saved and assessed after the fact. This revealed, among other things, that the answer distribution on 50-50 style questions was 50-50, signifying that the students did not know the answer, but were merely guessing. This led to an increased focus on the subject during the course.

MAIN POINTS

1. **Main problem/challenge:** Students struggle to remember the new concepts and terminology being rapidly introduced in 1st year courses.
2. **Teaching activity**: Students formulate two questions in pairs at the end of one session. A quiz based on the questions will be given in the beginning of the next session.
3. **How did it go?** The students were actively engaged throughout all steps of the teaching activity.
4. **What to do next?** The activity could be improved by instructing the students on how to ask 'good' questions.

Examining the quiz results also allows for further assessment. In the figure below, the answer times have been shown for correct and wrong answers alike. Shorter times are seen for the correct answers, as logically expected. Deviation from this behavior may indicate that even the students who answered correctly had to think a lot about the question, and more time should be spend on the given subject.



4. Looking forward

Some students had troubles formulating 'good' quiz questions. Either they were to specific or to general. During the first session, some time could be spend on instructing the students how to formulate quiz questions. The teaching activity could, in principle, be repeated at each session. The quizzes would then also serve as a repetitive learning tool during preparation for the exam.

References

[1] Mayer, Richard E. "*Can you repeat that? Qualitative effects of repetition and advance organizers on learning from science prose.*" *Journal of Educational Psychology* 75.1 (1983): 40.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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June 2020

An opportunity for learning

- How can students start perceiving course projects as a learning opportunity?

Learning Lab

Abstract: In project courses students often plan their prototyping process solely with focus on finishing the project while forgetting their own learning outcomes. This results in students not being able to understand and argue for the whole process, and less skillful students lacking further behind because they are not properly included in the process. This poster presents an activity where project groups are breaking their prototype into smaller tasks and distribute these tasks based on which skills group members would like to train. The aim is that students learn to perceive course projects as opportunities for leaning and start planning and managing them as such. The activity has not been implemented yet.

COURSE FACTS

- Course name: IT Product design Project (ITPDP)
- Level: Bachelor (first year)
- ECTS credits : 20
- Language: Danish
- Number of students: 50
- Your role: TA, supervise groups and provide feedback on written assignments.

TEACHING IN PRACTICE

1. Identifying a problem

In course projects where students work in groups on project management, product design, prototype implementation, user testing, etc. they often distribute the workload relative to group members' skills. This strategy imply multiple problems: Processes easily get black-boxed for other group members when one person is making the decisions and doing the work (E.g. only one group member actually understand the implementation of the prototype and is capable of making changes to it). The most skillful students are doing the majority of the work, while less skillful students are lacking further behind. Students are improving what they are already good at instead of 'filling gaps' in their skills and knowledge. As a result, at the exam many students are not capable of arguing for all aspects of the project or students lack compulsory skills later in the program because they did not took the opportunity to train these in their project courses.

2. Planning a teaching activity

This poster describes an activity aiming at learning students how to see the process of planning and implementing prototypes in project courses as an opportunity for learning. In a project course, each student is tasked to consider what they want to learn from their group's project and the groups plan how the prototyping process can be designed to help them improving group members skills.

To support this aim, students are introduced to the work-breakdown-structure tool, where larger projects are chunked into smaller manageable tasks. Each group is tasked to break down their prototype process into smaller tasks and consider which skills are required to solve each task. Using this illustration of their prototype, groups can discuss how the prototyping process can support their learning goals and distribute the tasks intelligently among group members.

3. Trying it out in practice

The activity will be implemented in the 9th week the the ITPDP course, where groups have conducted user studies and sketched an overall design concept, which they are going to materialize in one or more prototypes in the last weeks of the course.

A one-and-a-half-hour class will be scheduled for the activity and students will be asked, in advance, to pick two or three skills they want to learn or improve through the prototyping process. The class will begin with a short introduction to work-break-down-structures, followed by a session where each group will try to break down their own prototype into smaller tasks and identify which skills are needed to solve each task. The next task is shortly introduced: Each group discuss their skills in the group, how they can support each other in improving their skills, and how the prototyping process can help all group members improve their skillset. Based on this discussion they distribute the task from the work break-down-structure. The class will end with each group presenting their newly created prototype plan for the class.

MAIN POINTS

1. **Main problem/challenge:** Students should use project courses to actively improve their skills and fill the gaps in their knowledge.
2. **Teaching activity**: Project groups create a work-breakdown-structure to plan how they can use the project to achieve their personal learning goals.
3. **How did it go?** The activity was not implemented due to Covid-19.
4. **What to do next?** Implement the activity to test if it benefit students in the course and see if it changes their attitude towards future course projects.

TAs will provide feedback on students presentations and follow up on their plan during weekly feedback sessions with each group. Here the TAs will also evaluate the activity by monitoring if the groups are using prototype plan and distributing the tasks intelligently.

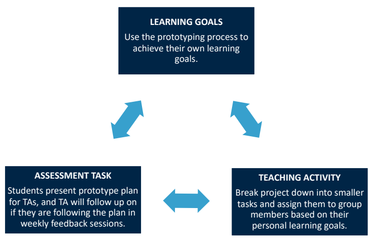

Figure 1: **Constructive alignment**

4. Looking forward

Implementing activities like the one described here into project courses can help students become more aware of their own learning process through the IT Product development program, why it would interesting to see how more focus on personal learning goals in the ITPDP course can help students in perceiving projects courses later in the program as opportunities for learning.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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To read or not to read?

- A questionnaire for out of class readings

Abstract: In many small class lectures the teaching is most effective when the students has read about some theory before class. Some students tend to do their reading after class or just before the exam. An online questionnaire along with the reading material was used to motivate the students to read specific parts of the material carefully to understand the theory. In this case, the students' answers showed that the questionnaire motivated half of the students to read. Further, inconsistent answers in two of the three topics indicated that these two topics required more focus during the lecture. In the future, the students could get a warning about the upcoming questionnaire in the previous lecture, which might lead to more answers.

COURSE FACTS

- Course name: Simulation of Building Energy Systems
- Level: Master
- ECTS credits : 5
- Language: English
- Number of students: 14
- Your role: presenting TA for one small-class lecture

TEACHING IN PRACTICE

1. Identifying a problem

The goal of this course is to teach the students how to use the program EnergyPlus (1). The lecture deals with implementing heat gains.

Learning a new program is easiest when trying it out, therefore most of the in-class time will be used on implementing heat gains in practice. For this to be a success the students need to read and understand the theory on how the program handles heat gains before class. From experience, it is known that some students tend to wait until the exam to read. The challenge is to motivate the students to read before class and for them to get specific knowledge out of their readings.

2. Planning a teaching activity

An online questionnaire, for the students to answer while reading, should motivate them to read before class. The learning outcome of the activity is knowledge of the theory behind three different heat gains in EnergyPlus.

With specific questions the TA can choose what the students should learn from their readings. From student answers, the TA can prepare a lecture that focuses on the topics that the students had a hard time understanding. Further, the answers can be used in-class as a basis for discussion to get a deeper understanding of the topic.

As the students are familiar with the topics they might be less hesitant to participate in discussions with the TA or the other students.

3. Trying it out in practice

Multiple platforms provide online questionnaires, google docs "Analyse" (2) was used here. The students were given three topics to cover with readings, and three to four questions per topic.

When the students had answered all questions, their answers were anonymously available to me, both individual answers and as an overview, see Figure 1.

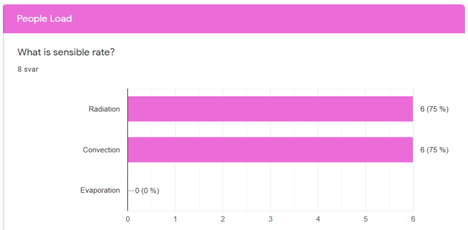

Figure 1: Example of students answers on one of the questions.

The example in Figure 1 show that some students answered "Radiation", some answered "Convection" and some students answered both to the question "what is sensible rate?". The correct answer is both. These answers show that they have tried to read the material.

Showing these answers in class lead to a conversation about why some students only chose one of the correct answers. It turned out there was some confusion about the question type, as some students did not get that it was multiple choice.

MAIN POINTS

1. **Main problem/challenge:** motivate students to read before class.
2. **Teaching activity**: Online questionnaire.
3. **How did it go?** Approximately half of the students answered the questions.
4. **What to do next?** Give oral warning on the questionnaire and deadline in the previous lecture.

In general the students' answers were more inconsistent in two of the three topics. This indicated that the students found these topics harder and it would be beneficial to focus my presentation on these two topics. Further, I tried to use their answers as basis for a discussion. The students were hesitant to speak in plenum, but using "Think-Pair-Share" got them talking in pairs.

All in all the questionnaire motivated half of the students to read before class. Their answers helped to get a feeling on what was most important to focus on during the lecture.

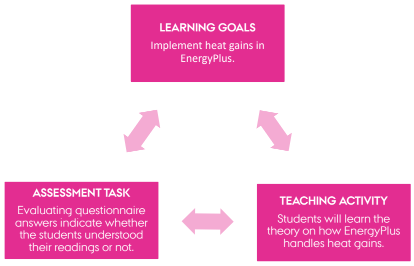

Figure 2: Constructive alignment

4. Looking forward

In the future the question types should be stated clearly in the question (multiple choice or not) to avoid confusion. Further, only 4 students made the deadline, and 6 students did not answer the questions at all. This indicates that not all students check up on blackboard. A solution could be to give a notice in the previous lecture, that they are expected to read the material and answer the questionnaire before a certain deadline. As the activity worked as intended I will use this in future classes.

References

(1) U.S. Department of Energy, http://energyplus.net/, Visited (28-05-2020)

(2) Google, https://www.google.dk/intl/da/forms/about/ , Visited (28-05-2020)

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Civil and architectural engineering
Department of engineering

A cookbook recipe for circuit problems in electrodynamics

- Understanding ingredients makes a better chef

Learning Lab

Abstract: **This project investigates how the 'Strip Sequence' teaching activity improves students' ability to solve circuit problems in electrodynamics. In 'Strip Sequence' students have to put in order a series of strips that describe different steps in solving a type problem. It is expected that this helps students tackle seemingly complex problems by carrying out a series of manageable small steps. The teaching material and lesson plan has been made, but the next step is to implement the teaching activity in real life.**

COURSE FACTS

- Course name: Electromagnetism & Optics (EMO)
- Level: Bachelor's level (1st year)
- ECTS credits : 10
- Language: Danish
- Number of students: 20
- Your role: TA in theoretical exercises. Overseeing problem solving in small class setting and correcting hand-ins.

TEACHING IN PRACTICE

1. Identifying a problem

Personal experience as student and TA and colleagues' testimonials point to circuit problems as a notoriously difficult topic for students. EMO is a first year course, so students come with only little prior knowledge about this type of problem. It is important to address this issue because two of the **learning goals** in the course are precisely to be able to **solve simple theoretical problems** and **argue for steps taken**. The aim of the teaching activity is thus to help students master this kind of problem by making it more accessible and training the step-by-step approach to complex problems.

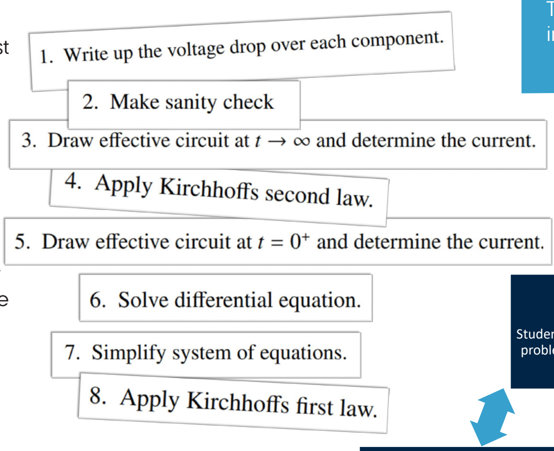
2. Planning a teaching activity

Although circuit problems can seem very complex, they are quite similar, and it is possible to reduce the solution of these into a series of steps. Making the students more aware of this should improve their ability to solve the problems. In the activity **Strip Sequence** students are **actively engaged** in ordering the steps, they give **peer-feedback** in the discussion afterwards, and finally get a chance to use their newly made recipe on a real problem. The students train reducing problems into series of steps and are likely to feel more confident. Being able to solve theoretical problems and arguing for steps taken are important learning goals that are addressed in this activity.

3. Trying it out in practice

1. Students are given solution steps for a generic circuit problem in random order.
2. In groups of 3-4, students have to reorganize the steps.
3. A plenum discussion about the 'correct' order is facilitated by the TA. Groups give each other feedback.
4. Students can correct their sequence and then have to solve a specific circuit problem using their recipe.

During the plenum discussion and solution of the specific problem, the **TA assesses** whether students understand the method and meet the learning goals. Alternatively, the specific problem is handed in and the TA corrects and gives feedback. **Student evaluation** is carried out in mentimeter. They are asked how they felt about the problems before and after this activity.



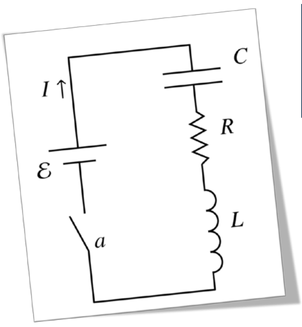


Figure 1: Teaching material for Strip Sequence exercise. Steps are in random order and should e ordered to find the current in the circuit below.

References:
https://stll.au.dk/en/resources/ - retrieved 15-06-2020

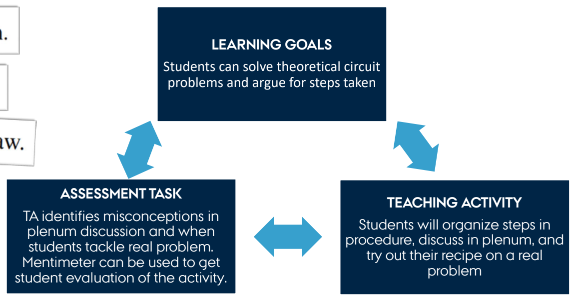
MAIN POINTS

1. Main problem/challenge:
Student difficulty with specific topic in theoretical exercises.

2. Teaching activity:
Strip Sequence, follow-up discussion, and try-out on real problem.

3. How did it go?
The problem is well-suited for the specific activity. Teaching material and lesson plan has been made and is expected to help the students.

4. What to do next?
The teaching activity should be implemented!



4. Looking forward

A concrete teaching activity and lesson plan has tailored to a specific learning challenge in Electromagnetism & Optics. The next step is to implement the teaching activity in a small-class setting. The students should report their initial level in mentimeter *before* the teaching activity. No student preparation is needed.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Esben Rohan Christensen
CCQ
Department of Physics

Documentation is key

- Teaching the importance of reading program documentation

Learning Lab

Abstract: EnergyPlus is an advanced building simulation program without a helpful graphical user interface. The students therefore have to learn that users need to rely on the thorough program documentation to understand the effect of inputs on the results. A Mentimeter activity was used to teach the students the importance of using the program documentation. As intended, the students understood the concept of reading the documentation already after the first question. Mentimeter is also a powerful tool for evaluation of students understanding, while providing a basis for class discussion. The activity helped the students interpret the documentation and find the relation of a specific set of inputs to the program outputs.

COURSE FACTS

- Course name: *Simulation of building energy systems*
- Level: *MSc*
- ECTS credits : *5*
- Language: *English*
- Number of students: *14 (9 present)*
- Your role: *Presenting teaching assistant*

TEACHING IN PRACTICE

1. Identifying a problem

EnergyPlus (E+) is an advanced building simulation program for energy and indoor climate analysis. Often, students are used to programs being intuitive with a helpful graphical user interface, however, E+ is merely a calculation engine, which provides no help apart from the documentation. As a TA, I have experienced students asking questions about the workings of the program, which is clearly stated in the documentation. Therefore it is equally challenging and important to make students use the program documentation and pay close attention to the mathematical processes of E+.

2. Planning a teaching activity

The learning goal of my teaching activity is to teach students the importance of using program documentation. The activity should make students understand that inputs they give the program will highly affect outputs/results. Specifically, the outcome of the activity is learning to make appropriate modelling assumptions. Through the activity, students will be forced to use the documentation to look up answers for specific problems,and hopefully realize that they are able to read and understand the documentation, and in many cases find answers to their questions themselves.

3. Trying it out in practice

The students were asked to read a part of the E+ program documentation describing the calculation of natural ventilation before class, see Figure 1. The part describes how the definition of constants A, B, C and D affect influence of temperature and wind on natural ventilation. In class they were asked to answer a Mentimeter question on how a specific set of constants affect ventilation, see Figure 2 (top). The answers were diverse, showing that many students did not understand the documentation. The answers were discussed in class and the students were asked to read the documentation again.

$$Ventilation = (V_{design})\,(F_{schedule})\left[A + B\,|T_{zone} - T_{odb}| + C\,(WindSpeed) + D\,(WindSpeed^2)\right] \quad (8.5)$$

Figure 1: Equation for calculation of natural ventilation in E+ EngineeringReference documentation.

The students were then asked to answer the second question on how a different set of constants affect the ventilation.

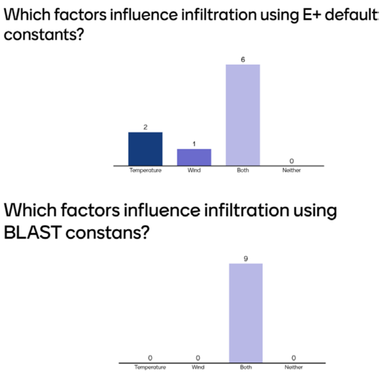


Figure 2: Questions from Mentimeter teaching activity

MAIN POINTS

1. **Main problem/challenge:** Students do not use program documentation
2. **Teaching activity**: Mentimeter questions
3. **How did it go?** Using two simple questions, the students realized the importance of using the documentation.
4. **What to do next?** Evaluate whether the activity helped the students working in the program.

Before answering, the students looked in the documentation, and all answers were now correct.
After the Mentimeter activity, the students were asked to use the different constants in a specific object in E+, to visually analyze the effects on ventilation rate.
Results from the Mentimeter activity showed that students learned to interpret the program documentation, and it provided a good basis for class discussion on the topic.

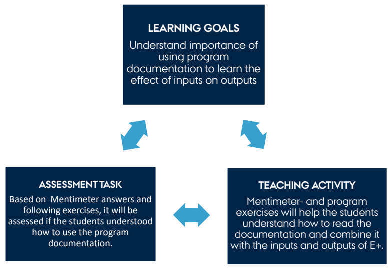


Figure 3: Constructive alignment

4. Looking forward

Mentimeter is a powerful tool to evaluate students understanding of reading material, and provide a basis for class discussion. The tool can be used to get an answer from all the present students, also the ones who do not like to actively participate. Through this exercise, all the present students answered the questions and it clearly showed whether the whole class could follow the point. A good exercise would be to supply this Mentimeter activity with an evaluation from the students, asking from their point of view whether the activity helped them working with the program.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Louise Christensen
Civil and architectural engineering
Engineering

Active Learning without a Protocol

- Strip Sequence with Integrated Multiple-Choice

Learning Lab

Abstract: It is challenging for students without prior experience in an organic chemistry laboratory to read a protocol (the scientific equivalent of a cookbook recipe) and following it – let alone rationalizing the individual steps of it! This deficiency means unnecessary long hours in lab, increased hazard risk and poor theoretical communication in the reports. This project describes a teaching activity based on the strip sequence principle with integrated multiple-choice tasks envisioned to muster the students' knowledge obtained from lectures and theoretical exercises and apply it to construct a real protocol which they will be working from later on in the course – assumably with increased skill. The activity can hopefully be tried out in 2021.

COURSE FACTS

- Course name: Organic Chemistry I – Functional Groups and Reactions
- Level: Bachelor (2nd semester)
- ECTS credits : 10
- Language: Danish
- Number of students: 20 per class
- Your role: Lab TA supervising and correcting mandatory reports.

TEACHING IN PRACTICE

1. Identifying a problem

As a teaching assistant (TA) for laboratory exercises (LØ), I have experienced that the students are ignorant as to why a protocol for a chemical synthesis is structured the way it is. Their lab reports may also bear witness to lack of understanding of the workflow of the synthesis. A deeper understanding of the synthetic procedures abates mistakes in the laboratory and streamlines their workflow.

2. Planning a teaching activity

The teaching activity is a strip sequence based on a protocol for a synthesis they will all perform to LØ later on in the course, but with the additional challenge that some of the strips contain multiple-choice questions to maximize their cogitation. As a motivation a small prize will be at stake.

The activity will be introduced after the first LØ-class (when they have had a chance to acquaint themselves a little bit with a chemical lab). They will work out of class in their usual lab-groups to facilitate good academic discussions, when putting the pieces of the protocol in the correct order and choosing the answers they find most suited for the synthesis in the multiple-choice tasks (Figure 1).

The following week we follow up in class and talk about the hardest parts in plenum and reward the group with most strips in the correct order – a disguised summative assessment.

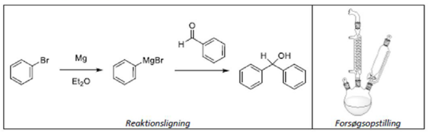
References:
[1] Based on protocol 4 from the booklet "Organisk Kemi – Laboratorieøvelse; Kemisk Institut", K. A. Jørgensen (2020).
[2] "F20 - Science Teaching" blackboard.au.dk

Hopefully, their good work bear positive reflection on the quality of the reports they hand in, as well as over their workflow while performing the synthesis and also allows for assessment of a more formative nature.

After some weeks, and when all have tried to follow the protocol they have worked with, we will have a brief general discussion as evaluation of the activity.

The teaching activity will help the student into a deeper mode of thinking about the chemical synthetic procedure to gain a better understanding of the purpose of the individual steps. They will need a basic chemical knowledge and use that for deducing the use of doing e.g. basic/acidic reaction work-up. When they understand the steps in a protocol, it will help them to work faster and safer in the lab. When they are always aware of what is occurring in the reaction flask, they will know what to do outside of the reaction flask in the lab. This will benefit their chemical way of thinking in general and ease report writing as well.

Øvelse 4: Benzydrol – Grignard reaktion



Ordn protokollen ved at forbinde hver handling med et tal, der angiver dens korrekte placering. De røde markeringer angive multiple choice spørgsmål. Vælg den mulighed som er korrekt.

1	Efter tildrypning opvarmes kolben i oliebad til reflux (kogepunktet for diethyl ether/brombenzen) indtil magnesiumspånerne er forsvundet (20 min) – tilsæt om nødvendigt mere diethyl ether/brombenzenopløsning. Reaktionskolben sættes i isbad.
2	Anbring magnesiumspåner og magnet i kolben.
3	Vask etherfasen med 20 mL mættet natriumcarbonatopløsning/1 M saltsyreopløsning.
4	Fortsæt tildrypning af brombenzenopløsningen. Reaktionen skal holde sig kogende.
5	Mål smeltepunkt og sammenlign med litteraturen.
6	Saml vandfaserne/etherfaserne og udryst med 30 mL 40% natriumhydrogenbisulfit-opløsning.
7	Lav brombenzenopløsning (brombenzen i tør/våd/ligegyldigt diethyl ether) og overfør til tildrypningstragt.
8	Flammetør alt glasudstyr.
9	Adskil ether- og vandfase. Ekstraher vandfasen med vand/diethyl ether.
10	Reaktionsblandingen kroger kraftigt op og bliver brun.
11	Tør over calciumchlorid, filtrer og inddamp på rotationsfordamper.
12	Lav benzaldehydopløsning (benzaldehyd i tør/våd/ligegyldigt diethyl ether) og overfør til tildrypningstragt. Tilsættes over 10 min. Fjern isbad og opvarm til reflux i oliebad i 15 min. Sæt på isbad og efter nedkøling tilsættes hurtigt is (20 mL) med glastragt/pulvertragt/tildrypningstragt.
13	Afvej produkt og beregn udbytteprocent.
14	I 15 mL vand tilsættes 15 mL konc. saltsyre/15 mL konc. saltsyre tilsættes 15 mL vand som tildryppes via tildrypningstragt indtil magnesiumhydroxidet er gået i opløsning.
15	Tilsæt hurtigt ¼ af brombenzenopløsningen under kraftig omrøring.
16	Omkrystalliser i heptan. Sugefiltrer og vask med lidt diethyl ether/heptan.

Figure 1: Material for the teaching activity [Ref 1]
It consists of 1) a short overview (reaction equation and reaction setup), and 2) the strip sequence activity with integrated multiple-choice tasks.

MAIN POINTS

1. **Main problem/challenge:** Improve understanding of the workflow of a synthetic procedure to streamline lab work and improve lab report quality.
2. **Teaching activity**: Strip sequence of a synthetic procedure with integrated multiple-choice questions.
3. **How did it go?** Has not been tried out in practice due to lockdown.
4. **What to do next?** Try it out in practice next year.

3. Trying it out in practice

The teaching activity has not yet been tried out in practice due the Corona-lockdown, but it can hopefully be actualized in the spring 2021.

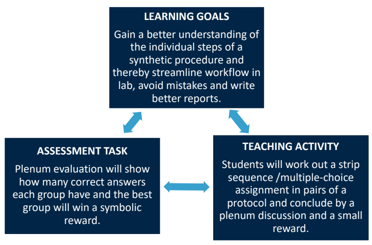


Figure 2: Constructive alignment
Alignment between 1) Learning goals 2) Teaching activity and 3) Assessment task.

4. Looking forward

It has not yet been possible to try out the activity in practice. I will, however, try to draw on whatever extra experience I get as a TA in the following autumn semester to look for possibilities to improve the activity outlined above. Options to consider is to include "the muddiest point" when evaluating the activity.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Mette Louise Christensen
Asymmetric Organocatalysis (Karl Anker Jørgensen)
Chemistry Department

Stripping the TEM
-Transmission Electron Microscope structure

Learning Lab

Abstract: In Nanocharacterization the students must learn the structure of the TEM and other electron microscopes. To make this task easier, A strip sequence of the TEM structure has been made. Hopefully encouraging students to discussion of the TEM structure. Giving the students an understanding of each part, what they do, and how moving the TEM parts would effect the picture the microscope takes.

COURSE FACTS
Course name: Nanocharacterization at the SDC (China)
- Level: Masters
- ECTS credits : 10
- Language: english
- Number of students: Unknown (5–100)
- Your role: TA and LA

TEACHING IN PRACTICE

1. Identifying a problem

In Nanocharacterization the students must learn and understand the structure of several electron microscopes. While the concept is similar to that of light microscopes, there are some key differences, and some concepts only present here. The students need to understand the role of each TEM-part, and how changing the order the TEM-parts might affect the image. Understanding the parts might make using a TEM easier if the students wish to change what the TEM does exactly.

2. Planning a teaching activity

Using a strip sequence of the TEM structure will hopefully encourage the students to discuss what each TEM-part does, and how moving the parts will affect the obtained image. Thus allowing the students to realize for themselves which parts are significant for what. Giving the students an understanding of the limitations of the technique.
The strip sequence elements are taken from [1].

3. Trying it out in practice

The idea is that the students are giving the strip sequence seen in Figure 1 (with the parts cut out so their order is not obvious). Then they can play around with the structure, and discuss how moving the aperture might change the picture.

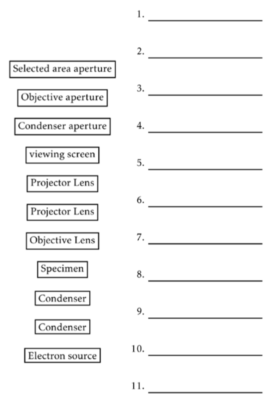


Figure 1: Strip sequence for a TEM, Can be easily adjusted for SEMs and possible light microscopes instead

As I have not taught in this semester, I have not been able to test it in practice
I hope the students would have liked it.

To assess the activity. One could start by doing a short discussion of the TEM setup, then do the strip sequence. And end with a small menti questionnaire on the different parts and their limits

MAIN POINTS

1. **Main problem/challenge:** Learning the structure of the TEM and SEM
2. **Teaching activity**: Strip sequence based on the structure of the TEM[1]
3. **How did it go?** Not at all
4. **What to do next?** Get a course to teach

I will see if I will end up teaching this course, or of the coronavirus have stopped my plans to teach it. As it is a course in China.

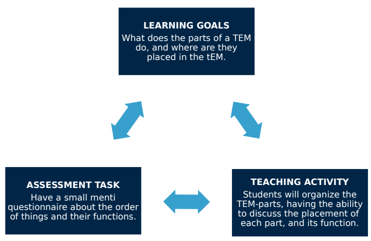


Figure 2: **Constructive alignment**

4. Looking forward

I think the strip sequence will work very well for this task, but without a course to teach right now, it has not been tested, hopefully that will change.

References

[1] David Muller 2008

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Thorbjørn Erik Køppen Christensen
Henrik Birkedal Group
INANO & department of chemistry.

Food Procecesses: Filtration and Homogenization

-imagining science behind the experiments

Learning Lab

Abstract:
A wide range of common unit operations such as filtration and homogenization are used by the food industry. In practical lessons that require practical application like this, students generally are given a experimental protocol and they are asked to follow it and obtain the results, However, most of the students do not know why they are following those steps. It important to solve this problem because students usually do not understand the physics and chemistry behind the experiments. To solve this challenge strip-sequence activity can be prepared for students to align the steps in a correct order. Assessment of this activity has been done by TA via looking at strips of the groups and asking some specific questions from students.

COURSE FACTS

- Course name: Food Processes
- Level: Bachelor Degree
- ECTS credits : 10
- Language: English
- Number of students: 20
- Your role: Laboratory TA

TEACHING IN PRACTICE

1. Identifying a problem

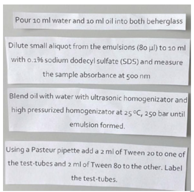
While there is a lot of protocol knowledge in food process area and also many science informations behind in the protocols, students do not comply because of the time limit in the laboratory. To complete the report and pass this course, they must understand the reasons for each protocol steps in order and be able to answer the report's questions. It's not possible, though, only by following the protocols like baking recipe without thinking profoundly about it. Therefore, the purpose of this exercise is to teach the experiments deeply and tell them what happens during each individual phase.

2. Planning a teaching activity

A teaching activity consisting of a strip sequence was designed to tackle the mentioned issue. This work involves for the students to align strips in the correct order. The activity aims to describe the experiments which they are supposed to perform. These skills will help the students interpret experimental methods by understanding why they are following related order or why they are adding related chemical ingredient. Also real life case (i.e: making mayonnaise) from industry will be given to the students to allow them to think about the food processes before come to class. The case based study will help the students imagine the real life cases and food processing principals by using the present knowledge on problems and facts.

3. Trying it out in practice

The strip sequence activity is designed according to the protocols in figure 1. The name tags (without numbers) will be prepared for the strip sequence and the students will try to align them in a correct order. At the beginning of the laboratory lesson, the students are divided into small groups (2 or 3 members) and given the strip sequences to solve, along with a clarification of the activity. Groups will compare their strip sequences, explain these and by that explain the physics and chemistry behind the experiment. TA will go around the laboratory and ask each group to ensure that the strip sequences are correctly aligned and the student figures out the definition for each steps. The students are then told to complete their experiments as normal and do observation during experiment and try to understand why they are doing so. Also the real case will be given to the students before the class (figure 2) and answer the questions and integrate them to their draft and final report.

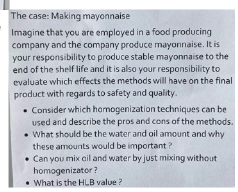

Pour 10 ml water and 10 ml oil into both beherglass

Dilute small aliquot from the emulsions (80 µl) to 10 ml with 0.1% sodium dodecyl sulfate (SDS) and measure the sample absorbance at 500 nm

Blend oil with water with ultrasonic homogenizator and high pressurized homogenizator at 25 °C, 250 bar until emulsion formed.

Using a Pasteur pipette add a 2 ml of Tween 20 to one of the test-tubes and 2 ml of Tween 80 to the other. Label the test-tubes.

Figure 1: Strip-sequence


The case: Making mayonnaise

Imagine that you are employed in a food producing company and the company produce mayonnaise. It is your responsibility to produce stable mayonnaise to the end of the shelf life and it is also your responsibility to evaluate which effects the methods will have on the final product with regards to safety and quality.

- Consider which homogenization techniques can be used and describe the pros and cons of the methods.
- What should be the water and oil amount and why these amounts would be important ?
- Can you mix oil and water by just mixing without homogenizator ?
- What is the HLB value ?

Figure 2: Case Study

MAIN POINTS

1. **Main problem/challenge:** The students just follow the experiment steps without deeply understanding.
2. **Teaching activity**: Strip sequence and case study
3. **How did it go?** Strip-sequence activity could not be carried out. However the case study carried out. It was good according to students feedbacks.
4. **What to do next?** Adding the details of more steps in order to cover all protocols and think about more case for food processing units.

The evaluation of the course will be oral examination however for the teaching activity that I am going to take place will be lab report. The evaluation of the lab part, will be focused on the presentation of the datas and discussion parts. Students will upload a draft and then get feedback to include in the final version. Students also include their strip sequence and a description/reasoning behind the order of the strips in their report. Assessment of this activity has been done by TA via looking at strips of the groups and asking some specific questions from students.

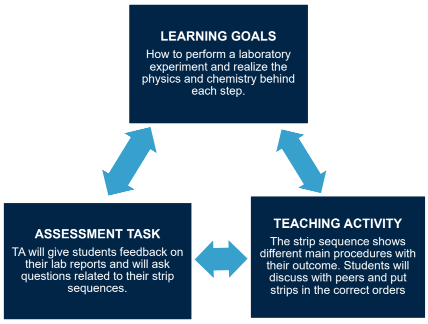


Figure 3: Constructive alignment

4. Looking forward

Although strip-sequence activity could not be carried out in real life, the final results from the feedbacks of course lecturers showed its usefulness as students probably could be able to solve it without any help. Presenting the teaching exercise need to be done for the students retain every move and plan of the day's experiment in their mind. On the other hand, case study was performed for one laboratory and it was very useful according to students feedbacks and therefore more cases need to be provided to them to imagine real processing parameters.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Ozgenur Coskun
Food Chemistry Technology Group
Food Science Department

How to make students quickly get main points of the course

- Strip sequences

Learning Lab

Abstract: For lab courses, although TA already upload the experiment protocols or relevant reading materials to blackboard before the class, most of the students still don't preview the materials. How to help students quickly get the main points of the experiment is very important, it determines whether the experiment proceed smoothly or not. Strip sequences can help students clearly and quickly to identify the order of experiment procedures and principles behind those steps. Use strip sequences correct can help improve the quality of lab courses.

COURSE FACTS

- Course name: oil refining
- Level: master student
- ECTS credits : 5
- Language: English
- Number of students: 14
- Your role: TA, assist students to finish the experiment

TEACHING IN PRACTICE

1. Identifying a problem

In lab courses, students have to finish a specific experiment in a very limited time. Therefore, it is very important that student can familiar with the experiment procedures for finishing the experiment smoothly in the class. Although TA always send the experiment protocol and relevant reading materials to students before they really start the class, the students seldom preview those studying materials in advance. So how to let students quickly get the main points in lab course is a very important question.

2. Planning a teaching activity

For solving the problem that how to make students quickly get the main points before they really start the experiment in the lab course, I will set a section of "strip sequences" in the beginning of class. The strip sequences give the key words of each experiment procedures, students have to arrange correct order of those strip sequences and talk about the principle behind the strip sequences.

Why the strip sequences can help students to quickly get the main points in the class? 1) The strip sequences present the key words of each procedures, those short terms make students can easily to remember; 2) When students work on arranging the correct order of those strip sequences, the all experiment procedures must be passed through their brain, they have to really think about items and give the right answer, this process help them to quickly familiar with the steps before operation.

3. Trying it out in practice

I will prepared the strip sequences which have the key words of each experiment procedures on it. The strip sequences were presented in Figure 1.

In this class, students will learn how to remove free fatty acid from oil in oil refining. The experiment procedures are denoted as the key words in 15 strip sequences. The order of those strip sequences will be disrupted, the students

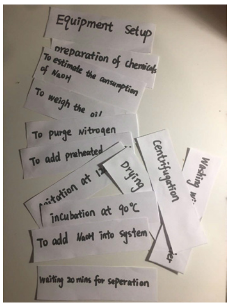


Figure 1: Picture of the strip sequences will be used in the class

have to arrange the correct order and give the principles behind those experiment procedures. Students can discuss with each other to arrange the correct order and to find the principles. If they get stuck, TA can involve into their discussion, give them some inspiration.

After discussion, students can give the correct order about those strip sequences that will help them quickly pass through the operation steps in mind. And students also can understand the reasons that why they perform those steps.

MAIN POINTS

1. **Main problem/challenge:** How to make students quickly get main points in the beginning of lab course?
2. **Teaching activity**: Strip sequences
3. **How did it go?** Have not been implemented.
4. **What to do next?** Perform the teaching activity and evaluate them.

The assessment are that to compare the students' strip sequences with correct answer and to observe students' operation in later experiment.

After the course, TA will distribute a questionnaire to students, TA can get the feedback from students through the answers of questionnaire.

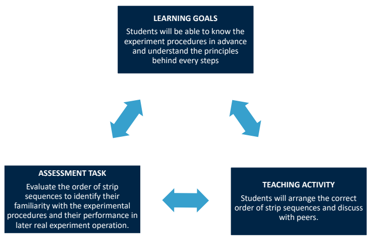


Figure 2: **Constructive alignment**

4. Looking forward

Although the teaching activities are not implemented yet, it should be useful to solve the problems that are identified during the course.

After applying the teaching activities, it would be easier to figure out the advantages and drawbacks.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Rongrong Dai
Agro-Biotechnology Science
Department of Engineering

Microbial-based product design

- A strategic activity to engage students in an online class

Abstract:

The unexpected change to online education was a challenge for professors and students. Long online classes cause students to lose focus. To mitigate this problem an activity is conducted in the middle of the class to engage students and build up their curiosity for the remainder of the lecture. Zoom's breakrooms tool is used to divide the students into groups. They post answers to the question " What are the steps to develop a microbial-based fertilizer?" in Padlet to discuss them and exchange feedback. At the end of the class, students provided positive feedback saying that they were comfortable with these types of breaks and activities. The activity was successful but some improvements can be implemented.

Learning Lab

MAIN POINTS

1. **Main problem/challenge**: Keep the students' attention in the lecture during an online session. Lacking interconnection of theoretical and applied knowledge (Fig 1).
2. **Teaching activity**: Group exercise and general discussion on developing a microbial-based product applying theoretical knowledge.
3. **How did it go?** It was effective. The students participated actively and applied theoretical knowledge gained during the lecture.
4. **What to do next?** Improve activity by giving students a prepared misordered sequence of steps to organize. Thus reduce activity time and lengthen discussion and feedback time.

COURSE FACTS

- **Course name:** Applied microbiology
- **Level:** Bachelor (2-3 year)
- **ECTS credits :** 10
- **Language:** English
- **Number of students:** 20
- **Your role:** Teaching assistant and lecturer

TEACHING IN PRACTICE

1. Identifying a problem

Due to the COVID-19, teaching was carried out online. This brings new challenges for professors, students and TA.Applied agricultural microbiology lecture is separated into two parts. First part covers theory and the second part is focused on applications. Since the lecture is planned for 2 hours it is easy for students to lose focus and interest, especially during an online class. Students usually manage to keep their focus only for the first part of the class. It is however essential that students see a link between the theory and applications. The challenge here is to engage students and keep their focus for the second part of the lecture.

2. Planning a teaching activity

The activity brings back students' attention because it requires peers discussion, argumentation, and theoretical knowledge acquired during the first hour. Students' become engaged and curious about the second part of the lecture because it verifies their answers and shows them how experience is required in addition to theoretical knowledge in developing a microorganism based product for the agricultural industry (Figure 1).

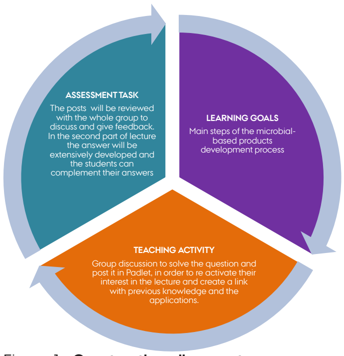


Figure 1 : **Constructive alignment**

3. Trying it out in practice

After the theoretical part of the online lecture, students are divided into random groups of 3-4 people in breakrooms. Each group is answering the question "What are the steps to develop a microbial-based fertilizer?" using theoretical knowledge from the course. The answers are posted on Padlet in real-time(Fig 2). After 15 min answers are discussed with the whole class to share opinions and feedback. During the lecture, students participated and commented on other groups' answers. Some groups also included humorous answers regarding profitability of their products. These reactions show that the activity helped them to regain interest. In the second part of the lecture, I delved into the answers and compared it with the source material. At the end of the class, students were asked to provide feedback on the activity which was mainly positive.

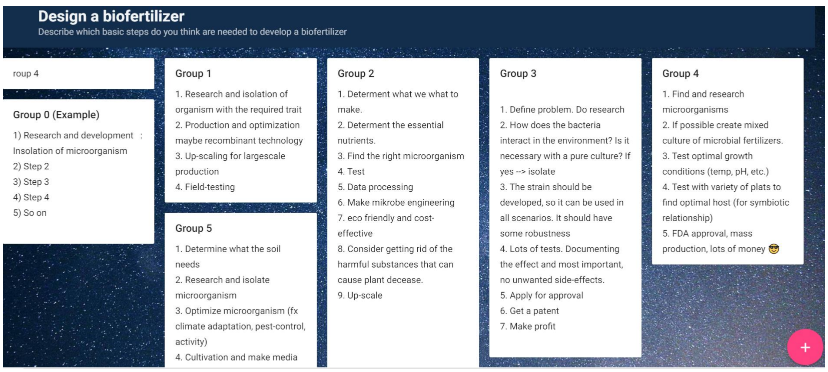


Figure 2: **Padlet** generated by the students after their group discussions

4. Looking forward

The activity was effe8ctive in involving students during the lecture. It allowed them to regain focus by a change of paste and group work. It helped to create interest in the second part of the lecture. The activity could be improved in terms of time management. A possible improvement is to provide a misordered sequence of steps to be organized thus allowing faster and clearer feedback. The activity could be further improved by including a survey at the end of the class to gather feedback.

References

Padlet dashboard. https://padlet.com/lauramunozduarte/vfvrzxraapa6

Bioprocess Design and Control (48th ed.) Springer-Verlag Berlin Heidelberg (1993).

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Laura Daniela Munoz
Microbial electrosynthesis
Biological and chemical engineering

Data Caching in Practice

Applying theoretical knowledge to solve an exam problem

Learning Lab

Abstract:

Students of the Computer Architecture BSc course had problems applying the knowledge about data caching to solve practical problems, some of which are expected to appear at the exam as well. I have prepared and described to them a detailed, step-by-step breakdown of a typical exam-level problem, and assessed their learning by giving a similar practice problem later. Almost every student group succeeded in solving the same type of problem the second time.

COURSE FACTS

- Course name: Computer Architecture
- Level: BSc
- ECTS credits : 5
- Language: English
- Number of students: 60
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

Students of the Computer Architecture course receive homework every few weeks that they have to solve and submit in small groups. One particular problem about data caching proved to be too hard for almost every group to get a grip on.

2. Planning a teaching activity

The goal of the teaching activity is to give the students a step-by-step guide to interpret, analyze and solve the problem.

The exercise text states a few facts about the data cache system, and asks the students to trace a list of memory address reads and find out if they are served from the cache or the main memory. The key to solving this problem is to visualize the cache structure and simulate how it would work in a real computer.

To help the students attack this type of problem, we will develop a step-by-step methodology of interpreting the pieces of information of the problem text and sketching the described cache system.

By having this guide, they will be able to solve any variant of this problem at the exam.

3. Trying it out in practice

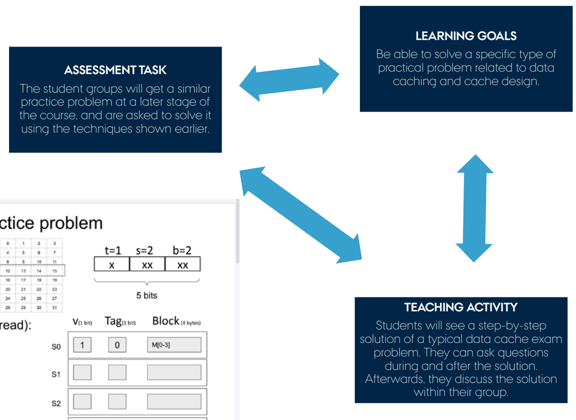
The teaching activity was carried out online via Zoom. At first, a typical instance of the problem was introduced to the class. Next, the critical pieces of information was identified in the problem text. Then the key step was discussed: interpreting the given information and drawing the defined data cache structure. Finally, the address trace was completed.

After solving the example problem the students had time to discuss the process in their groups, and reflect on what was not clear earlier.

The student learning was assessed later in the course when the groups received a similar practical problem. All groups submitted a solution, most of them the correct one.

MAIN POINTS

1. **Main problem/challenge:** Students had difficulty applying their knowledge about data caching to solve practical problems
2. **Teaching activity**: Present a step-by-step solution process, give them time to discuss and ask questions.
3. **How did it go?** After seeing the detailed process, most groups succeeded solving a similar problem.
4. **What to do next?** Extend the lecture about data caching with a step-by-step guide.



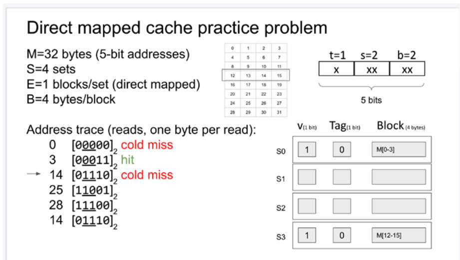


Figure 1: One stage of solving the cache problem by visualizing the system

4. Looking forward

It was very effective to show the students how to break down the practical problem to smaller steps, and how to simulate what's going on in the system when each step is executed.

We have concluded that the course material should be extended with the detailed description of how to apply the theoretical knowledge of data caching to solving this typical exam-level practical problem.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Marcell Fehér
Agile Cloud Lab
Department of Engineering

Understanding scientific articles

A method to familiarize students with scientific journal articles

Learning Lab

Abstract

Understanding scientific journal articles can be a daunting task for students. However, quickly extracting relevant information from scientific articles is an important skill for future academics. To familiarize students with scientific literature it is essential to increase their engagement with scientific articles. To achieve this, reading scientific articles, presenting and discussing them with peers in small groups and in plenum turned out to be a useful teaching activity to improve the students' handling of scientific literature. In the future, to increase the students' involvement in the discussion one might ask all the students to think about a specific question for the presenting group.

COURSE FACTS

- Course name: Ecology
- Level: Bachelor
- ECTS credits : 10
- Language: Danish and English
- Number of students: 25
- Your role: Teaching assistant in small classes

TEACHING IN PRACTICE

1. Identifying a problem

Scientific journal articles can be difficult to navigate for anyone unfamiliar with its structure. Most bachelor students have not gotten in contact with scientific journal articles so it can be very tiring and even daunting reading through scientific literature and extracting relevant information.
The aim is thus to familiarize students with scientific articles so they are getting used to the structure and the language of the scientific articles.

2. Planning a teaching activity

To become familiar with scientific literature students have to increasingly engage with scientific articles.
A way to achieve this is to instruct students to read through a scientific article on their own with the aim to be able to reproduce the main points in a structured way. Discussing the paper with other students and helping each other to understand the main points will then force the students to skim the article again and again and the students realize that specific information is found in predictable locations. The learning goal is that students feel confident and become more efficient navigating through scientific articles.

3. Trying it out in practice

Each student had to read one selected scientific article (of totally five different articles) before the course.
In a first step, the students had to group with four students that have read another article and each student had to present his article to the group.
Second, groups built of students that read the same article had to prepare a short PowerPoint presentation (consisting of five slides with the following content: introduction, methods, results, discussion, and personal opinion/critique of the article).
The third part of the course consisted of the presentation of the scientific article in plenum followed by a discussion of the article. The TA provided feedback after each presentation, zoomed out and highlighted the main points again.

The learning of the students was assessed by listening to the presentations of the students and by asking questions. The TA walked around during the second part of the activity and listened to the discussions in the small groups to uncover potential problems and to get a feeling of common issues.
The teaching activity worked out as planned and I was positively surprised about the students understanding of the articles and about their ability to present the articles in plenum in a concise way.

MAIN POINTS

1. **Main problem/challenge:** Students have problems understanding scientific journal articles.
2. **Teaching activity**: Presenting a scientific article in front of a small group and in plenum.
3. **How did it go?** All the student did a really great job and seemed motivated.
4. **What to do next?** Developing an appropriate tool to assess the learning outcome of the teaching activity.

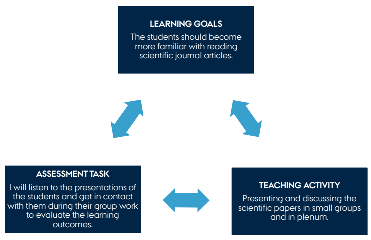


Figure 1: **Constructive alignment**

4. Looking forward

Overall, the teaching activity was a success. I was impressed by the students' skills of presenting the journal articles and it seems as if they are now more familiar with scientific articles. However, an objective evaluation of the teaching activity was missing like e.g. feedback from the students via a Mentimeter-questionnaire. To have a more active discussion in plenum one might ask each student to think about a specific question for the presenting group. This kind of teaching activity could also be used in master classes on more complicated scientific articles.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Vincent Fehr
Section of Ecoinformatics and Biodiversity
Department of Biology

Spectra Interpretation

- Solving Spectra like a Puzzle

Learning Lab

Abstract:

Solving spectra of organic molecules are an important tool for organic chemists. When learning how to solve spectra quite a few students can have a hard time finding the structure that fits them. This poster presents a teaching activity based on strips sequences where the students have used the strips sequences to get some degree of structure for solving NMR spectra. The overall impression based on the students feedback is that the teaching activity were successful but there are room for improvements.

COURSE FACTS

- Course name: Organic Chemistry I: Functional Groups and Reactions
- Level: Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 24 (on my team)
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

Solving the spectra of organic molecules can be simplified as doing a puzzle where you have to find the pieces first. Like a puzzle there is generally a logical order to solve the problem faster. This logical order can be difficult for students to find early on when they are introduced to spectra.

The teaching activity aims to get the students to think about this logical order before they start solving spectra.

2. Planning a teaching activity

The teaching activity uses strips sequences where the students will put the different strips in order and then compare with their fellow students. This should act as a good starting point for each student to find their own optimal order to solve spectra.

The strips will contain statements on what tasks you usually do when you solve a ^{1}H- or ^{13}C-NMR, but these statements can easily be applicable to IR spectra as well.

It is expected that some students will have a very good idea about how they will structure the spectra solving from previous experiences.

In addition, the teaching activity will be done on Zoom due to Covid-19.

3. Trying it out in practice

The teaching activity consisted of 3 main parts done before and during the first class: Preparation, strips sequence solution, and evaluation. The main part of the teaching activity will all be done on Zoom.

Before the first class the students were sent instructions for the first class as well as the strips sequences. They were tasked to put the strips in order before the class, but only spend around 5 minutes on it at most.

At the first class I gave a short introduction to what they were supposed to do over the next 4 weeks as well as an introduction to the teaching activity.

The students were asked to compare their sequences with each other in predetermined groups and then come up with a shared sequence. They were then asked to send that sequence to me by e-mail such that I had them.

These e-mails showed me that all groups came to the same overall structure as hoped and it were the first part of the evaluation.

I next gave a short presentation to the students using one of the orders to show how they can be used. In addition, the presentation served as an example to how they could present a predetermined problem at a later class. After the presentation the students were sent into groups again to solve as many spectra as they could.

MAIN POINTS

1. **Main problem/challenge:** Some students struggle solving spectra because of a lack of structure.
2. **Teaching activity**: Strips Sequence
3. **How did it go?** There are room for improvements but overall it seemed like the students benefitted from the teaching activity.
4. **What to do next?** Refine the teaching activity for future use.

At the end of the class the students were asked to answer an evaluation. In the evaluation they were asked to what degree the teaching activity had helped them:

25% said to a large degree
50% said to some degree
25% said to a small degree
0% said not at all

I also got a comment, that it would have been helpful if she had not already been though all of it extensively in high school.

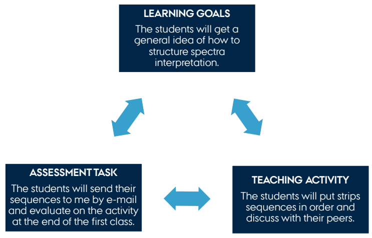


Figure 1: **Constructive alignment**

4. Looking forward

The teaching activity worked decently well despite having to be done on Zoom which made it a lot harder to interact with the students as I wanted to. In addition, the evaluation should have been postponed or redone at a later class as well. This would have given the students time to figure out if the teaching activity actually helped them in the long run which were the aim. Overall the teaching activity need some refinement in terms of the strips used and how much time the teaching activity uses.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Martin Frandsen
Gothelf Lab
iNANO

Be an examiner

- Generate your quiz questions on soil water repellency

Abstract:

The main challenge of an intensive course is to be sure that students have digested and grasp what they have been taught in a small amount of time. To tackle it, Quiz Questions and Think-Pair-Share are designed in the teaching activity in one of the lectures in this course. By asking students to think of quiz questions and their answers, it will help students to form a clearer framework of the topic they are taught. Discussing with their peers will help deepen their understanding and clear some confusion they may have encountered. These techniques can be adapted and applied in a very broad way in the future, for example, to refresh students' memories in the following lectures.

COURSE FACTS

- Course name: Advanced Soil Physics
- Level: PhD
- ECTS credits : 5
- Language: English
- Number of students: 12
- Your role: Teaching Assistant – will be giving one lecture on soil water repellency

TEACHING IN PRACTICE

1. Identifying a problem

The main problem of an intensive 5-day course is to make sure students fully understand crucial concepts and mechanisms in a given limited time. Specifically speaking, the topic I will be teaching is about a natural phenomenon. To be able to analyze and grasp the causes and reasons behind this phenomenon and the relevant issues, students are required to understand mechanisms they have been taught in the present and prior lectures. Solving this problem can maximize the outcome of this intensive course.

2. Planning a teaching activity

The teaching activity includes Quiz Questions and Think-Pair-Share[1]. The goal of these techniques is to enhance students' understandings of the topic and the memory of concepts, moreover, to link the knowledge they learned from prior lectures. Thinking of good and valid quiz questions requires students fully understanding class materials, as they need to think of both questions and answers. Think-pair-share will enable students share different aspects to deepen the understanding.

Learning outcomes
Understand the basic concepts and mechanisms of soil water repellency and its related issues; be able to link them with previous lectures from this course.

3. Trying it out in practice

a) Introduction

The lecture starts with introducing "what is soil water repellency (SWR)". Show students a few real soil samples and a video of this phenomenon in nature[2] (Fig.1).

Figure 1. A water repellent soil sample (left), the video clip (right).

b) Main Lecture

The causes of SWR, methods to quantify the degree of SWR, its natural effects, its application and remediation will be given as a regular lecture. Materials from prior lectures in this intensive course will be referred.

c) Quiz Time

Students will be paired and they will be asked to come up with two quiz questions that they would like to test other classmates. The questions should be posted on Padlet (Fig. 2). Keywords will be presented on the screen (Fig. 2).
The quiz questions and their answers will be required to send to TA for individual assessment.

d) Assessment & Evaluation

One question from each pair, in total six questions will be selected to test the whole class verbally. The pair who writes the question will serve as the examiner to check the answers and the TA will assess whether the answers are correct.
Students will be required to rate the usefulness of this activity and leave their comments on Mentimeter as evaluation.
The individual assessment will be done after class, based on questions and answers sent by students.

MAIN POINTS

1. **Main problem/challenge:** Understand the crucial mechanisms and build the knowledge framework in a limited time.
2. **Teaching activity**: Quiz Questions and Think-Pair-Share.
3. **How did it go?** Has not been implemented yet.
4. **What to do next?** To implement the activity

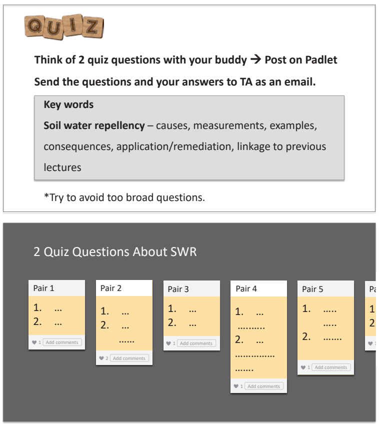


Figure 2: The slide of the guideline for this activity (top); the imaginary result on Padlet from the activity (bottom).

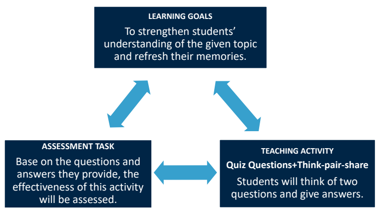


Figure 3: Constructive alignment of the teaching activity

4. Looking forward

As the activity has not yet been implemented, the actual results from this activity will be the first thing to anticipate. If the outcome is satisfying, these techniques can be modified and applied in other lectures in this course. The time and guidance might need to be adjusted which shall be based on the real results and feedback.

References

1. Active Learning And Adapting Teaching Techniques, University of Toronto
2. https://www.youtube.com/watch?v=3a02Bf8977s

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Yuting Fu
Soil Physics and Hydropedology
Department of Agroecology

Organized Spectral Analysis

- Helping students to solve problems more easily

Learning Lab

Abstract: To help students to learn how to identify unknown compounds using the information from the spectra a Strip-Sequence teaching activity is presented herein. This teaching activity demonstrates an approach where students learn a sequence of steps required to identify the unknown compound efficiently. As students are often confused by loads of information obtained from the spectra this approach would be a suitable way for analysis in an organized way and it should help students to draw conclusions about the compound more easily. The teaching activity is also open for modification based on the questions from students and general feedback.

COURSE FACTS

- Course name: Organic Chemistry I Laboratory Exercise
- Level: BSc
- ECTS credits : 10
- Language: Danish/English
- Number of students: 19
- Your role: instructions in the lab and during online sessions

TEACHING IN PRACTICE

1. Identifying a problem

Spectra exercises for the first-year students are likely to be a mind-boggling experience as the extraction of the information from the IR, NMR and MS spectra is not easy for a first year student and requires intense TA' s guidance. The main issue is the lack of structure on how to approach the problem, thus, the aim is to provide the students with a plan for efficient analysis of the spectra which will help to make logical conclusions more easily and guess the molecular structure correctly.

2. Planning a teaching activity

The students are intended to learn how to interpret NMR, IR and MS spectra and also practice their analytical skills. They should identify functional groups corresponding to the bands in IR, assign NMR peaks and identify molecular ions in MS. However, there is some difficulty on how to approach the problem not even in gathering information from the spectra, but also summing up the data which would lead to a proper conclusion. Therefore, the students need to know the sequence of necessary steps and the order on how they will gather the information and use it to make conclusions about the unknown compound. That is where *Strip-Sequence* teaching activity comes into play as it would help student to adopt the efficient and clear analysis algorithm. This teaching activity should make the analysis a bit smoother.

3. Trying it out in practice

Students are asked to make a flowchart based on the spectra analysis guide provided by the course coordinator. The students work individually. Then, they are asked to pair up and compare his/her flowcharts (*Think-Pair-Share*).

Subsequently, TA asks students to form groups of 4 people and the groups will be given 10 strips with notes. The instructor asks the groups to list these notes in a logically correct order (*Strip-Sequence*) (**Fig. 1**). TA works with individual and at the end presents the correct order of strips. The example of lesson plan for implementing teaching activities:

- TA gives a brief theory (10 min)
- Students make flowcharts in pairs (25 min)
- Students tries to put the strips in a logical order in groups of four (15 min)
- TA helps the groups individually and shows the correct order (10 min)

After *Strip-Sequence* activity the students are asked to determine a few molecular structures from the exercise book and present their analysis procedure and results. TA will provide feedback and address mistakes.

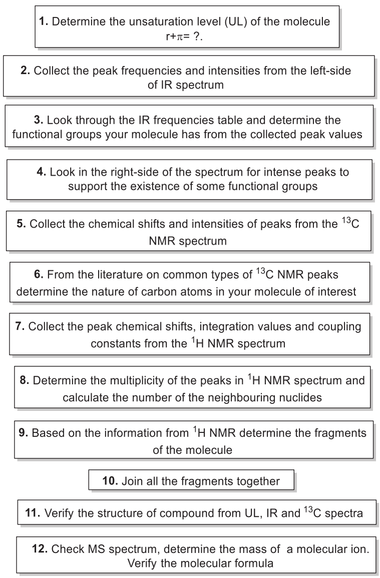


Figure 1. An example of the list of strips.

4. Assessment

Students are given to determine one molecular structure before the end of the class and provide an answer as "*Ticket-out-of-the-door*". The results are then sent to students and the overall result is presented as a column chart (**Fig. 2**) to the whole class during the next session.

MAIN POINTS

1. **Main problem/challenge:** Extracting and using relevant information from IR, NMR, MS spectra.
2. **Teaching activity**: Think-Pair-Share, Strip-Sequence, Ticket-out-of-the-door.
3. **How did it go?** Generally, students had a positive opinion on Strip-Sequence. It helped them to perform an easier analysis.
4. **What to do next?** Possibly, it would be better to make student presentation part a bit shorter so students would have more time to practice.

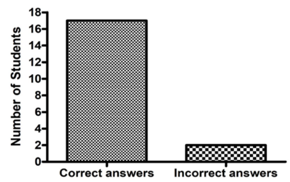


Figure 2. The number of students who guessed the structure correctly vs incorrect answers. Overall evaluation of the teaching activity.

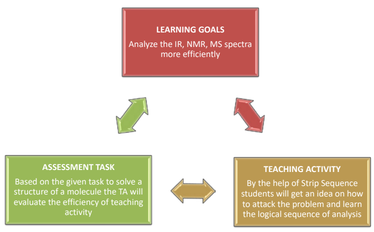


Figure 3. Constructive alignment

5. Looking forward

Due to the close down of the university this teaching activity was employed to a lesser extent via ZOOM. This activity could be used in the same course next year as students generally had a positive feedback. They appreciate the guidelines which make the task easier to analyze and solve. For an improvement, student presentations could be shorter as they would have more time to analyze the spectra.

References
- Active learning and adapting teaching techniques (from Toronto University).
- Posters from "Conference Proceedings Spring 2019"

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Laurynas Gausas
Prof. Troels Skrydstrup Group
iNANO

Stimulating creative thinking during small classroom teaching

Combining think-pair-share, group work and ticket out of the door in small classroom teaching for teaching about glacier algae and PAM fluorometry

Learning Lab

Abstract: I used a set of activities to teach a small group of students having diverse backgrounds (Bachelor, Master and PhD's). The learning goal was to stimulate creative thinking and to challenge the students by applying their previously learned knowledge onto a new subject. This task is often neglected in other lectures but an important skill to have. I combined the think-pair-share activity with an open general question and a group work including drawing of the results on paper to achieve this. Ticket out of the door was used to assess student learning. I got good feedback and I was able to spark interest in the new subject. The next step is to structure the group work better through handing out work sheets, since the available time was a bit too short.

COURSE FACTS
- Course name: Sea Ice Ecology
- Level: Bachelor/Master/PhD
- ECTS credits : 5
- Language: english
- Number of students: 12
- Your role: Guest lecturer (trial class)

TEACHING IN PRACTICE

1. Identifying a problem

The group of students had diverse backgrounds and educational levels and to apply the learned knowledge about PAM fluorometry onto a new experimental set-up is challenging and requires creative thinking (Biggs 2012). This thinking is often not enough stimulated in lectures. The aim of this lecture was therefore to spark interest into the new subject and to challenge the creative thinking of all students with their different backgrounds, a skill needed in science (Fig. 3).

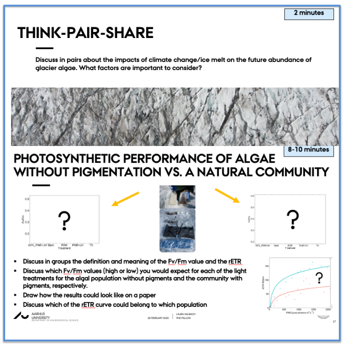


Figure 1: Think-pair-share and group work instructions

2. Planning a teaching activity

The think-pair-share activity will activate the students and also induce communication between students with different backgrounds, the open question given out to the students further requires creative thinking (Goodwin 1999). The group work will bring new students together and give them space to communicate. Since they have to apply their newly learned knowledge onto a new subject, they have to think first creatively and then also are challenged to draw the results onto a graph, this exercise certainly challenges the students and therefore helps to address the goal of the lecture. The bigger groups give also space for the few PhD students of the course to answer questions from the other students with a Master and a Bachelor study.

3. Trying it out in practice

The Teaching activity consisted of three parts:

- first the think-pair-share activity (Fig. 1+2): For this the students were supposed to chat in groups of two or three, and talk about an open question. The questions (how will climate change affect the future abundance of glacier algae?) was an open question and gave space for creative thinking and a bit of speculation.

- The next activity (after some more slides with me talking) was a group work (Fig. 1): Groups of 5 people were formed and the students got the task to solve a question and apply their previously learned knowledge onto a new experimental set-up. They were also asked to draw their answer in form of a graph onto paper. Afterwards, I asked the groups to present their results. There was only time for one group to present their results.

- After the lecture I handed out several tickets out of the door (Fig. 4) to assess weather they got interested into the subject, what was challenging and also asked about suggestions to improve my lecture.

Figure 2: Think-pair-share activity in the classroom

MAIN POINTS

1. **Main problem/challenge:** How to teach students with different learning levels (Bachelor to PhD range)?
2. **Teaching activity**: Think-pair-share, group work incl. drawing and ticket out of the door
3. **How did it go?** It worked out well and the feedback from the students was very good
4. **What to do next?** Prepare clear work sheets for students next time and structure group work more

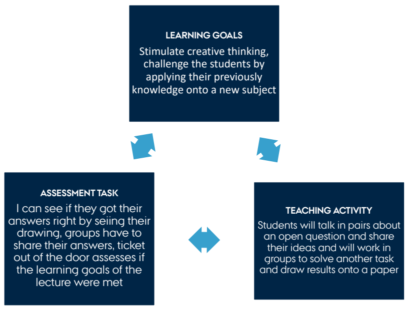


Figure 3: Constructive alignment of learning goals, teaching activity and assessment task

TICKET OUT OF THE DOOR

What was most exciting in this lesson?

What surprised you?

What was the hardest part of the lesson?

What did you like about this lesson?

What could be improved in my teaching skills?

Figure 4: Ticket out of the door

References

Biggs, J., 2012. What the student does: teaching for enhanced learning. High. Educ. Res. Dev. 31, 39–55.

Goodwin, M. W., 1999. Cooperative learning and social skills: What skills to teach and how to teach them. Intervention in School and Clinic, 35, 29–33.

4. Looking forward

The think-pair-share activity is such an easy but powerful activity and stimulated the creative thoughts of all students. The group work, also including the drawing of a result into a diagram challenged the students. Designated worksheets printed out with the questions and a blank diagram could have helped them to solve the question easier. Next time, less is more: I would try to create a shorter and easier groupwork. The ticket out of the door helped me to get feedback for the lesson.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Laura Halbach
Cryo-microbiology group
Environmental Science

Differentiating mechanisms

- Structured problem solving to differentiate between different reaction types

Learning Lab

Abstract: One of the mayor problems in organic chemistry is to differentiate between different reaction types. This teaching activity describes how flowcharts can be used to make this problem more simple and easier for the students to solve. The flowcharts for three different starting materials were made in collaboration with the students and provides them with a product that can be used at the exam. Ticket out the door assessment showed that 90 % of the students was able to solve the problems using the flowcharts.

COURSE FACTS

- Course name: Organic Chemistry I
- Level: 1st year bachelor course
- ECTS credits : 10
- Language: Danish
- Number of students: 18
- Your role: TA at theoretical exercises

TEACHING IN PRACTICE

1. Identifying a problem

One of the mayor problems for students in first year organic chemistry courses is differentiating between the large number of chemical reactions and their mechanisms. This is especially a problem for the mechanisms for the different substitution and elimination reactions, as these share some of the same reagents.
The mechanism can be found by analyzing the molecules and conditions for the reaction.

2. Planning a teaching activity

The goal of the teaching activity is to give the students a tool to differentiate between the five difference substitution and elimination reactions; S_N1, S_N2, E1, E1cb, and E2. This will be achieved by making flowcharts which should make it possible to predict the reaction type.
The flow charts will be made as a collective effort by discussing each part in plenum.
The main way to distinguish between the mechanisms is by analyzing the two reacting molecules. This can be troublesome since the mechanisms can be effected by a lot of different parameters.
By making the flowchart the students only have to consider one parameter a time, which will make the problem easier to solve.

3. Trying it out in practice

The activity was carried out online utilizing Zoom. At first the mechanisms of the five different reactions was discussed in plenum. Then empty flowcharts were showed on a shared screen and filled in a discussion between the TA and the students.
In the end three different flowcharts for three different starting materials had been prepared (Figure 1).

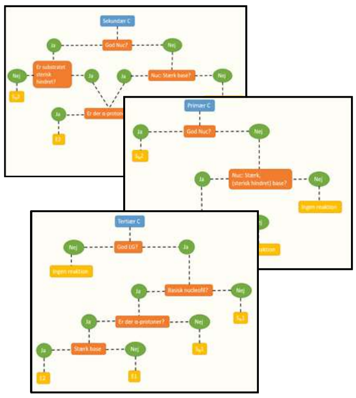


Figure 1: The three flowcharts prepared in the teaching activity.

After preparing the flowcharts a couple of reactions was solved using the charts. Due to the simplification of the charts, the limitations of using them was discussed.
At the end of the class an online ticket out the door to assess the student learning and to evaluate the teaching activity.

MAIN POINTS

1. **Main problem/challenge:** Differentiating between five different mechanisms
2. **Teaching activity**: Structured problem solving combined with online ticket out the door.
3. **How did it go?** Most students where able to solve the problems and the evaluation was positive.
4. **What to do next?** Expand the flowcharts to cover more reaction types.

4. Assessment

The activity was assessed by an online ticket out the door performed utilizing Mentimeter (Figure 2).
In this assessment the students should predict the mechanism of two reactions. The reactions was solved with 90 % success.
In addition to the assessment, the students was asked to rate the outcome of the exercise from 1-5 and give comments. The average rating was 4.4 and the comments was positive.

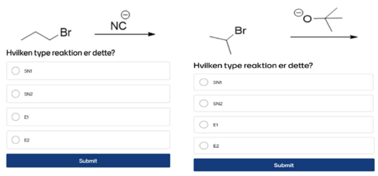


Figure 2: Online ticket out the door performed using menti.com.

4. Looking forward

Based on both the feedback and the assessment the teaching activity was successful. 90 % of the students was able to predict the reaction mechanism upon preparing the flowcharts. To improve the teaching activity the flowcharts could be expanded to cover more than these five reactions.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Rikke Hansen
Gothelf Lab
iNANO and Chemistry

How to reduce the ECHO

- The art of reducing pulse-sequences

Abstract: Write a short abstract here

In the course Structural Chemistry IIa the students are expected to be able to utilize pulse-sequences, a series of mathematical operations used to interpret what type of signal is produced from the sequence, but this is usually difficult. By learning to identify common building-blocks pulse-sequences become much more manageable to utilize by reducing the number of mathematical operations that need to be carried out. Results have not been obtained as the teaching activity was not implemented.

Learning Lab

TEACHING IN PRACTICE

1. Identifying a problem

In the course the students are expected to learn to write up and reduce pulse-sequences, this topic is difficult for the students as it involves both Quantum-chemistry and magnetism. The pulses are usually built from common building blocks called ECHOs which can simplify the sequence. Knowing how to identify these ECHOs and how they reduce to simpler operations enables the students to quickly attain a simple sequence.

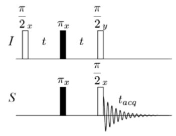


Figure 1: **A figure of an NMR experiment.**

In the figure above is an example of a pulse-sequence and the operations corresponding to the figure is:

$$\xrightarrow{\frac{\pi}{2}I_x}\xrightarrow{\omega_I t I_z}\xrightarrow{\omega_S t S_z}\xrightarrow{\omega_J t 2I_zS_z}\xrightarrow{\pi I_x}\xrightarrow{\pi S_x}\xrightarrow{\omega_I t I_z}\xrightarrow{\omega_S t S_z}\xrightarrow{\omega_J t 2I_zS_z}\xrightarrow{\frac{\pi}{2}I_y}\xrightarrow{\frac{\pi}{2}S_x}$$

Figure 2: **Pulse-sequence corresponding to the NMR experiment in Figure 1**.

Where each arrow represents a mathematical operation. By identifying the ECHOs present in the figure the sequence can be reduced to:

$$\xrightarrow{\frac{\pi}{2}I_x}\xrightarrow{\pi I_x}\xrightarrow{\pi S_x}\xrightarrow{\frac{\pi}{2}2I_zS_z}\xrightarrow{\frac{\pi}{2}I_y}\xrightarrow{\frac{\pi}{2}S_x}$$

Figure 3: **The reduced pulse-sequence from Figure 2.**

2. Planning a teaching activity

The teaching activity will familiarize the students with the building-blocks of NMR pulses, in the future they will be better at recognizing the ECHOs and this will enable them to reduce the pulse-sequence and thus enable the students to properly utilize the reduced sequence.

3. Trying it out in practice

The students receive pictures of the 4 different ECHOs, along with their full pulse sequence and the reduced sequences. The students are then paired up and have to mix and match, the figures, the full pulse. sequence and the reduced pulse sequence. After 15 mins the pairs are split up and paired with new students. These new pairs now compare their solutions and alter if necessary and discuss them. It will end with a quiz/poll to access whether the learned the skill. Before and after the exercise a poll will be conducted, where the students will answer how confident they are in their abilities in reducing pulse-sequences, and comparing the two polls will enable us to see if this has been improved by the exercise.

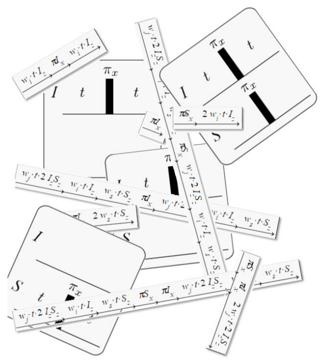


Figure 4: **Strips for teaching acitivity.**

COURSE FACTS

- Course name: Structural Chemistry Iia: Spectrscopy in organic Chemistry
- Level: Bachelor
- ECTS credits : 5
- Language: Danish
- Number of students: 58
- Your role: TA in Theoretical excercises

MAIN POINTS

1. **Main problem/challenge:** Identify ECHO and correlate with reduced sequence
2. **Teaching activity**: Mix and Match
3. **How did it go?** Was never conducted
4. **What to do next?** Conduct the exercise and receive feedback.

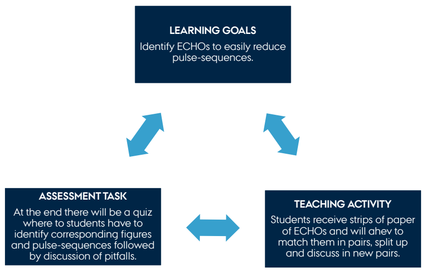


Figure 5: **Constructive alignment.**
Figure showing the correlation between the learning goals, teaching activity and assessment of the excercise for the students.

4. Looking forward

The excercise has still not been implemented, so this would be the first course of action. With the planned feedback the excercise could be improved through the participant feedback

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Name etc. should be added on your final poster but not on your draft poster
Magnus Hansen-Felby
Organic Surface Chemistry
Department of Chemistry

How to understand 3D (through 2D online teaching)

- Using homemade tetrahedra to assign chiral centers

Learning Lab

Abstract: Understanding 3D structures and using it to solve exercises can be difficult for students limited to 2D online teaching. The activity sets out to improve the students' spatial understanding and aid comprehension of the steps for assigning configuration of chiral centers. This is done through a contest ("Who can make the best/most creative/most illustrative tetrahedra??") together with group discussion and peer-review. The students were happy with the activity, but suggested to implement it earlier in the semester, test their understanding in practice through exercises and do a plenary recapitulation.

COURSE FACTS

- Course name: Basic General and Organic Chemistry
- Level: Bachelor, 2nd semester
- ECTS credits : 10
- Language: Danish
- Number of students: 11
- Your role: Teaching assistant for theoretical exercises (problem solving).

TEACHING IN PRACTICE

1. Identifying a problem

From discussions with the course lecturer and another TA who had taught the course before, it became clear that a challenge for the students is the configuration of chiral centers in molecules. It is a central concept in the course and always appears in the final assessment. Despite this, it has been seen both in the final assessment (by the lecturer) and through the continuous assessment of mandatory exercises (by the other TA) that many students struggle with it. Obtaining a good spatial understanding can be a challenge when only reading about it and solving exercises in 2D – however, now that the teaching is online and has been limited to 2D as well, it is even more difficult for the students to visualize. The aim is to provide tools to help them in this regard.

2. Planning a teaching activity

Without tools to help visualize 3D structures, it will remain a hurdle. This is one of the things, the activity will address to aid understanding of one of the steps for assigning the configuration. The remaining steps will be discussed in small groups using my handout "recipe for assignment" (fig. 1).

Using various activities, such as a creative task, a competition for motivation, group discussions, and peer evaluation/ feedback, the goal is to give the students better conditions for fulfilling the course learning outcome: "***Describe** and **assign** configuration of chiral centers in molecules.*" (1)

References

(1) Jørgensen, J.E.. (s.d.). *AU Course Catalogue*. Basic General and Organic Chemistry. https://kursuskatalog.au.dk/en/course/97313/Basic-General-and-Organic-Chemistry

(2) University of Toronto. (s.d.). *Science Teaching course page: Course day 1*. Active Learning and Adapting Teaching Techniques.

3. Trying it out in practice

The teaching activity can be summarized in the following way:

Week 1:

- At the end of class: Introduced the plan of having the activity. Sent an email-summary of their out-of-class task.
- Out-of-class: The students were encouraged to make tetrahedra in creative ways and use them for solving/correcting exercises.

Week 2:

- Reintroduce plan for activity.
- Breakout rooms: Groups of 2-3 students discuss questions in "recipe" and upload answers to Padlet (fig. 1). Afterwards: Peer-review the answers of one other group.
- Using Mentimeter: Evaluation of the activity and voting for the best/most creative/most illustrative tetrahedra.

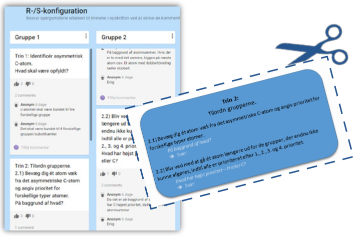


Figure 1: Step 2 from "recipe" for assigning the configuration of chiral centers (right), and excerpt from the Padlet used to share the students' answers (left).

The learning goal was assessed by reading the students' answers to the questions and comments to the other groups. Additionally, it was assessed by the student evaluation of the activity (fig. 2), which functioned somewhat like a "ticket-out-the-door" (2).

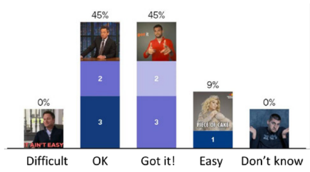


Figure 2: "Evaluation of their feelings towards R/S after the activity. The bottom number in split boxes indicate answers to how they felt before the activity.

MAIN POINTS

1. **Main problem/challenge:** Difficult to assign configuration of chiral centers – especially without a spatial understanding.
2. **Teaching activity**: Making tetrahedra, answering questions in "recipe", and evaluating the input of peers.
3. **How did it go?** 6-7 of the students made tetrahedra. The overall activity was rated "good" by 11/11 of the students.
4. **What to do next?** If I shall teach the same course again, the activity will be implemented earlier in the semester with exercises to test their understanding.

From the evaluation, it was seen that 6/11 students felt more comfortable with the topic after the activity compared to before (fig. 2), and 6/7 students who made tetrahedra thought they could use them. Their suggestions for improvement were to implement the activity earlier, to make it last longer and to use the recipe in practice.

Figure 3: Pictures of the students' tetrahedra with creative solutions ranging from almonds to pieces of garden hose. The student-selected winner of the most creative/illustrative contribution was the cork tetrahedron.

4. Looking forward

The idea of the activity was good, as seen from evaluations, but not all students did the out-of-class task. This could be circumvented by bringing materials to a physical class, but this would give them less flexibility and room for creativity.
In the future, it would make sense to implement the activity earlier in the semester when the relevant exercises are covered – this would simultaneously give more time to follow up on the exercise and use the recipe in practice.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Xenia Hassing-Hansen
Inorganic Chemistry / Materials Chemistry
Department of Chemistry

Solving exercises with spider webs

- Connecting the mathematical dots

Abstract: Students new to university level mathematics often struggle to solve exercises. One issue is that they have trouble understanding how the different elements of the theory is connected. By creating a spider web they will be forced to think about which methods apply to which concepts. Unfortunately it was not possible to try it in practice due to COVID-19.

COURSE FACTS

- Course name: Numerical Linear Algebra
- Level: 1. year bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 71
- Your role: TA - Conducting exercise classes, grading assignments

TEACHING IN PRACTICE

1. Identifying a problem

The students often have problems solving the exercises. This is an issue in this course and in almost every other mathematics course. Often the students doesn't understand how the different methods and concepts connects to each other.

Mathematical theory is structured in layers. Concepts are defined. Then you have theorems which can tell you something about the definitions. The theorems have assumptions which often is described in the definition.

An example from the course is numerical integration: The students are presented a number of ways to integrate numerically. Later the students are expected to use numerical integration when computing the discrete Fourier transformation.

2. Planning a teaching activity

The students will be given a list of concepts/methods from the course. Then they will have to connect the different concepts in a spider web. This will force them to think about what each method do and to which elements they apply. Hopefully it will also give them insight into how solve exercises with different concepts, as they have learned to connect mathematical concepts and methods.

3. Trying it out in practice

Unfortunately due to COVID-19 all teaching was moved online, and after a couple of weeks of online teaching the students stopped showing up to class. Hence the activity was not tried in practice.

Detailed lesson plan

- The students will be divided into small groups.
- The TA will present the list of concepts and instruct them to make a spider web.
- When the students have completed their spider webs they are asked to solve a number of exercises which uses the concepts and methods from the spider web.
- In particular they will be asked to identify which part of the spider web is relevant for each exercise.
- At the end there will be a class discussion, discussing the exercises and whether or not they found the spider webs useful.

MAIN POINTS

1. **Main problem/challenge:** Students find it difficult to find the right methods to use for solving exercises.
2. **Teaching activity**: Creating a spider web and using it solve exercises.
3. **How did it go?** It did not.
4. **What to do next?** Actually try it in practice.

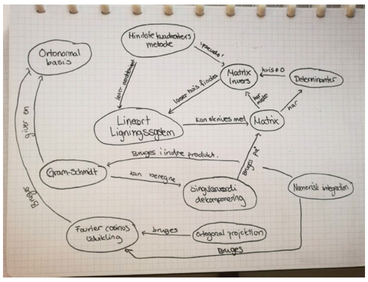


Figure 1: Example of a possible spider web for the given words.

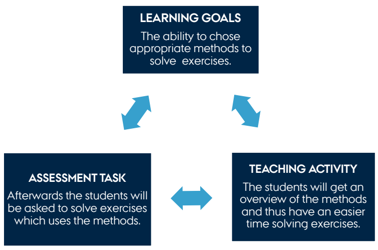


Figure 2: **Constructive alignment**

4. Looking forward

Unfortunately I was not able to carry it out in practice. I hope it will be possible in a future course.

Learning Lab

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Helene Hauschultz
Department of Mathematics

- Mind map exercise

Helping students in independent research

Learning Lab

Abstract:

This course is based on an independent, research project. The project is usually defined and lead by the student(s) with a close guidance of supervisor(s). The project is both theoretical and experimental based. The learning outcome of the project, is that the student should be able to identify, limit and formulate a scientific problem based on scientific literature survey. Many students often have problems kickstarting their research due to lack of organizational skills. A mind map is an effective method to organize and keeping track of complex information. A supervised mind map sessions was performed with the student in the initial phase of the project, to decompose the important parts of the project in blocks.

COURSE FACTS

- Course name: Research and Development Project in Engineering
- Level: Master
- ECTS credits : 5/10
- Language: English
- Number of students: 1
- Your role: Co-supervisor

TEACHING IN PRACTICE

1. Identifying a problem

Since many students are used to getting their topics, reading-materials and problems handed out by their teachers throughout their educational-life, they have trouble conducting and planning their own learning. The students often feels confused, lost and don't know how to tackle the project. Therefore, as a supervisor, it is important at beginning of the course to help the students understand the problem, possible solutions and formulate a proper research questions.

2. Planning a teaching activity

The student(s) will learn to break down a complex project in blocks, so he/she can get a better overview. At beginning the student, should figure out what the problems are. In many instances, students look for solutions, without understanding the issues completely. In this course, the project is defined by the TA (me). The students will be given a short introduction to the project, where keywords are emphasized before he starts, his research and study period. This is to avoid that he waste a lot of time and reduce the chance of him getting lost by looking in the wrong directions. On a weekly basis, the student will be asked to present his findings, and what kind of problems, he has encountered and how this can be used to solve his problems. He will be asked to write research questions and a mind map related to his findings – here he will get some assistance from the TA. The most important learning outcome is the critical thinking and the independent drive.

3. Trying it out in practice

The teaching activities have been done online. The student have been handed several research papers in the project domain. The teaching activity is to learn the student to formulate research questions. The TA, presents the concept of Mind map. The student was given 1 hour to construct a mind map.

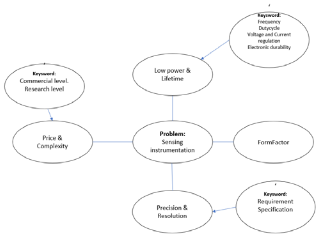


Figure 1: **Mind map of the project**

After constructing the mindmap, it was much easier for the student to grasp the project – by having a better overview. He was able to formulate a set of research questions . He was also able to choose a good approach for solving the technical problems. The Mind map has also been a good tool for assessment of the student's approaches, and basic knowledge in the project domain.
From this the TA, could know how much assistance and help the student needed.

MAIN POINTS

1. **Main problem/challenge:** Students must conduct their own research and experiments. They can feel lost and do not know how and where to begin from,
2. **Teaching activity**: Presentation and discussion of his findings. Mind mapping exercise
3. **How did go?**: The student was able to create a better overview of all his knowledge.
4. **What to do next?** Use the evaluation and assessment results to make improvements.

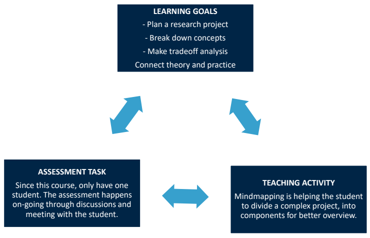


Figure 2: **Constructive alignment**

4. Looking forward

The next plan is to do something similar with the experimental part of the project. The student didn't feel confident at start of this course – but through this method, he seems more confident and independent, and he knows now how to tackle the problem theoretically. It will be good to see, if the concept can be used for a practical purpose, when we are going to do the experimental part of project.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Jaamac Hassan Hire
Integrated Nanoelectronics
Department of Engineering

Prepare to Learn

- Evaluating student knowledge in order to build a solid learning foundation using TPS-based methods

Learning Lab

Abstract: A university education is usually build up from a series of courses and projects. While it may in some cases not seem so, the courses are mostly interconnected building upon each other in a progressive manner. However, courses may change over the years, which requires TA's and professors to be vigilant when it comes to what the students actually know from earlier courses. In this teaching activity, the student's knowledge about simple quantum mechanics and linear algebra is probed with a perspective to what knowledge is needed as a basic foundation for the microscopic physics part of the course "Fysisk Kemi I: Termodynamik og Statistisk Mekanik". The chosen teaching activities serve as a quick brush up for the students.

COURSE FACTS

- Course name: Fysisk Kemi I: Termodynamik og Statistisk Mekanik
- Level: 2nd year
- ECTS credits : 10
- Language: Danish/English
- Number of students: ~25 per classroom session.
- Your role: TA in classroom teaching.

TEACHING IN PRACTICE

1. Identifying a problem

With course curriculum changing in supporting courses it is important to ascertain which tools the students may be missing at an early stage so a solid foundation for student learning can be constructed or improved.
For the microscopic physics part of the course considered here, it is my experience that the students often struggle with simple quantum mechanics as well as a few relevant concepts from linear algebra.
A teaching activity is developed here, which serves to uncover lacking student knowledge (this can be used to improve the course subsequently and tailor the teaching) and give a brush up on existing knowledge on these subjects.

2. Planning a teaching activity

In order to uncover concepts which are difficult for the students to grasp, a Mentimeter quiz with questions covering some of the basics of quantum mechanics, including relevant concepts from linear algebra, is prepared. This incudes subjects such as eigenvalue equations, construction of operators in quantum mechanics, the physical interpretation of wave-functions using the Born rule and other relevant aspects from the course literature.

In order to asses student learning, a short One-Minute-Paper (OMP) [1] is handed out after the quiz containing three questions relevant to the quiz-content. In the OMP the students also get to practice how to apply the concepts brushed up in the quiz. This, along with the Mentimeter quiz, should result in a more solid foundation for student learning.

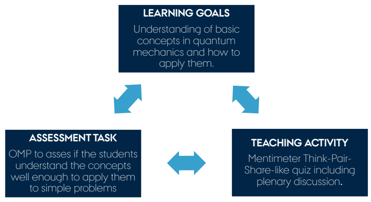


Figure 1: Constructive alignment diagram showing how the teaching activity and assessment task support the learning goals.

3. Trying it out in practice

As I have not been teaching during the last quarter the teaching activity presented here will first be tried out during the next semester.

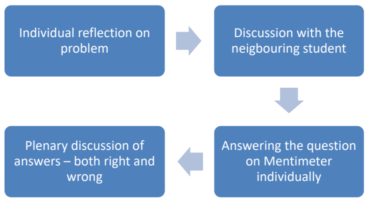


Figure 2: Illustration of the process of the TPS-like Mentimeter quiz.

The quiz is carried out in a Think-Pair-Share-like (TPS) manner [2], where a multiple choice question is presented on the projector. The students are given 1 minute to reflect individually, 1 minute to discuss with the person next to them, and then answer the question individually in Mentimeter. A short plenary discussion of the answers is then carried out. Compared to an individual quiz, the students get to discuss with their peers which serves to highlight aspects they may not have considered individually. Plenary discussion of both right and wrong answers helps to avoid mis-conceptions.

MAIN POINTS

1. **Main problem/challenge:** University courses build upon each other, why it is important to ascertain what students know before trying to build upon perhaps non-existing knowledge.
2. **Teaching activity**: TPS-like quiz on basic quantum mechanics concepts followed by a One-Minute-Paper.
3. **How did it go?** The activity has not yet been tested.
4. **What to do next?** Test the activity in practice.

After the quiz, a short OMP with 3 questions relevant to the quiz-content is distributed. The students answer these individually and hand in the OMPs anonymously. Correct answers are made available online.

In order to evaluate the teaching activity, a questionnaire is handed out during the classroom session in the following week. Here, the students are asked to rate their outcome based (among other things) on if they felt the teaching activity had an effect on their preparation for this classroom session.

4. Looking forward

As the teaching activity has not been tested yet, no data has been collected as to conclude what went well and what could be improved. Looking forward, the teaching activity will be implemented next semester.

References

[1] Angelo, T. A . & Cross, K. P. (1993), Classroom Assessment Techniques – A Handbook for College Teachers, John Wiley & Sons, 2nd edition.

[2] Kagan, S. (1994). Cooperative Learning. San Juan Capistrano: Kagan Cooperative Learning.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Kristoffer Holm
Center for Materials Crystallography
Department of Chemistry

Replication, transcription or translation?

Improving the overview of the central dogma of molecular biology with a strip puzzle

The course 'Fundamental Molecular Biology' aims to give students an overview and understanding of the processes of the central dogma of molecular biology. However, many students struggle with achieving a good overview. To address this challenge a strip puzzle was developed consisting of strips with statements related to one, two or all three processes of the central dogma. During the activity students will assign the statements to the process(es) and thereby train to explain, compare and relate concepts across the curriculum in a group discussion. The teaching activity has yet to be implemented in class, but has been offered as an optional out-of-class activity for exam preparation. In the future, the activity could easily be expanded to include additional or other statements or modified to address related challenges students often face in the course.

COURSE FACTS

- **Course name**: Fundamental Molecular Biology
- **Level**: Bachelor (2nd semester)
- **ECTS credits** : 10
- **Language**: Danish
- **Number of students**: 20-25 students per class
- **Your role**: Teaching assistant at theoretical exercises

TEACHING IN PRACTICE

1. Identifying a problem

The main learning goal of the course 'Fundamental Molecular Biology' is to achieve an overview and understanding of the processes of the central dogma of molecular biology: replication, transcription, and translation. However, based on experience from the course coordinator and fellow teaching assistants, a major challenge students encounter is reaching a good overview of the processes. Students often confuse the processes and lack overview of how the processes are related and compare. It is very important that students achieve this comprehension as it provides them with basic knowledge that is the foundation for mastering more advanced courses and projects in their educational programme.

2. Planning a teaching activity

The teaching activity aims to solve this challenge by making students recall, explain, compare, and relate key terms and concepts covered across the curriculum and decide which process or processes the terms/concepts are true for. Moreover, the activity results in a concrete product students will be encouraged to use as a starting tool for continued work and exam preparation. Thus, the learning outcome of the teaching activity is to reach a better overview of the similarities, differences and relationship between the processes of the central dogma of molecular biology.

3. Trying it out in practice

Teaching material

The strip puzzle consists of strips with statements concerning the processes of the central dogma of molecular biology. The statements are true for either one, two or all three processes. During the activity students should assign the statements to the correct process(es) (Fig. 1).

Figure 1 The strip puzzle Statements (orange) assigned to the correct process (blue) or processes (green)

Implementation

The teaching activity was developed as an in-class activity, however it was only implemented as an optional out-of-class activity available as a tool for exam preparation due to the COVID-19 lockdown. Assessment and evaluation was not included in the out-of-class version. The intended workflow of the in-class version of the activity is illustrated in Fig. 2. Students will initially work in pairs and subsequently discuss their answers in groups of pairs. The activity will be concluded by a classroom discussion.

MAIN POINTS

1. **Main problem/challenge:** Students struggle with achieving a good overview of the processes of the central dogma of molecular biology
2. **Teaching activity**: Strip puzzle: assign statements to the correct process(es)
3. **How did it go?** Activity was offered as an optional out-of-class activity.
4. **What to do next?** Implement teaching activity in class

Assessment and evaluation

Assessment of student learning will be conducted by inspection of the answers students upload in Padlet both before and after the group work session. Student evaluation of the teaching activity will be performed by a brief questionnaire in Mentimeter immediately after the activity. Figure 3 illustrates the constructive alignment of the teaching activity.

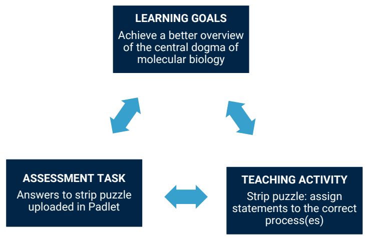


Figure 3 Constructive alignment

Figure 2 Workflow

4. Looking forward

The teaching activity has not been implemented in class yet, but I expect some optimization in regards to the level of difficulty and adjustments of time provided for the activity may be required after the first implementation. In the future, the activity could easily be expanded to include additional or other terms and concepts or modified to address a related common challenge students encounter: namely achieving an overview of which concepts and terms that are general for the process(es) and which that are specific for prokaryotes and eukaryotes, respectively.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Camilla Myrup Holst
Department of Molecular Biology & Genetics

Steps for straightforward modeling

- Reducing the level of complexity with a set of strip sequences

Learning Lab

Abstract: MEMS study course is about designing and fabrication of micro-scale electromechanical devices. The course is organized in two parts; theoretical and experimental. In the theoretical part, students use a multi-physics software called COMSOL[1] for designing a piezoelectric actuator. Students often feel confused because of different available physics they face when for the first time start to make a model in the software. The goal of this teaching activity is to reduce the complexity of the modeling in the software by providing a set of strip sequences. The learning goal is to solve every multi-physics model step-by-step in micro-scale devices and presentation of results.

COURSE FACTS

- Course name: MEMS study course
- Level: Master
- ECTS credits : 5
- Language: English
- Number of students: 5
- Your role: Teacher Assistant (TA)

TEACHING IN PRACTICE

1. Identifying a problem

In the theoretical part of the MEMS study course, students intended to be learned how to do multi-physics simulations of micro-scale devices. They are engineering students with general background in different physics, however they feel embarrassed when they face with a problem which needs to be computed with several physics simultaneously. Therefore, the aim of the teaching activity is to reduce the complexity of modeling in the software by providing a set of strip sequences.
As an example, students should simulate a piezoelectric transmitter in a fluid media where the acoustic waves distribute in water domain and they need to characterize acoustic properties of the transmitter.

2. Planning a teaching activity

First, I will give students a problem with multi-physics model and ask them to think individually and then discuss in group **(Think-Pair-Share)** and share their responses with the class. Then, I will give them **strip sequences** and ask them to put papers in correct order.
The learning outcome is students will be able to choose the best strategy by selecting appropriate physics, modeling scheme, and interpretation of results.

3. Trying it out in practice

Teaching activity will be implemented in the following way:
1- A model of acoustic transmitter will be shared with students.
2- The students will be asked to think individually about the required physics as well as the steps for doing the simulation.
3- They will share their inputs with their peers (Think-Pare-Share).
4- TA will distribute a set of strip sequences which is included the steps as shown in the figure 1.
5- Students will put papers in the order that they think it might be true.
6- The sequences will be implemented by each group in the software.

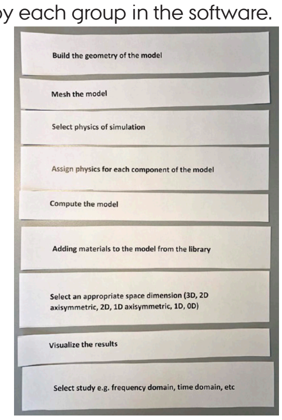


Figure 1: Set of strip sequences

For assessing the learning outcomes, TA will walk around each group and write down the misconception parts. Then, TA ask each group to present their order with the model in software and justify their reasons.

MAIN POINTS

1. **Main problem/challenge:**
2. Selection of appropriate physics and the correct order of steps in the software
3. **Teaching activity**: Think-Pare-Share combining with strip sequences
4. **How did it go?** Will be evaluated in the next semester
5. **What to do next?** Increase the level of difficulty of the problem with the feedback from each group

If other students have different orders and reasons for the problem, they should provide their inputs and discuss about the correct order. Finally, TA will execute the correct order in the software.

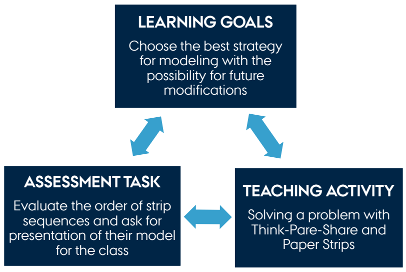


Figure 2: Constructive alignment

4. Looking forward

TA expect that the tool goes well with each multi-physics modeling in COMSOL since the steps will not change for the next possible models and students can implement these steps for their future use. However, more practice with these steps would be better to settle in student's mind. For future improvement, TA will try to increase the level of difficulty and focus more on clarifying the misconception parts of the teaching activity for the future students.

[1] COMSOL Multiphysics v. 5.4. www.comsol.com. COMSOL AB, Stockholm, Sweden.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Seyedsina Hosseini
Integrated Nanoelectronics
Department of Engineering

Different proof methods

Learning when to use which

Learning Lab

Abstract: In the course Discrete Mathematics students learn about different *proof methods*, i.e. different ways of proving (and disproving) mathematical propositions. However, they often struggle to apply these on concrete statements and find it difficult to judge which proof method they should try using. In this activity, the students are asked to only consider *which methods* could be used to prove (or disprove) a series of mathematical statements, rather than actually prove/disprove them.

The students responded positively to the activity, judging that they had a better understanding of how to approach problems.

COURSE FACTS

- Course name: Discrete Mathematics
- Level: Bachelor
- ECTS credits : 5
- Language: Danish
- Number of students: ~30
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

One of the first subjects of Discrete Mathematics is "proof methods" where the students learn about different ways to prove and disprove mathematical propositions. The students, however, find it hard to apply these in practice. When students are asked to prove or disprove a mathematical proposition, it can be a problem for many to *even get started.* This can discourage many students.

The aim of this activity, is to give the students a chance to discuss different proof methods and get a better idea of how to spot which proof method is suitable to a given problem.

2. Planning a teaching activity

This teaching activity tries to address the problem by giving the students some practice in working out what the first few steps of a proof should be, without having to worry about the complete solution.

This is done by presenting them with a variety of propositions and having them first jot down their own ideas, then discuss their ideas in groups and finally get input from the TA and the rest of the class.

By trying themselves they get to practice and by discussing with their peers and TA they get other perspectives on how to come up with different approaches.

After the session the students should be better at judging what proof method might be suitable to a given problem, e.g., when to use induction, contraposition, counterexamples etc.

3. Trying it out in practice

The activity is introduced in approximately 5 minutes, with an emphasis on the learning outcome, i.e. to be able identify possible proof techniques to a given proposition.

Subsequently, the students are presented with 10 mathematical propositions, one at a time, and given 1 minute to think individually about how to approach a solution and what proof methods might be suitable.

After these 10 minutes, the students are paired up and given 20 minutes to discuss and share their thoughts.

Finally the propositions are discussed on class where both the teaching assistant and the students give input.

Using a short questionnaire, the session is evaluated and the students learning assessed. Furthermore, the students learning is assessed at the final exam.

I implemented the activity with roughly this structure, though I gave the students a bit longer to discuss in pairs. In the assessment, the students gave the impression that their understanding of when to use which proof method was 'somewhat better', but very few answered the evaluation. The students also expressed that there was too little time to discuss.

MAIN POINTS

1. **Main problem/challenge:** Students find it difficult to identify which method to use when proving mathematical statements.
2. **Teaching activity**: Think-pair-share activity
3. **How did it go?** The students thought that it helped them somewhat in identifying when to use which proof method.
4. **What to do next?** The activity could be extended with actual solutions rather than only the approach ideas.

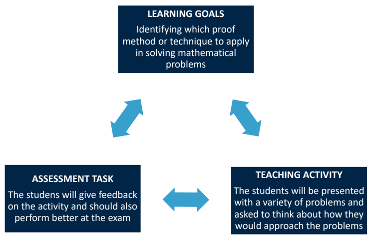


Figure: **Constructive alignment**

4. Looking forward

I think in general focusing on the 'how to solve' rather than the concrete solution can be very instructive in many cases. This particular activity had some flaws including too little time to discuss the approaches. In my implementation, I was also not clear enough about the goal of the exercise; many students tried to actually solve the problems, rather than just discuss different possible approaches.

The next step could be to actually prepare different solutions based on different proof methods and ask the students to do the same. This way, the students could see examples of how to proceed with different approaches; this would probably require stretching the activity over multiple lessons.

An alternative addition could be to have the TA begin the session with a few examples, so the students have a better idea of what the exercise is about. This would avoid the problem of students misunderstanding the goal.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Benjamin Salling Hvass
COBRA
Department of Engineering

Problem based learning

Computational fluid dynamics: Analysis and validation

Learning Lab

Abstract:

Traditionally empirical equations are used to analyze air distribution in ventilated rooms. However, due to advancement in computer tools and hardware it is possible to visualize airflow in rooms using Computational fluid dynamics (CFD) methods. The aim of this part of the course is to give hands on experience of one state-of-the-art CFD tool which will enable students to understand the dynamics of air in ventilated rooms. The teaching activity will be think-pair-share where students will individually think and share with their own group and later with the whole class. Students will be given a task where they will learn the physics by solving an industrial problem.

COURSE FACTS

- Course name: CFD in Architectural Engineering
- Level: MSc
- ECTS credits : 5
- Language: English
- Number of students: 12
- Your role: TA

TEACHING IN PRACTICE

1. Identifying a problem

In practice, architectural engineers are supposed to solve complex ventilation problems. CFD is a tool that helps not only to solve the ventilation problems but also helps engineers to visualize and ultimately optimize the ventilation systems. Therefore the present course is an specifically design for architectural students who are soon to be in labor market.

2. Planning a teaching activity

TA will ask students to revise selected lectures/topics which were delivered by the main professor of the course. TA will start the lecture topics in terms of the flow chart shown in figure 1. These topics are connected to each other in terms of a process. Each process has its own mindmap. At first TA will solved an example of mechanically ventilated room. Later, students will be given a problem where they have to simulate air flow in the same room with different boundary conditions. Students will be divided into 3 groups. One group have to change the mesh size to analyse the effect on the result, second have to change the inlet temperature and third has to check if gravity is important.

Students are supposed to ask questions while they are solving the problem. The results from 3 groups will be compared with test results and the students will be asked questions about possible causes of difference between test and simulation results.

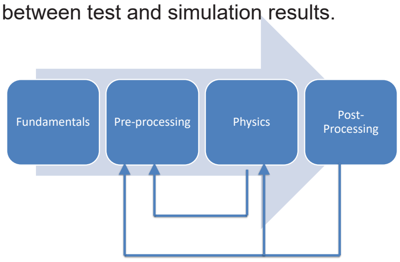


Figure 1: Flow chart of the topics

3. Trying it out in practice

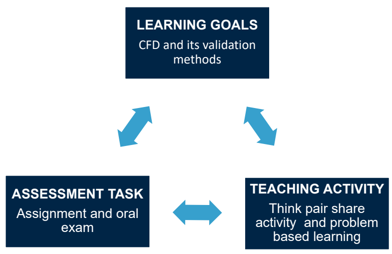
Think-pair-share activity will be carried out to understand fundamentals of CFD. Foremost, the students will have to go through the fundamentals of CFD, afterwards TA will solve a CFD problem. Later students will be divided into groups where they will solve a problem mentioned in Iqbal et al 2012. During solving the problem students will learn different aspects by asking questions. Students will discuss the outcomes from the software in their groups where they will be asked to modify the solutions based on different parameters. Each group will be given a different parameter to change and they have to discuss how close their solution is with the test results. In the last 30 minutes, students will participate in a plenary discussion where individual group will have a chance to give input and answer the questions which other participants may have. Students will be given an individual problem where they will have to read few articles to solve the problem – hence learning by solving.

MAIN POINTS

1. **Main problem/challenge:** Realization for the students that software works on models and the importance of the selection of the right model.
2. **Teaching activity**: Think-pair-share and problem based learning
3. **How did it go?** Its planned (will probably go in 2021)
4. **What to do next?** Suggestion from peers will be discussed with the professor.

4. Evaluation

Students will be evaluated based on assignment submitted by individual student and an oral exam.
Students will be given a questioner to evaluate the teaching activity and TA.



4. Looking forward

At present I am looking forward to implement my teaching in practice.

References

White, F.M. and Corfield, I., 2006. Viscous fluid flow (Vol.3, pp. 433-434). New York: McGraw-Hill.

Versteeg, H.K. and Malalasekera, W., 2007. An introduction to computational fluid dynamics.

Iqbal, A., Nielsen, P.V., Afshari, A. and Heiselberg, P., 2012. Numerical predictions of the discharge coefficient of a window with moveable flap. In Healthy Buildings.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Ahsan Iqbal
Building ventilation and fluid mechanics
Civil and Architectural engineering

Improved Ability to Interpret Spectra

- Using Ticket Out The Door and Kahoot quizzes

Learning Lab

Abstract: In this poster a teaching activity planned for the Organic Chemistry I course is presented. The purpose of the teaching activity is to improve the students ability to interpret several types of spectra and improve their naming abilities, by putting a larger focus on this part of the curriculum. The teaching activity include the use of "Ticket Out The Door", working in pairs, and Kahoot quizzes. The next step is to trying the teaching activity out in practice.

COURSE FACTS

- Course name: Organic Chemistry I
- Level: 1st year
- ECTS credits : 10
- Language: Danish
- Number of students: 20
- Your role: Laboratory TA
  - Correcting lab reports

TEACHING IN PRACTICE

1. Identifying a Problem

In this course the students, have to learn about mechanisms in organic chemistry, naming organic compounds, how to behave in a laboratory, and learn about interpreting ^{1}H-, ^{13}C-NMR, IR, and MS to identify unknown compounds. In my experience, as a TA, students find it hard to specifically name organic functional groups and interpret spectra. The reason for this is that there are not much coverage on this topic in the course lectures and in my opinion these specific skills need to be trained by using the skill. The students need to obtain these skills, because they are directly evaluated on their ability to interpret spectra and name organic molecules during the exam. Therefore, there is a need for a bigger focus in this area of the curriculum.

2. Planning a Teaching Activity

In this teaching activity there is going to be a large focus on learning to interpret spectra and naming organic molecules. The leaning goal for this teaching activity is to improve the students ability to interpret several types of spectra and improve their naming abilities.
This is the case, because the students are allowed to ask a couple of relevant questions about naming, chemical shifts, coupling patterns and so on related to a specific molecule in an anonymous manner. This will create a safe space to ask questions.

The answers to these questions are then discussed in class and/or in pairs the following session meaning that gaps in knowledge are filled. This overall process will thus put a larger focus on these topics and increase the specific knowledge needed to interpret spectra and name organic molecules.

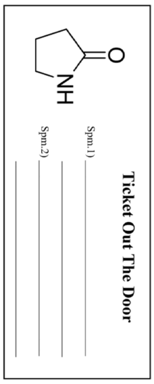


Figure 1: Example of a "Ticket out the Door" including a molecule, and space to write two questions.

3. Trying It Out In Practice

The teaching activity is simple. In the last 5 minutes of the first session, the students are handed a piece of paper where a given molecule is present. All students are handed the same molecule. Then The TA ask the students to come up with two questions about this specific molecule, which they do not know the answer to, in regard to naming, chemical shifts, coupling patterns, and so on. The students are allowed to discuss their knowledge in pairs. When the session has ended, the students hand the questions in to the TA as a "Ticket Out The Door". During the time until next session the TA prepare a Kahoot with the questions. In the beginning of the second session, the students pair up to discuss and answer all the questions in the Kahoot. Discussing the point in pairs would make it possible for more people to attend the discussion.

MAIN POINTS

1. **Main problem/challenge:** The students find it difficult to name organic compounds and interpret spectra.
2. **Teaching activity**: Using the muddiest point the students ask one question about a given molecule. These questions are then answered the following session.
3. **What to do next?** Trying the teaching activity in practice.

Finally, the correct answers to the quiz are discussed in plenum by the students and the TA. This is a good way for the TA to assess the students knowledge, while the TA/student discussion during the Kahoot will be a good way to inform the students what they need no know and also fill in gabs in their knowledge.
After class the teaching activity can be evaluated using a questionnaire on BlackBoard to get the answers anonymously. Questions in the evaluation could include what they think about the exercise, the quality of the questions they provide, and if they think something could be better or differently.

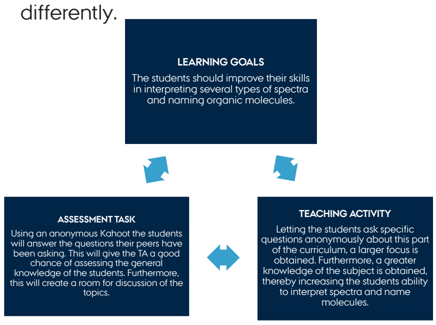


Figure 2: Constructive alignment

4. Looking forward

This teaching activity was not tried in praxis, since we have been locked out of the Campus. Therefore, the next step is to try it out in another course, where the same concept is applicable or next time Organic Chemistry I is taught. Based on the comments obtained from this poster, the teaching activity have to be improved.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Joakim Bøgelund Jakobsen
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Department of Chemistry / iNANO

Spectroscopic skill level

- Identifying the knowledge of spectroscopic interpretation

Learning Lab

Abstract: A part of the laboratory exercises in "Organic Chemistry I" is to teach the students how to interpret spectroscopic data. Some of the students have already learned a little about this subject in High School while others have not. Therefore the students' knowledge about the subject was tested through a quiz and afterwards the answers to the quiz were discussed in plenum. This way it was made sure that the students all had been given the same basic knowledge of the subject.

COURSE FACTS

- Course name: Organic Chemistry I – Functional groups and reactions
- Level: 1st year bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 308
- Your role: TA in laboratory exercises and spectroscopic interpretation for a small team of 18 students

TEACHING IN PRACTICE

1. Identifying a problem

The course "Organic Chemistry I" is the first and fundamental course in organic chemistry at Aarhus University. The students in this course have very different educational backgrounds; they have different educations (STX, HTX etc.) and they have been tought by different teachers, who have focused on different subjects in organic chemistry.
The challenge as a TA in this course is therefore to identify how much the students know and what they do not know. Hereafter the job of the TA is to make sure that all the students have the same level of basic knowledge in the field of organic chemistry.

2. Planning a teaching activity

A way to identify how much the students already know and what they do not know could be to do a variant of the student made quiz. Here the students can ask questions to the TA, and then the TA will gather all these questions and put them together in a short quiz. When the quiz is given to the students, the TA gets an overview of how many students struggle with different aspects of the given subject.

3. Trying it out in practice

To identify how much the students already knew in the topic "spectroscopic interpretation", the students were asked to write down what they had struggled with during the first day of spectroscopic interpretation. From this information a quiz was made by the TA. An example of a question in the quiz is given in figure 1. At the beginning of the next session all of the students had to answer this quiz in kahoot and afterwards the answers to the quiz was discussed in plenum to make sure, that all the students understood why the correct answer was correct and why the wrong answers were wrong. Thereby it was made sure that the students had the same basic knowledge in spectroscopic interpretation.

What is the coupling pattern for the highlighted H-atom?

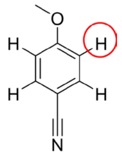

Figure 1: *Example of a question in the quiz*

After going through the answers to the quiz, the students were interpretating spectroscopic data and thereby they had the opportunity to use their new knowledge right away and ask question to the TA if there was something they realised that they did not understand anyway after looking at the spectroscopic data.

MAIN POINTS

1. **Main problem/challenge:** Identifying the students basic knowledge in interpretating spectroscopic data.
2. **Teaching activity**: Quiz/test questions made based on what the students had struggled with during the first session.
3. **How did it go?** The students were really positive about the questions and the activity went well.
4. **What to do next?** Now the students basic knowledge has been clarified it is possible to build on top of their knowledge

4. Assessment

In the end of the teaching session the students were asked to go to menti.com and evalutate the quiz. The evaluation of the quiz from the students were overwhelmingly positive. They had learned the basic skills necessary to interpret spectroscopic data and afterwards it was possible for the TA to build further knowlegde on top of their basic knowledge on the subject. One of the students would have liked to have the questions beforehand as a help to read up upon the subject and then get a multiple choice quiz at the teaching session, but most of the students liked the quiz as it was and the discussion of the answers afterwards.

4. Looking forward

All the students participated in the quiz, but only five of them participated in the discussion afterwards. A task for next time will therefore be to try to encourage the students to participate more actively in the discussion. Another way to assess if the students have learned something from this teaching activity could be using the technique Think-Pair-Share.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Department of Chemistry

Discussion Board Teaching

Converting weekly class sessions to weekly discussion board sessions during the COVID-19 lockdown

Learning Lab

Abstract: Carrying on studying under sudden and very different circumstances is a challenge virtually all students has had to take up during the COVID-19 lockdown. This poster presents one possible way for the students to carry on studying, with the aid of their TA, from home: Participating in the replacement of their weekly class sessions by weekly online discussion board sessions, in which the latter attempts to mimick the Q&A and discussion aspects of the former. The activity was carried out four times over four weeks, and it was rather successful. It does seem, however, that the activity can not stand on its own for too long, and it should therefore be complemented by other activities.

COURSE FACTS

- Course name: Experimental Physics and Statistical Data Analysis
- Level: Bachelor, first year
- ECTS credits : 10
- Language: Danish
- Number of students: 20
- My role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

A most relevant challenge during the lockdown of the Danish Universities is ensuring that the students still reach the learning goals of their courses, despite the much greater difficulty in their doing so.

Specifically, in this first year course, the students are still acclimatising to the life as a student, and, in order for them to be able to succeed in their upcoming more advanced courses, it is crucial to maintain the students' commitment to solving theoretical exercises. The lockdown, however, has made this quite a challenge.

2. Planning a teaching activity

The activity is a replacement of the weekly 3-hour small class teaching sessions by weekly 3-hour online question/discussion sessions on the students' discussion board. During these sessions the students are supposed to work on solving the weekly theoretical exercises, posting questions and discussing the exercises with each other and their TA. The idea is to carry on the teaching as similarly to the teaching before the lockdown as possible.

The learning outcome is simply understanding the content of the theoretical exercises, only under these different circumstances.

The relations between the course's learning goals, the activity and its assessment is summarised in figure 2.

While online written discussions are considerably less dynamic compared to, for example, an online video meeting, discussion board teaching is far less fleeting: The students can efficiently revisit a particular topic later on and, if necessary, ask follow-up questions.

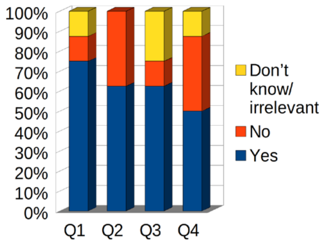


Figure 1: Students' answers to questionnaire handed out after fourth and final discussion board session.
Q1: "Had the class sessions not been replaced by online sessions, would your personal approach to the theoretical exercises have been different?"
Q2: "Did you gain anything from the online sessions?"
Q3: "Has studying for the theoretical exercises during the lockdown been more time-consuming?"
Q4: "Does the amount of what you have learned from the new teaching format live up to your expectations?"

3. Trying it out in practice

A day prior to an online session, the TA posts suitable hints to some or all of the exercises to ensure that the students have some basis for a discussion. The TA then sits at the ready in the discussion thread, while students post questions and discuss the exercises they are trying to solve during the session. Preferably, the students discuss the exercises amongst each other – the TA encourages this by referring the students to each other's posts whenever possible.

The students' learning is assessed by evaluation of their written assignments which they are to hand in a week after the online session; these assignments are (and were, prior to the lockdown) part of the exercises to be discussed during the session. The assignments are mandatory and "pass/fail".

The activity was carried out four times, accompanied by online notes and supplementary discussion threads over the weeks, until there were no more sessions to be held.

The students were then given a questionnaire, asking them their opinion of the teaching format and how they had been studying for the course during the lockdown. Some combined results can be seen in figure 1.

MAIN POINTS

1. **Main problem:** Carry on discussing and solving theoretical exercises whilst class sessions are cancelled.
2. **Teaching activity:** Discussion board sessions.
3. **How did it go?** Pretty well.
4. **What to do next?** Complement the activity with other activities, as it seems the activity can only stand on its own for a limited amount of time.

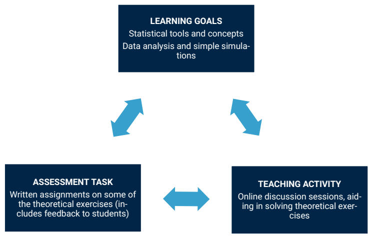


Figure 2: **Constructive alignment**
The students learn the course material through weekly online discussion sessions, aiding them in solving theoretical exercises. Some of the theoretical exercises are to be handed in as written assignments, and these serve to assess the students' learning outcomes, while also providing feedback to the students.

4. Looking forward

Under the circumstances, and in the short period the teaching activity was carried out, it worked rather well. The students were frustrated by the lockdown, but nevertheless had some gain from the teaching activity: A substantial number of students were active on the discussion boards, and most of the teaching material was covered. The activity of the students who did not post on the discussion board is, of course, difficult to gauge, but all students at least handed in their written assignments. It seems, however, that this activity can only maintain student interest for so long, and it should probably be supplemented by other activities, were it to be carried out again.

References

Science and Technology Learning Lab, *Science Teaching*, https://stll.au.dk/kurser-workshops-mm/science-teaching/

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Erik Jensen
Subatomic Physics
Department of Physics and Astronomy

Getting the terms straight

- A learning activity to help students get an overview of the terms and quantities in a course

Learning Lab

Abstract

Keeping track of all the terms and quantities often introduced over a relatively short period of time can prove hard for a lot of students. This learning activity aims to provide the students with a self-manufactured lookup table of all or a selected portion of the course's terms and quantities. The process of making the lookup table will include a lot of group discussion and through these provide the students with a deeper understanding of the terms and quantities. The activity has not been implemented, but can be adjusted and expanded to fit most academic courses.

COURSE FACTS

- Course name: Experimental Physics & Statistical Data Analysis
- Level: 1st year, BSc in Physics
- ECTS credits : 10
- Language: Danish
- Number of students: 20-25
- Your role: Teaching Assistant in theoretical exercises

TEACHING IN PRACTICE

1. Identifying a problem

A common challenge in physics, if not most academic branches, is the very extensive introduction to a lot of new terms and quantities over a relatively short period of time. Keeping track of all these new terms can be difficult and losing track will in most cases decrease a students' likelihood of understanding future topics build on such terms. Often, if overwhelmed by terms and quantities, a student will just acknowledge the presence of a given term, as they remember being introduced to it, without actually understanding it fully – this will inevitably lower the outcome of e.g. a lecture. The aim of this activity is to provide the students with an overview of these terms and quantities and thereby help them to learn new material based upon these more easily.

2. Planning a teaching activity

An obvious way to provide the students with an overview would be to hand out a list of definitions and descriptions of the most commonly used terms and quantities. Unfortunately, just providing knowledge does not necessarily lead to a learning process.

This exercise have been developed with the goal of having the students create such a list themselves. The list itself will provide the students with a lookup tool for the remainder of the course. However, more importantly the students will have to get acquainted with the terms themselves through group discussions in order to create the list, which will hopefully help them to remember the terms better. Ideally, they would not even need the list after the exercise, but it is a nice biproduct of the exercise.

3. Trying it out in practice

The teaching activity has yet to be implemented, and will be done using the following plan.

The students will be divided into four groups and each group will be assigned a color. All students are then handed a document containing a simple color-divided table. Each row will contain a term or quantity from the course and the groups will then have to provide a definition, formula, name, etc. for all terms in their color. An example of such a table is provided in table 1.

When all groups have provided the needed information for their terms, the groups are mixed using the matrix concept. In the new groups, the representative(s) from each color explain their terms. The remaining group members are supposed to write this information down in their own tables. At the end, all students should have a completely filled table written by them selves.

The activity is summarized by a plenary discussion of all the terms supervised by the TA, where the students can confirm their table entries are correctly filled.

Symbol	Name	Formula	Description
σ			
σ_{N-1}			
χ_{min}^2			
α_{CE}			

Table 1: *Example of a table with terms from the course 'Experimental Physics and Statistical Data Analysis'. The amount of terms in each color-category can be adjusted to the time available for the activity. Note the entries should be larger allowing for the students to write in them.*

MAIN POINTS

1. **Main problem/challenge:** Lack of overview in course related terms
2. **Teaching activity**: Group discussion with matrix-rotation and plenary evaluation
3. **How did it go?** Has yet to be implemented
4. **What to do next?** Carry out the activity

4. Assessment and student-evaluation of the activity

The teaching activity is assessed partially by observing the group discussions, but mainly by the plenary discussion summarizing all the terms on the list.

The activity is evaluated by a Menti-questionnaire, investigating the students' experience and self-evaluated outcome.

This activity can provide valuable information to the lecturers about which quantities to dwell on in the future. The terms which the students struggle the most with should thus be provided to the lecturer.

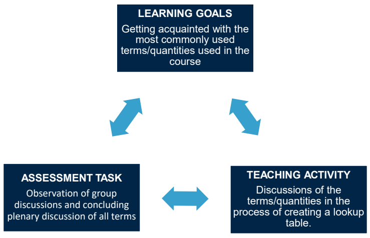


Figure 1: *Constructive alignment.*

5. Looking forward

The next step would be to implement the activity and observe how the students embrace the exercise. Most importantly, one would have to evaluate the activity using e.g. a Menti-questionnaire in order to address the students' experience doing the activity. Furthermore, this evaluation could be expanded to include a grading of the three terms or quantities the students find the hardest to define, which could be passed directly on to the lecturer.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Mads Lykke Jensen
3D-Dosimetry Group
Department of Physics and Astronomy

How to figure out the purpose of 65 instructions with just 10 paper strips

- Using a strip sequence puzzle for active learning of a lab protocol

Learning Lab

Abstract: Students often struggle to get the overview of the different procedures they performed in one of the lab exercises of Food Structure and Enzymes. The exercise has three different parts and the students often misrelate the data of the different parts in their reports. This teaching activity is designed to promote the students to gain a structured overview of the key concepts in the exercise. The teaching activity use a strip sequence to organize the main steps in the complex lab protocol. The aim is to promote the discussion between students and the TA on the structure of the exercise and provide the students with a possibility for getting direct feedback on their understanding of the exercise. Unfortunately it has not been able to implement the teaching activity yet, but it will be implemented for the lab exercises in 2021.

COURSE FACTS

- Course name: Food Structure and Enzymes
- Level: Masters
- ECTS credits : 10
- Language: English
- Number of students: ~30
- Your role: TA, lab exercise

TEACHING IN PRACTICE

1. Identifying a problem

It is part of the learning goals for the course, that the students should be able to use different analytical methods to evaluate specific enzymes and describe the correlation to various structural and sensory qualities on food (1). The lab exercise is about the effects of processing on green beans and consists of three separate parts; a enzyme analysis, a sensory analysis and an analysis of the aromatic compounds. Each their processing of sample material, analytical manipulations and data set. During lab exercises, some students tend to lose overview of how the different parts relate. We know from lab reports of previous years that the understanding of what they measure in the individual parts and how they can relate the different parts can be poor, as students often over conclude. You could also see them interpreting and relating data from the biochemical and sensory part in a way that is not in compliance with the sample preparation.

In order to write a good report, that demonstrates mastering of the learning goals at stated in the start of this section, the students will need to have a good overview of the performed procedures, the information that you get from these and their limitations.

2. Planning a teaching activity

For the lab exercise, one of the main learning goals is that the students are able to understand the different steps in the protocol; How the different steps manipulate the sample material, what they actually measure and how they can relate the data from the different parts of the exercise.

In the teaching activity, the students will arrange some pre-made paper strips with key elements of the protocol into a sequence/flow-chart. This will help the students to get the overview of key concepts of the practical lab work.

It is believed that an better overview of the lab work will make the students able to explain the key concepts of the exercise and discuss it with their peers.

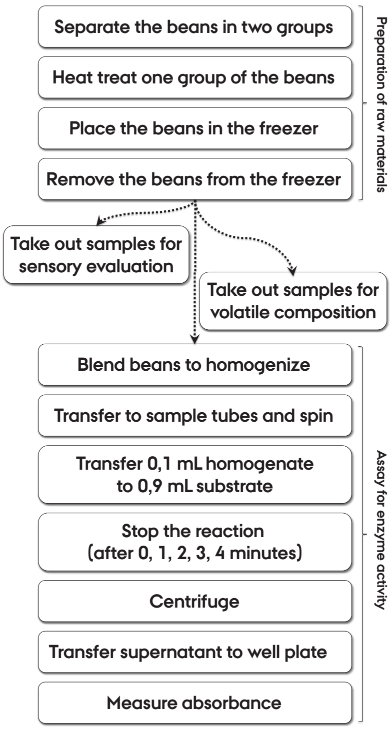
References

(1) https://kursuskatalog.au.dk/da/course/98234/Food-Structure-and-Enzymes

3. Trying it out in practice

The lab exercise is a 5-hour session, where the students will work in teams with natural breaks while waiting for equipment/incubations etc.

The teaching activity will be a 25-minutes session as part of the introduction to the exercise in plenum. The teaching activity will be introduced in the beginning of the session. The students will be divided into groups of 3 and each group will be provided with a set of paper strips with key steps of the lab protocol written on them. The groups will be asked to arrange the strips into a linear or branched sequence to represent the structure of the exercise. The groups will arrange the strips for 15 minutes, then they will upload their strips to Padlet. One of the (most correct) sets of arranged strips will form the basis of a class discussion in plenum about the structure and concepts of the exercise.



MAIN POINTS

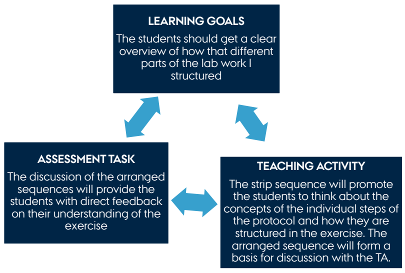
1. **Main problem/challenge:** Difficulties overviewing the structure and different concepts of/in lab exercise
2. **Teaching activity**: Strip sequence
3. **How did it go?** The teaching activity has not been tried out yet. Lab exercise has been cancelled in 2020 due to COVID-19

Once the groups have started the practical lab work, the TA's will look at the strip sequences of the groups and identify misconceptions in the different groups. This will be used to promote discussion between the groups and the TA's during the exercise.

The assessment of the students' learning from the activity can be divided in two parts:

1) From the discussion about the sequence in class and the promoted discussion about the protocol in groups, the students can get instant feedback on their understanding of the exercise.
2) The students will hand in reports and get written feedback. The reports will form part of their exam.

The evaluation of the teaching activity will take place during a short recap session when the students have finished their lab work. The students will be asked to answer a Mentimeter questionnaire with a few questions on their opinion on the teaching activity.



4. Looking forward

The teaching activity has not been tried out yet. It will be implemented in the course in spring 2021. It is expected, that the answers from the students can then be used to improve or modify the protocol further on to prevent common misconceptions.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Nikolaj Bjerring Jensen
Plant, Food & Climate
Department of Food Science

Encouraging engagement with theoretical principles in undergraduate laboratory sessions

Learning Lab

Abstract: Students often fail to properly engage with the theory behind an experiment prior to the practical tasks. In this exercise the students were asked to pair previously measured data with the corresponding light sources for first low quality and then high quality measurements. This served the dual purpose of demonstrating the effect of varying experimental resolution and requiring research into the mechanisms behind the light emission for each data set. A majority of students were able to complete the exercise correctly and showed an understanding of the key points to think about.

COURSE FACTS

- Course name: Experimental Physics 2
- Level: 2nd Year
- ECTS credits : 5
- Language: English
- Number of students: 12
- Your role: Laboratory Instructor

TEACHING IN PRACTICE

1. Identifying a problem

A vital part of experimental physics is having a firm grasp of the underlying theoretical principles behind a given experiment. Without this the experimental scheme will be followed as a rote list and intelligent experimental design decisions, like the kind of measurements to take, are not possible.

In my experience students regularly fail to even look at the introductory material provided, let alone build an understanding in themselves of what to do with this information. This activity aims to help the students engage with the theory behind a specific example exercise

2. Planning a teaching activity

This teaching activity will attempt to address this problem for the example of a single experiment as part of this course. The students will be given a selection of undersampled 'low resolution' spectra from the different light sources they will be measuring, and be asked to assign the correct spectrum to each source. This will be then repeated for higher resolution versions of the same spectra, to demonstrate the need for, and effect of, such a resolution.

The learning goals of this activity are for the students to be able to describe how the spectrum of each light source is produced and to understand the practical effects of varying the experimental resolution, both vital points in the decisions the students will need to make in the practical part of the experiment.

3. Trying it out in practice

This exercise was implemented purely online via Zoom. The students were introduced to the activity and given a document with the 'low resolution' spectra, the light sources, and a brief description of how each light works. They were then split into pairs to discuss the answers.

After some time to discuss and research, we returned to a single large group, and the student answers were polled, see figure 1. Justification was requested from volunteer students for their reasoning.

This process was repeated with new, 'high resolution' spectra and different pairing of the students to facilitate new discussions. After collecting student answers the second time the correct answers were discussed as a group to ensure all were on the same page.

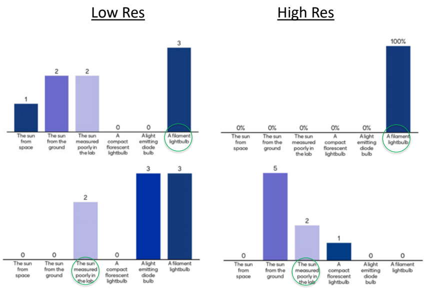


Figure 1: Example results from students for low (left) and high (right) resolution spectra. The correct answer is circled in green for each.

As the two representative data sets in Figure 1 show there was an improvement in assignment for the high resolution compared to low resolution, although confusion between very similar spectra still occurred.

MAIN POINTS

1. **Main problem/challenge:** Student understanding of basic theory concepts
2. **Teaching activity**: Examining of different emission spectra
3. **How did it go?** Students performed as expected and showed they had understood the core concepts
4. **What to do next?** Adapt exercise for different experiments in the course

One issue with the two stage approach used is that the improvement may have not only been due to the change in resolution of the spectra, but also this being the second chance at looking at each. This was reduced by not telling the students the correct answers after the first exercise, and by giving the spectra in a different order each time.

At the end of the exercise students were asked to anonymously give what they believed to be the key takeawaypoints of the exercise, and of their opinion of the exercise. The former showed about half of the students correctly grasped the important points, while the latter showed a majority saw the exercise as positive.

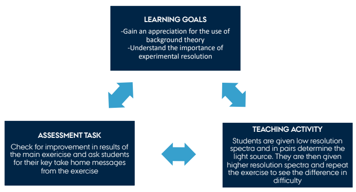


Figure 2: **Constructive alignment**

4. Looking forward

The activity in general was successful, with the principle goal correctly completed. The students also reacted positively with the exercise and seemed engaged with it. The indirect learning goal of emphasizing the need for theoretical learning before an experiment cannot be assessed by this exercise, and as such modification of the activity is necessary in future to align better with this goal.

The next step would be to modify this exercise for different experiments in the future, while also adding some component to allow better assessment of the second learning goal.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Alfred Jones
Centre for Dirac Materials
Department of Physics and Astronomy

Academic Writing for Reporting on IT Product Design Projects

Teaching topic sentences and argumentation analysis to IT-Product Development Master's Students

Learning Lab

Abstract:

A core challenge of the 20 ECTS IT-Product Development course Innovation Project is for students to write scientifically about their projects, and argue for design choices made along the way. To address this, I have developed a teaching activiry in which students will learn to analyze, compare and create their own scientific arguments. To do so, analysis of existing literature and peer reviewing of students own work is utilised as a teaching acvitity. The analytic first half of the activity has been carried out, while the later, peer reviewing part, has not. First half carried out. Results indicate that students could identify the use of topic sentences and succesfully analyse arguments.

MAIN POINTS

Main problem: Students often have difficulty writing academic reports especially with regards to structuring paragraphs and arguments.
Teaching Activity: Analysing paragraphs and arguments from literature with regards to their structure. Peer reviewing each other's work.
How did it go? First half carried out. Results indicate that students could identify the use of topic sentences and succesfully analyse arguments.
What to do next? Carry out the full activity (incl. peer review). Adjust to fit time frame.

IDENTIFYING A PROBLEM

A core challenge in the Innovation Project is to have students connect their ideas and prototypes to research, and have them argue for their design choices not only in designerly terms, but also based on research. One of the learning goals in the Innovatiovation Project states that students should be able to "**relate and compare the selected development process as well as IT product concept with state-of-the-art research and technologies in the field**".

This is a challenge because the project is done in collaboration with an external company, and students design and prototype an innovative solution to a problem posed by the company. This often leads to students aiming to make the best solutions in market-terms, which makes it difficult for them to argue about their solutions in terms of scientific contribution and merit. This has especially proven to be a challenge due to the special circumstances of only being able to teach remotely, due to the Covid-19 crisis.

COURSE FACTS

Course name: Innovation Project
Level: Master's Programme
ECTS credits : 20
Language: English
Number of students: 19
Your role: The single TA of the course. Mostly project supervision of groups.

PLANNING A TEACHING ACTIVITY

To adress this challenge, I will teach students about structuring paragraphs and arguments in academic writing, by drawing on related research. My teaching activities will have the following learning goals:

- Students will be able to **identify** and **describe** the structure of a scientific argument from the field of Human-Computer Interaction (HCI).
- Students will be able to **analyze** and **compare** scientific arguments within HCI.
- Students will be able to **create** their own scientific arguments for the scientific relevance and position of their IT concept.

TRYING IT OUT IN PRACTICE

In practice, the teaching activities will unfold as follows: It will be an online session, lasting 60 minutes. First, students are given a brief introduction to scientific writing, specifically about the use of **Topic Sentences** [3]. Next, students will read and analyze the introduction section of a research paper [1] to identify the topic sentences of the paragraphs in the section. Next, students are given an introduction to argumentation, specifically the **Toulmin's Model of argumentation** [2]. Then, they will work in groups with analysing the same section again, but using the Toulmin model to identify the claims, warranties and groundings in the section. Each group analyse the paper together after which groups will be scrambled, and the analyses will be presented and discussed in new groups. Finally, students will prepare their own introductory sections for their project reports. After this is done (might take a few weeks), students will provide peer feedback to each other's work, and will have the chance to alter their reports based on the feedback. Whether this can be managed in the time frame of the course, is uncertain.

The first half of the teaching activity was carried out as remote teaching. Only the first half was carried out, as there was not enough time before the exams, to carry out the peer feedback. 5 students participated in the teaching activities. The zoom call was video recorded, and notes were made, by the author during teaching.

REFERENCES

1. Bilstrup, Karl-Emil Kjær, Magnus Høholt Kaspersen, and Marianne Graves Petersen. "Staging reflections on ethical dilemmas in machine learning: A card-based design workshop for high school students." ACM conference on Designing Interactive Systems (DIS). Association for Computing Machinery, 2020.
2. Karbach, Joan. "Using Toulmin's model of argumentation." Journal of Teaching Writing 6.1 (1987): 81-92.
3. Purdue Online Writing Lab. Topic Sentences. https://owl.purdue.edu/engagement/ged_preparation/part_1_lessons_1_4/index.html, accesed 02-06-2020

LOOKING FORWARD

The activity laster for 60 minutes, which was not enough for in-depth analysis of the included paper. Going forward, this time should be expanded, to allow students to work more closely with the literature.

Due to the placement of the activity in the course, the was not enough time, to carry out the peer-reviewing activity, which I believe is core to address my third learning goal. In addition, the attendance of the activity was low (only 5 out of 19 possible students). This can also be attributed to the placement of the activity close to the report deadline.

Going forward, I belive this acitivty should be integrated early in the course, to allow students to integrate their learnings into their final reports, and to receive peer feedback on doing so.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Center for Computational Thinking & Design
Department of Computer Science

Online quizzes

- A tool for just-in-time teaching, knowledge construction and formative assessment

Learning Lab

Abstract: It is often a challenge to streamline the lecture based on the students' level of understanding of the subject when they hail from different backgrounds. Although the pre-course material is sent out well in advance, it is difficult to assess if the students understood it thoroughly and will be ready to grasp new information. I propose the use of online quizzes as a tool for just-in-time teaching, knowledge construction and formative assessment to streamline lectures based on students' knowledge, to foster students to identify the key concepts, and as a measure to see if the students learnt what you intended to teach. The teaching activity greatly improved the students' participation and it is a plan to try it out in large class teaching going forward.

COURSE FACTS

- Course name: Advanced Soil Physics
- Level: Masters; PhD
- ECTS credits : 5
- Language: English
- Number of students: 8 – 24
- Your role: Lecturer

TEACHING IN PRACTICE

1. Identifying a problem

In the course, I teach a module on different sensor-based methods for soil mapping and we often get students who hail from different backgrounds. Thus, it is difficult to get a sense of understanding of the students' knowledge of the subject, to assess if they followed the pre-course material thoroughly and identified the key concepts in line with the learning outcomes so the new information we intend to pass on during the lecture is not overwhelming. Moreover, at the end of the lecture we need a method to evaluate the students' learning.

2. Planning a teaching activity

The aim of the teaching activity is to motivate students to identify key concepts, help the lecturer to streamline the lecture based on the level of students' knowledge, and for knowledge construction and formative assessment.

In this teaching activity, along with the pre-course material and assignments students will be asked to provide answers for a online quiz before class. This online quiz will be designed to assist the students to identify key concepts and provide the lecturer with a sense of understanding of the students' knowledge and adapt his teaching accordingly.

During the lecture, the answers provided by the students can be shown up in the power point presentation while discussing the key concepts to provide framework before building up the new information.

The use of answers provided by the students during the lecture and discussing the concepts which are difficult to many of them makes them pay more attention as the lecturer shows that he cares about the students and reflect on their opinion.

At the end of the lecture, a similar Mentimeter quiz with slightly advanced questions will be organized and the students will be asked to answer the questions with peer instruction. This activity will help the students to share their perceptivities to get a deeper insight of the key concepts and assist the lecturer to assess if the students learnt what he intended to teach. In this way, the lecturer can further discuss the difficult to understand concepts in plenum and ensure the learning outcomes are met.

3. Trying it out in practice

A part of the activity was implemented in a journal club with four students in a small class setting. The students were sent out a research article as a pre-course material one week in advance to come prepared as this same paper was discussed in detail in the class later. As the lead instructor, I organized a quiz during the first 15 minutes focusing on the key concepts to get a sense of the students' understanding of the article. Simultaneously, the correct answers were provided after each question and I stimulated a discussion among the group when their answers were wrong or did not align with each other. The students showed keen interest in the discussion afterwards.

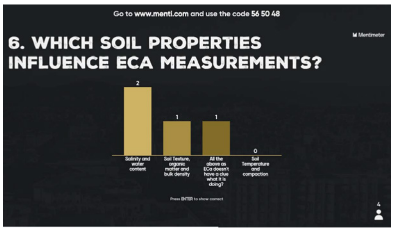

Figure 1: Illustration of a Mentimeter quiz showing a question about a key concept.

MAIN POINTS

1. **Main problem/challenge:** Lack of knowledge about the students' level of understanding of the subject.
2. **Teaching activity**: Mentimeter quiz.
3. **How did it go?** Implemented in a small class teaching and received good feedback from the students.
4. **What to do next?** To compare and contrast the differences in answers provided by the students at the beginning and end of the lecture in plenum.

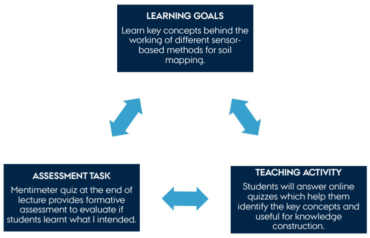

Figure 2: Constructive alignment

References

- Active Learning and clickers – Science and Technology Learning Lab, Aarhus University.
- Module on lecturing – Science teaching course, Aarhus University.
- Crouch, C. H., & Mazur, E. (2001). Peer instruction: Ten years of experience and results. American journal of physics, 69(9), 970-977.

4. Looking forward

As an instructor, this activity assisted me to adjust my teaching to the level of students' knowledge. The students participated more enthusiastically in discussing the research article. The reasonable next step is to try the complete activity in large class teaching. Moreover, alternative methods such as concept maps will be implemented in the tutorial session revolving around the difficult to understand key concepts.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Soil Physics and Hydropedology
Department of Agroecology

Every answer begins with a question

- Motivating students to question and discuss

Learning Lab

Abstract: An important skill to gain during student education is the ability to phrase questions and engage in discussion where students can practice stating arguments and answering scientific questions. This activity was developed to encourage students to question and discuss the teaching material using an anonymous 'ticket out of the door' exercise combined with peer discussion in pairs and as a group. **N.B.** owing to university lockdown the activity was not implemented in practice, however the activity addresses universal academic skills and can easily be incorporated into future courses.

COURSE FACTS

- **Course name:** Fundamental Molecular Biology
- **Level:** Bachelor 2nd semester
- **ECTS credits:** 10
- **Language:** Danish
- **Number of students**: 20-30

Your role: Teaching assistant (TA)

MAIN POINTS

1. **Main problem/challenge:** Motivating students to question and discuss teaching material
2. **Teaching activity**: Ticket out of the door, think-pair-share and plenum discussion
3. **How did it go?** The activity had not been performed when this poster was created
4. **What to do next?** Implement in practice

TEACHING IN PRACTICE

1. Identifying a problem

Getting students comfortable with asking questions and entering class discussions during small classroom teaching can be a challenge.
Being able to phrase and raise scientific questions is an important skill to gain early on in student education to deepen the understanding. In addition, by motivating students to become more engaged in both questioning and discussions could improve the dynamics of small classroom teaching.

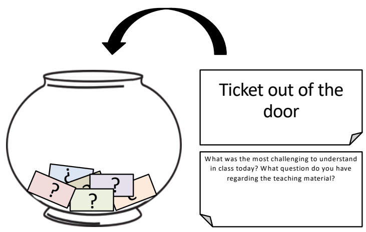
Reference
University of Toronto. Active Learning and Adapting Teaching Techniques, *Centre for Teaching Support & Innovation.* Available at: [Active Learing and Adapting Teaching Techniques]

2. Planning a teaching activity

The teaching activity is intended to help students practise their ability to question their understanding of a given scientific topic and phrase and raise questions to others regarding their own doubts. The activity will support learning outcome by motivating them to actively take part in the teaching and think about what they understand and do not understand about the topic.

3. Trying it out in practice

Activity: The teaching activity will be done as a 'ticket out of the door' combined with a 'think-pair-share' exercise.
At the beginning of class, the students will be introduced to the activity and asked to each contribute with a question regarding the scientific topic of the day. The question should be given anonymously on a piece of paper at the end of class and will be their ticket out of the door.



Out of class, the TA reads through the questions and assess the most common question(s). The TA prepares a short introduction to how the question can be addresses and which concepts could be important.

At the beginning of the following class, the TA presents the question together with the short introduction. Hereafter, the students are asked to discuss in pairs how they would answer the question and if they agree or disagree on how solve it. Finally pairs will enter a plenum discussion, talking about possible answers and how they addressed the question.

Assessment: The TA will be able to assess the students scientific understanding and engagement in the activity by reading the questions handed in and by seeing how active the students are in the discussions.

The students will be able to self-assess their own way of thinking together with their paired fellow student and comparing their answers with their peers.

Evaluation: The students will have the opportunity to evaluate the teaching activity using a poll on Mentimeter (or similar tool) by the end of the activity. The evaluation will focus on if students think the activity aided for a greater understanding of the given topic/question.

4. Looking forward

I did not have the opportunity to implement the teaching activity in practice during this course because of university lockdown. However as the activity addresses universal skills, I will be able to try it out in the coming semester.

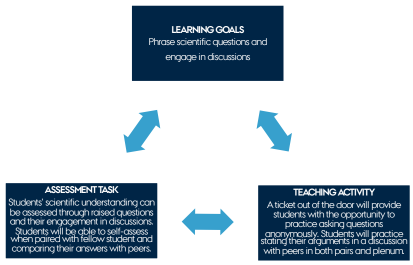


Figure 1: **Constructive alignment**

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Astrid Lauridsen
Gene Expression and Gene Medicine
Molecular Biology and Genetics

What is the true statistical model?

- An individual-group-share activity to identify the statistical model for a dataset

Abstract: *The students in mathematical statistics often struggle to identify the statistical model for a dataset. To overcome this struggle, this teaching activity is designed as an individual-group-share activity. The students are shown descriptions of unseen datasets, where they first try to identify the statistical model individually, then discuss the answers in small groups and at last share their answers. The different answers are discussed and compared by both the teacher and students. Most of the students saw this as a challenge themselves and thought the exercise helped them to identify and write the statistical model. If the activity had to be conducted online again, it would be favorable to give the students a few proposals to choose between, as there were spend a lot of time for the students to type-in the model on the computer.*

COURSE FACTS

- Course name: Mathematical Statistics
- Level: Bachelor
- ECTS credits : 10
- Language: Danish
- No. of students: 15
- Your role: Teaching Assistant. Helps the students to get familiar with the curriculum through theoretical exercises 2h each week.

1. Identifying a problem

In mathematical statistics most of the exercises are built upon a certain statistical model. The statistical model gives an overview of the assumptions made for a specific dataset and helps to understand the statistical tests required for the data. In the assignments they hand-in each week I often notice that they have troubles identifying the correct statistical model, which leads to wrong conclusions and comments in the exercise. Sometimes I see that the students have the right idea, but the writing of the indexes doesn't make sense in the context of the current dataset. The writing of a statistical model is also not unique, which makes it really challenging for the students to identify. An example of a statistical model is the regression model below that could estimate height(Y) based on weight(x):

$$M: Y_{gi} \sim N(\alpha_g + \beta_g x_{gi}, \sigma^2)$$

for $g \in \{girl, boy\}$ and $i = 1, \ldots, n_g$.

2. Planning a teaching activity

In the teaching activity I would like the students to practice identifying the statistical model from a description of a dataset. I found a few examples from a teaching book [1] of a similar course, taught by the same lecturer. As the lecturer is the same, the dataset descriptions are very similar to the ones they have seen in the course already and would be exposed to in the exam.

The important factor is that it was descriptions of new datasets they had not seen before, to make it as much like the exam as possible. The teaching activity should increase the ability to identify the statistical model for new datasets.

3. Trying it out in practice

The teaching activity was conducted online in Mentimeter due to COVID-19. The students were presented with the descriptions of three different datasets (A,B and C). First, they were given 10 min to individually identify the true statistical model. Afterwards, they were split into smaller groups of 2-3 people, where they had to compare and discuss their answers. After 15 minutes of discussion they were asked to share an answer to each of the three datasets in Mentimeter. The different answers were compared and discussed by the students and teacher. In Figure 1, the responses for Dataset A is shown. There is no unique way to write a statistical model, which lead to the very different answers as seen in Figure 1. The answers also shows where and how they still struggle to identify and write the statistical model. Which is good for further teaching.

Figure 1: **An example of student answers to Dataset A in Mentimeter.**

References

[1] Jensen, Jens. Ledet. *Introducerende Statistik og Dataanalyse med R (Fag): Teoretiske Øvelser.*

MAIN POINTS

1. **Main problem/challenge:** Identify the statistical model from the description of a dataset.
2. **Teaching activity**: Individual-group-share the statistical model for a described dataset.
3. **How did it go?** There were some limitations with writing mathematics online, but the activity gave a good insight into the thoughts and troubles of the student.
4. **What to do next?** Challenge the students to individually report the statistical model for a new dataset.

Figure 2: **The results from the evaluation.**

In the end, the activity was evaluated by a small quiz. The results are seen in Figure 2. The results show that some students really struggle to identify the statistical model, and some think it is very easy. They all agreed that the exercise helped them to identify statistical models some extend.

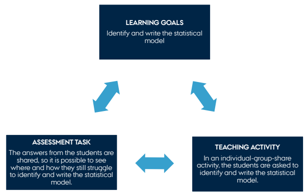


Figure 3: **A flow diagram of the teaching activity**

4. Looking forward

The teaching activity had to be online, which had some disadvantages. The writing of the statistical model requires a lot of upper- and lower-case letters, which is difficult and takes a lot of time to do online. Explaining a statistical model is just easier to do face-to-face with a piece of paper. If the activity had to be conducted online again, it would have been better to make a few proposals they could choose between. This would save a lot of time and potentially give time for more examples.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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(Mind) mapping out experiments

Critical preparation prior to laboratory exercises

Learning Lab

Abstract:

In the laboratory, students are faced with a challenge of translating the rudimentary protocols into workable data which can be evaluated against theoretical frameworks. A critical overview of the anticipated results and experimental uncertainties is necessary to ensure obtaining reliable data. A mind map exercise was employed in order to highlight the crucial role of thinking ahead, and to facilitate drawing connections between theory and practice. The collaborative and reflective aspects of the activity were met with positive responses from students. Group discussion sessions, based on this exercise, could be carried out at the beginning of each experiment.

COURSE FACTS

- **Course name:** Experimental Physics 2
- **Level:** Bachelor (2nd year)
- **ECTS credits:** 5
- **Language:** English
- **Number of students:** 12 per group
- **Your role:** supervision of laboratory exercises + report marking

TEACHING IN PRACTICE

1. Identifying a problem

In the laboratory setting, students often experience a disconnect between the idealised theoretical models introduced in other courses, and the data they collect - influenced by a variety of factors including the instrumental resolution, systematic and random errors. Moreover, the multi-step experimental procedures may at first appear daunting since only a rudimentary protocol and an outline of a theoretical background underlying the experiment are provided prior to the class. Critical assessment of the anticipated results and experimental factors is necessary to select a sufficient range and sampling of datapoints, so that reliable conclusions can be drawn from the data analysis, but students often only start considering these aspects when writing the reports.

2. Planning a teaching activity

The mind map teaching activity is designed to enhance students' appreciation of proper planning in anticipation of the experiment. The activity promotes proactive approach to the laboratory work, which induces critical thinking and helps to bridge the gaps in understanding between the theory and experiment.

In a wider outlook, this skill is invaluable in both industrial and research settings, especially when applying for experimental time at external facilities.

3. Trying it out in practice

The activity was carried out via Zoom and Padlet platforms. Students worked in the groups of three. The usual lab partners were assigned to different groups, so that in addition to the core activity, teams were encouraged to share practical experiences from previous experiments.

Each group was given access to a Padlet canvas with some suggestions already in place, as shown in Fig. 1. Interestingly, most groups decided to start building up their mind maps almost from scratch, scrapping the hints. The TA was moving between the groups to gauge the level of understanding and fuel the discussions.

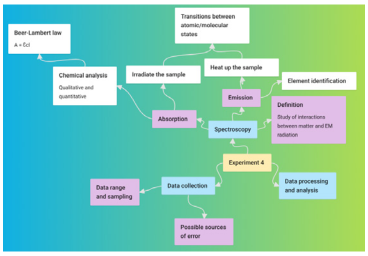

Figure 1: partially-filled mind map template.

Each of the groups produced a very different kind of mind map, perhaps reflecting their learning styles. Some of the teams made intricate spider webs, while the others concentrated on more thorough descriptions of fewer points.

After working for 25 mins, students were allocated to new groups. Their task was to comment on the canvases completed by someone else – did they agree with the descriptions? did they think that something vital was missing? In each team, there was one person who had worked on the discussed mind map, and who could clarify and "defend" their map.

MAIN POINTS

1. **Main problem/challenge:** lack of "thinking ahead" for the laboratory classes
2. **Teaching activity**: mind map
3. **How did it go?** Students stated paying more attention to the preparation stage
4. **What to do next?** Implement as a group discussion session

At the end of the activity, students were asked to fill out a short survey of three questions via Mentimeter. Selected answers are presented below.

What was the most important point you learned today?

"It has made me think more about the errors in the setup."

"I think the important point is that it taught me that this is a good way to start an experimental report before actually writing it. Sharing it with a TA and exchanging points here could save time later, I can imagine."

What did you like about this exercise?

"It was nice to talk with other groups about the exercise."

"Option to discuss the intuition behind the decisions in the exercise as well as the general intuition behind the rest of the exercises in the course."

What did you dislike about this exercise?

"Somewhat constrained to talking about recent exercise due to the mindmap being focused on it. If there was time to do this once for each exercise it would be great (even if time is sparce in a 5 ECTS course)."

"I am not a big fan of mindmaps, because I think it is difficult to get into the details."

4. Looking forward

Collected feedback indicates that the activity was successful in conveying its main message to students, making them realise the importance and usefulness of preparation prior to the laboratory classes. Students especially enjoyed the collaborative nature of the exercise, and this should be the focus for future iterations. A group discussion session, with a goal of producing a set of handy guidelines, could be implemented at the beginning of each new experiment.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Learning the tools of online pitching a scientific idea

- How to pitch in a clear and well formulated manner.

Abstract:
The teaching activity plans to learn the students how to prioritize and present a scientific solution/idea to a selected world challenge. The activity involves a short introductory lecture to pitching and is followed by student work, where they build and practice their own pitches. Student feedback will be activated by the peer element and assessments from the teaching assistant the following week.

COURSE FACTS

- Course name: Trends in Nanoscience
- Level: Master
- ECTS credits : 10
- Language: English
- Number of students: 22
- Your role: TA

TEACHING IN PRACTICE

1.Pitching in front of a computer
Pitching an idea, in a good manner, takes years of practice on what to say and equally important, how you present it. The students have generally no experience with pitching, and they are assessed in the exam on how well they pitch a two min idea. The students, therefore, struggle to prioritize what to say and how to present it. Further, they frequently do not estimate enough effort into actually practicing the pitch, and due to the circumstance, they have to pitch in front of a computer with no immediate response.

2. How to pitch?
The learning goal is to develop the students' presentations and communication skills. They should be able to communicate their project in a clear, relaxed, and professional manner in a limited time.
The students will get the tools to structure and prioritize their pitch from a lecture given by me. The student learning will be supported in the best possible way, by making and presenting a pitch to each other and give feedback. These actives every student in regard to practice the tools but they further also utilizes the peer element[1] to improve their classmate skills and their own.
The students have the opportunity to pitch their group presentation the following week to me and get feedback on this.

References

Include selected references here

Include selected references here

3. Trying it out in practice
The teaching activity was divided into two sections, one conducted by me and one conducted by an external expert, I contacted, who agreed to give a lecture on how to pitch in an online setting. All of the teaching occured by the usage of ZOOM.
The first part of the teaching activity consisted of a small introduction lecture on what is a pitch and a presentation of the NABC model for structuring and prioritizing a pitch.

NABC Model
N: The need
A: The approach
B: The benefits
C: Competitors

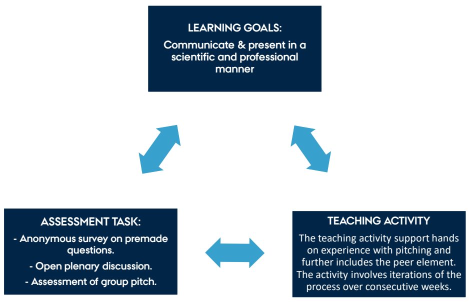
Figure 1: The NABC model structures a pitch on a generated solution/idea into four key aspects. This allows for delivering a clear message to a desired target group

The lecture was limited to 15 minutes to activate and engage the students by creating their own two minutes pitch. They had ten minutes to prepare a pitch where they followed the proposed NABC model. The students were then allocated into groups of three where they should pitch to each other. The teaching activity enabled them to practice the learning outcome and ensure that every student received training in communication. The group work consisted also of peer feedback[1] as a tool for the students to provide improvements to each other and reflect on their own work. The group work was conducted in break-out rooms allowing me to move back and forth to listen to their presentation. The students had the opportunity to present and receive feedback on their group pitch from me the following week

MAIN POINTS

1. **Main problem/challenge:** How to deliver a scientific idea in four minutes.
2. **Teaching activity**: Lecturing, small group work and peer feedback
3. **How did it go?** Good, but crucial assessment and feedback were missing
4. **What to do next?** Ensuring feedback and assessment

The feedback for teaching activity was planned to be conducted in two ways. Firstly by a premade survey, utilizing the poll system in ZOOM, allowing for anonymous comments and secondly by an open session in plenary. The poll feature did not work due to technical issues, and the open plenary sessions were skipped due to lack of time since the external guest lecture surpassed the allocated time. The students were assessed in the group the following week



4. Looking forward
The students seemed to gain a lot from the session, therefore I suggest doing it next year. The settings will be different next time making suggestion for improvement slightly difficult and inappropriate. A clear improvement for further teaching will be to ensure a strict timeslot for gathering student feedback.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Ticket out the door

- A way out of misconceptions in laboratory procedures

Learning Lab

Abstract: In laboratory classes, students often have trouble to link practical work with theoretical knowledge and/or application, which impacts their ability of properly analyzing the data obtained and writing the report. This teaching activity aims to help students bridge this gap between practice and theory through group discussions and a more perceptive overview of the lab procedure. Even though it was not possible to implement the activity, it is expected that students become aware and connect the steps of the lab work with theoretical concepts.

COURSE FACTS

- Course name: Experimental Biorefining
- Level: Master
- ECTS credits : 10
- Language: English
- Number of students: 14
- Your role: Setting up lab experiments, assisting during lab practice, report correction.

TEACHING IN PRACTICE

1. Identifying a problem

This course requires that students carry out a series of laboratory experiments. When teaching in this course, I observed that students often have difficulties in connecting practice with theory and/or the purpose of the experiments. It is important that students have a clear overview of the tasks they need to perform and are able to relate theory and practice, so that they can properly analyze their data and write their reports.

2. Planning a teaching activity

In this teaching activity, students will have the opportunity to discuss, reflect upon and integrate procedure, theory and aim of the lab work as well as predict possible results through short and simple pre and post laboratory exercises.
The main learning outcome of this teaching activity is to facilitate and help students bridging the gap between practice and theory/application which directly reflects on some of the course learning outcomes of being able to analyze experimental data and combine theoretical knowledge with practical results.

References

1.UNIVERSITY OF TORONTO. Active Learning and Adapting Teaching Techniques.

2. PSILLOS, D & NIEDDERER, H. Teaching and Learning in the Science Laboratory. Kluwer Academic Publishers, 2002.

3. Trying it out in practice

This teaching activity contains pre and post laboratory exercises. The "pre" exercise is an out-of-class activity, in which students write questions related to the lab procedure on an online Padlet board. 5 minutes prior to the lab work, the TA will briefly clarify any misconceptions with the whole class based on the students' questions and introduce the post-activity.

1) In your understanding, what was the main goal of today's experiment?

2) How do the results of this experiment relate to the next step? How/What for will you use the results you obtained?

3) What is your opinion about today's lab work? (Was it well organized? Level of difficulty?

4) Evaluation question.

Figure 1: Ticket out of door example questions

For the "post" exercise, students will receive a Menti code (online ticket) which they need to access and respond before leaving the lab. The Menti "ticket" will contain two questions related to the lab experiment, one evaluation question and a free comment on the lab work (See Figure 1) which students will need to discuss within their groups.
In the next lab session, the TA will promote a short open class discussion based on students' answers and comments.

MAIN POINTS

1. **Main problem/challenge:** Ability to link practical work with theoretical knowledge and understanding the objective of experiments.
2. **Teaching activity**: Ticket out the door
3. **How did it go?** It was not possible to apply the activity.
4. **What to do next?** Apply activity and evaluate outcomes.

Students learning will be assessed during the open class discussion and based on their answers to the Menti "ticket". Students can provide their feedback on the activity by answering the evaluation question in the Menti ticket (available on the second day so students can evaluate the previous activity). An evaluation questions could be: "How useful was the activity and how did it contribute to your learning?" Figure 2 provides an overview of how learning goals, assessment and teaching activity are aligned.

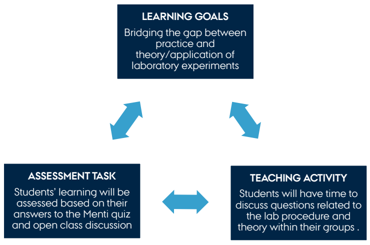

Figure 2: **Constructive alignment**

4. Looking forward

It was not possible to implement the activity this semester. However, it is expected that it will help students get a more perceptive overview of the laboratory procedure in relation to its application and the theoretical concepts behind it. Once this activity is applied, it will be possible to assess if the learning outcomes were achieved and receive feedback for future improvements.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Setting up a filtration system

Maximizing students' overview without protocol

Learning Lab

Abstract: Food Processes is a Bachelor Course for Engineering Students in Chemistry and Food Technology. The course contains a significant portion of laboratory based teaching through which the students will obtain hands-on experience with the related topics. However, students tend to loose overview and understanding of what the lab exercises are about, because they get too focused on the steps in the protocol. This teaching activity herein offers the students a frame for a lab exercise but does not include a protocol. Thus, it is up to the students themselves to make one while running the experiment. The teaching activity was tried out once, with positive feedback from the students.

COURSE FACTS

- Course name: KF4FØPC Food Processes
- Level: BA
- ECTS credits : 10
- Language: Danish and English
- Number of students: 30
- Your role: Planning of and assisting with lab exercises.

TEACHING IN PRACTICE

1. Identifying a problem

It is no news that students often lack the overview when performing laboratory exercises. They get lost in the protocol and blindfold themselves by focusing only on the individual steps of the protocol. Only when they have to complete the final report, they are forced to reflect upon the quality and meaning of the lab-exercises.
The aim of this teaching activity is to help students gain this overview while doing the lab exercises. This will leave the students with more room for reflective thoughts about the nature, background, usages and applications of the exercises

2. Planning a teaching activity

The teaching activity presents the students a frame for a lab exercise but does not include a protocol. They have to make one themselves, while performing the exercise. In this way, the students cannot loose overview of the exercise because they are *creating* the overview. This will force students to reflect upon the principles and components of the exercise while performing it. Thus, the goal of the teaching activity is to maximize the students' overview and qualitative understanding of the lab exercise.

3. Trying it out in practice

A student group of five people was presented to a Minimate ™ TFF Capsule filtration system and they were told that the aim is to filter skim milk and to concentrate the retentate to the double concentration. They had to do so without any protocol.
The students' learning was assessed and observed while the students collaborated to set up the filtration system. I observed the communication amongst the students and asked follow-up questions to confirm that the students actually understood what they were doing. When the students seemed to be finished with setting up the filtration system, I went through the setup together with the students and clarified eventual questions or wonderings.
Finally, they also had to complete a lab report in which they were asked to explain the components of the filtration setup, as shown in Figure 1. Students had positive feedback to the exercise, expressing: "*It was nice to try setting up the system from absolute scratch – it made you think more about what you were doing*".

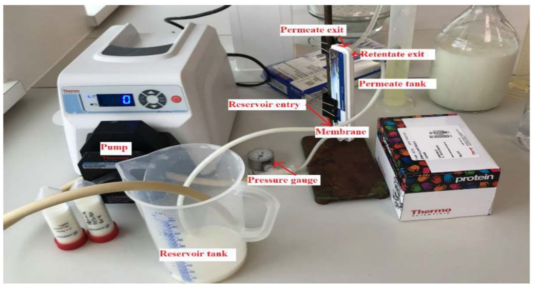

Figure 1. The experimental filtration setup

MAIN POINTS

1. **Main problem/challenge:** Lack of overview and qualitative understanding of lab exercises.
2. **Teaching activity**: Setting up a Minimate ™ TFF Capsule Filtration System without protocol.
3. **How did it go?** Positive feedback was given.
4. **What to do next?** Evaluate previous reports with current ones, to evaluate the teaching activity.

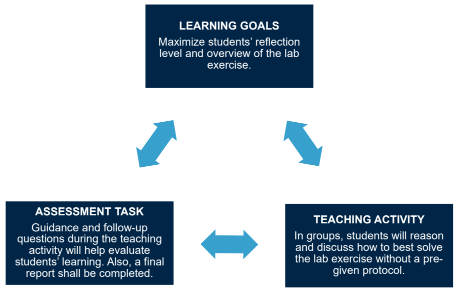

Figure 2. Constructive alignment

4. Looking forward

It would be interesting to evaluate the outcome of the teaching activity by comparing the quality of the reports from previous students with the reports made by students having tried out the discussed teaching activity.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Department of Food Science

To give is better than to receive[1]

- Using peer feedback in proposal writing

Abstract: Through their studies, students need to write scientific documents in many different forms. In Synchrotron and Neutron science a well-written beamtime proposal is a key document that decides if an experiment is allotted time. For many students, a proposal is a new form of scientific document and this course presents the first time they have to write one. Consequently they struggle with writing proposals. A *Peer Feedback* exercise was planned and carried out, to engage, asses and enhance students writing skills. Strong engagement from students was achieved, and giving feedback to peers was reported to be of high value.

Learning Lab

COURSE FACTS
- Course name: Materials Chemistry IIId
- Level: Master (+ some PhD students)
- ECTS credits : 10
- Language: English
- Number of students: 20
- Your role: Exercises, Journal club (½) and assignments.

TEACHING IN PRACTICE

1. Identifying a problem

Scientific proposals is a writing style students are less familiar with. Simplified, it is an argument of how to solve a problem [2].
In most proposal writing several rounds of feedback is given from collaborators.
Individual feedback and mentoring from the TA or lecturer on several assignments is rarely possible.

To advance their writing skills students need a way to read several examples, practice their writing, get feedback on their writing. Most importantly students need to actively reflect on what makes writing good.

2. Planning a teaching activity

Peer feedback was chosen to tackle this problem as the act of giving feedback was shown to greatly improve writing [1]. Peer feedback engages students in a active learning process through reflection, evaluation, judgement and explanation to their peers [3].

At the same time students gain practical experience in providing and receiving constructive criticism which are essential skills for their academic and professional careers [3,4].

The teaching activity was designed to activate students by including the following:

A) Exposition to other writing and argumentation styles by reading work from peers.
B) Active reflection on their writing while: evaluating, judging and explaining their feedback to their peers and when receiving it.
C) The "raise flag" as an option to summon TA / Lecturer and clear up any confusion or disagreement between peers in their feedback.

3. Trying it out in practice

Students were given the article, assessment criteria and proposal template. After one week they handed in the proposal and began peer feedback. After one week feedback closed and students could choose to incorporate feedback and self-assess. As seen in Figure 3 and 4 students ranked peer feed back as the best value. Students self-evaluated clear improvement in the categories: Abstract, Figure, Clarity, Justification and Overall impression.

Q4 · Scale · Requires additional comment
Figure(s) and/or table(s):
Rate from 1 (lowest) to 5 (highest)
And explain your reasoning in the comment.
Consider how well the Figure(s) and/or table(s) helps illustrate some of the following:
The experiment plan, the expected results, preliminary experiments or other important details.

Figure 1: Example of rubric given for evaluating the use of Figure(s) and table(s) in the proposal.

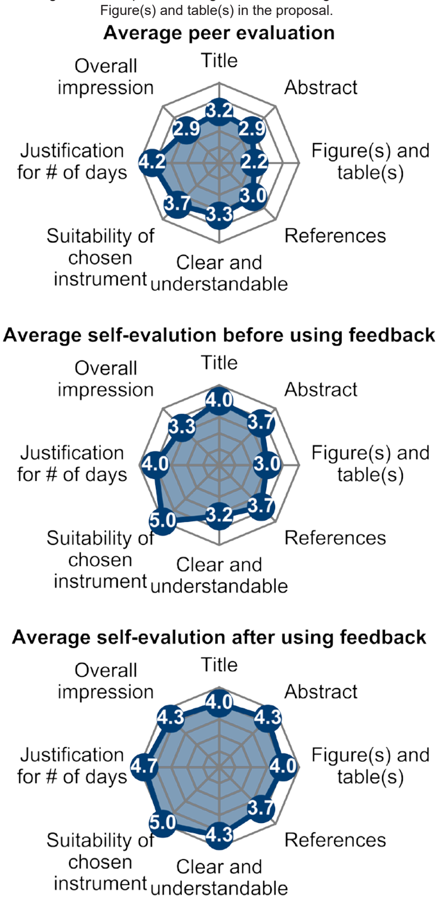

Figure 2: Result of the peer evaluation and self assessment.

MAIN POINTS
1. **Main problem/challenge:** Writing a new form of scientific document: A proposal.
2. **Teaching activity**: Peer-Feedback on beamtime proposals
3. **How did it go?** Very good engagement in peer-feedback! Less so in voluntary feedback incorporation and self-assessment.
4. **What to do next?** Compulsory feedback incorporation and self-assessment.

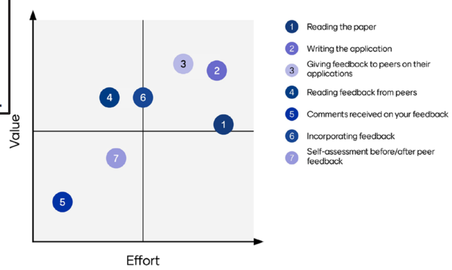

Figure 3: Students reported effort spent and value gained from each sub-part of the teaching activity.

The best part of the assignment is giving feedback to someone else. It was harder than i thought to incorporate the feedback and own conciderations in my own proposal - very good exercise. Rating my proposal gave a hint to where it could be improved.

Figure 4: Anonymous student quote on the value of giving peer feedback.

4. Looking forward

Students rated great value of giving peer feedback, but found self-assessment, reading feedback and giving comments of less value. Based on this the following is considered:
- Let students read *and* give feedback on "exemplary" and "non-exemplary" proposals.
- Let students discuss feedback on a "non-exemplary" proposal with peers to promote the use of the "comments" in peer review.
- Let students incorporate feedback on "non-exemplary" proposal, self-asses and give peer feedback.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

References:
[1] Lundstrom, K., 2009. Journal of Second Language Writing, 18(1), pp. 30-43.
[2] Alley, M. The craft of scientific writing. New York: Springer, 1996.
[3] Nicol, D., 2014. Assessment & Evaluation in Higher Education, 39(1), pp. 102-122.
[4] Anewalt, K. 2005. J. Comput. Sci. Coll. 21, 148-155.
https://educate.au.dk/en/focus-areas/peer-feedback-in-teaching/

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Magnetic Matter Aarhus
iNANO

From gymnasium to university

How to do scientific reports for freshmen

Learning Lab

Abstract:

First-year students often have issues with how to structure reports and determining how to properly present their data. Here I present a suggestion for a teaching activity which might help.

COURSE FACTS

- Course name: Inorganic Chemistry I: General Chemistry
- Level: bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 20
- Your role: LØ TA

TEACHING IN PRACTICE

1. Identifying a problem

Coming fresh from the gymnasium, 1st year students often have difficulty with the structure and content of a scientific report (what goes into which section, significant figures, figures and tables etc.).
This course requires the students to hand in several mandatory reports where they are to explain their findings and discuss the results.
Knowing how to present your data in a concise and clear fashion is of utmost importance in the field of science since this constitutes one of the primary methods of communication.
From past experience teaching in this course, this issue can persist over an extended period of time.
Additionally, the students come from different backgrounds and prior knowledge, and there are non-aligned expectations between them and the TA.

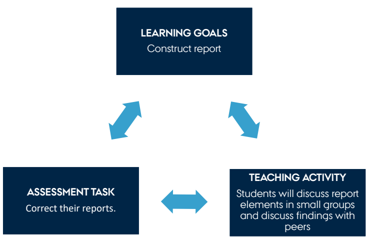


Figure 2: **Constructive alignment is good**

References

www.Heste-nettet.dk

2. Planning a teaching activity

The teaching activity has been designed around identifying and correcting the most common problems found in the reports. This will make the students able to quickly notice missing key elements.

3. Trying it out in practice

Due to Corona this activity has not been implemented. Instead a description of the implementation is provided.
Two mock reports with different things that are right and wrong focusing on the "Results and Discussion" section, will be constructed for the students to evaluate.

Figure 1: Stock photo of someone doing something

Guidelines and general Information regarding the activity will be prepared by the TA and handed out to class during the very first laboratory class. The first week in lab consists only of a short safety course and an Introduction to the glassware and equipment in the laboratory. This way the students can read the details at their own leisure since they are heavily bombarded by new Information the first week in university but will be required to have read it before the following week.

MAIN POINTS

1. **Main problem/challenge:** Students have issues with report structure.
2. **Teaching activity**: Students evaluate two examples of mock reports.
3. **How did it go?** Not completed.
4. **What to do next?** Implement it.

The next class a short Introduction to the exercise will be given by the TA and the groups are asked to correct and evaluate the two reports as described in the guidelines (10 minutes). Once the groups have gone through both reports they will team up with another group to discuss their answers (10 minutes). During the entire process the TA will walk among the groups discussing the material.
At the end a "correct" report will be handed out to self-assess their findings to be done out of class and will help them with writing their first report.
The success of this technique will be displayed in the number of approved first attempt reports compared to previous years. The students will be able to provide feedback on the activity by utilizing the 'ticket out of the door' the week after the teaching activity has been performed and they have handed in their first reports.

4. Looking forward

Implementing it in the future.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Martin Ottesen
Martin Bremholm
Chemistry

Feedback Activity

- Improving students projects reviews

Abstract:

In a group-based project work course, it has been observed low effort between students to understand and review the project of other groups in the last years. An active learning activity was implemented to engages students to do an useful review of the other group project. The activity consisted of a competition where each group present their project to another group, which will give a review of the presentation; and vice-versa. There were two winning groups: the best presentation and the best review performance. It was observed that the students were very motivated and very involved during the activity. A future improvement for this activity could be the addition of bringing materials or equipment that were used in each group project.

COURSE FACTS

- Course name: Kemiteknologisk project 1
- Level: Bachelor
- ECTS credits : 5
- Language: English
- Number of students: 24
- Your role: Teaching assistant (TA)

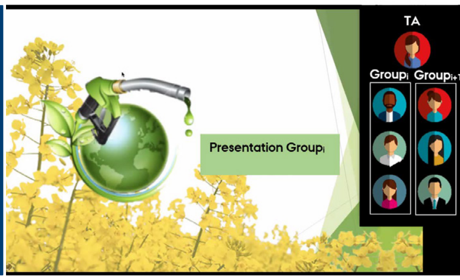


Figure 1 – Student presentation.

MAIN POINTS

1. **Main problem/challenge:** Low effort to review groups project.
2. **Teaching activity**: Student presentation and review.
3. **How did it go?** Increased level and quality of participation.
4. **What to do next?** Show some materials.

TEACHING IN PRACTICE

1. Identifying a problem

The course is a group-based project work. The students are divided into eight groups. Each group choose a project related to chemical technological production. During the course, each group shall design and carry out the experimental work needed to study the process. In the end, each group write a report.

During the last two years, each group had reviewed the report of one of the other groups. However, it has been observed an unbalance in the effort to do the review between the groups. Therefore, the challenge of this activity was to engage the student to do a proper review.

2. Planning a teaching activity

A competition rewarding the best presentation and review should motivate students to engage in both presentation and review. The students will practice different skills.

When the students are doing their presentation, they practice: (i) how to perform a presentation; and (ii) how to explain their work to other people.

When the students are observing the presentation of the other group, they practice different outlearning of the course: (i) identify the experiment and methodology that the other group used; (ii) analyse the data and results presented by the other group; and (iii) work as a team-work to ask and to answer questions.

3. Trying it out in practice

The teaching activity was done using Zoom since it was during CoV19 period. To improve the participation of the students, the 4h lesson was divided into four sessions of 1h with only two groups (table 1).

Table 1 -Schedule 4h lesson.

Time	Group
8:00 - 9:00	Zoom with Group 1 and 2
9:00 -10:00	Zoom with Group 3 and 4
10:00 -11:00	Zoom with Group 5 and 6
11:00 -12:00	Zoom with Group 7 and 8

Each group has to present their project to another group (and vice-versa) in 15min (Figure 1). At the end of each presentation, the TA asked 5 questions to the group who was as an audience, and they also asked 3 questions to the other group. Table 2 shows the schedule of the 1h session.

Table 2 -Schedule 1h session with 2 groups

Time	Activity
8:00-8:15	Presentation from Group$_i$
8:15-8:30	Questions to and from Group$_{i+1}$
8:30-8:45	Presentation from Group$_{i+1}$
8:45-9:00	Questions to and from Group$_i$

The activity was a competition with two winning groups: the best presentation and the best one to give a review. In the end, TA published the winners and the awards (beer bones).

A guideline both how to do the presentation (table 3) and the structure of the questions session (table 4) was published two weeks in advance.

Table 3 – Presentation session structure.

Time	Activity
8:00-8:03	Introduction
8:03-8:08	Material and Methods
8:08-8:13	Results and Discussion
8:13-8:15	Conclusion

Table 4 – Questions-QUS session structure

Time	Activity
8:15-8:20	5 QUS from TA to Group$_{i+1}$
8:20-8:23	3 QUS from Group$_{i+1}$ to Group$_i$
8:23-8:26	Group$_i$ answer the above 3 QUS
8:26-8:30	Feedback from TA

Each group was observed during the 1h session. When the group was presenting, TA observed how they did overcome difficulties, have used the literature, have designed the experiments, have analysed the data and have drawn their conclusion. During the question section, TA could assess how the group interpreted the presentation from the other group.

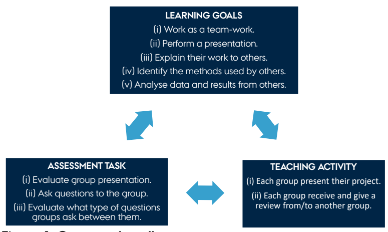


Figure 1: **Constructive alignment.**

4. Looking forward

Zoom app provided the tools to perform the activity, and the students did a great job. The activity engaged the students as hoped. The activity will be repeated during the next years since students gave an excellent comment in the survey. This activity is also a simulation of the exam. To improve this activity for next year, it will be face to face mode and students could provide any materials or equipment that they used during the experiments.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Yolanda Maria Lemes Perschke
Environmental Technology
Department of Engineering

Sorting in practice

- How small group dynamics impact confidence in presentations.

Learning Lab

Abstract: Understanding theoretical abstraction for new students have always been a challenge. In this study we will implement a teaching activity which builds upon the students prior knowledge surrounding sorting. By working in smaller groups the students will be able to work in an environment in which they can express their doubts safely. Lastly the students will present their solution in front of the rest of the class.

COURSE FACTS

- Course name: Algortihms and Datastructures
- Level: Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: 150
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

I have encountered two problems in which I would like to address in this teaching activity. First of, when teaching an introductory course in theoretical Computer Science the level of abstraction can be hard for the students to grasp, since they have never encountered anything like it in high school. Secondly, it is always a challenge to engage a large group of the students to come to the white board and present exercises, normally you are stuck with only a few doing the exercises each week.

2. Planning a teaching activity

The idea is to build upon the knowledge the students already have. Most people have tried to sort a hand of playing cards and hence we will start the activity by letting the students sort a deck of cards. To make this a collaborative experience, while making it safe for the individual student they will be placed in groups of size three. After they have sorted the deck of cards, they will analyze its running time and think of ways to improve their sorting. Lastly one from each group will present the groups solution in front of the rest of the class room. Then to wrap everything up, they will be asked to implement their solution in java until next time, thereby giving us a way to evaluate if the students learned something about algorithmic design.

Sorting: https://en.wikipedia.org/wiki/Sorting_algorithm

3. Trying it out in practice

This is where I ran into a major issue, since we are in these very strange times. I do not teach the course right now and therefore it has been hard for me to access the students. Therefore I have carried out the activity with two pseudo students. The first student is my little sister, who is a first year student at an engineering education at Aalborg University and the second student is my brother in law who is a second year student here at Computer Science in Aarhus.

They both straight away applied the insertion sort, which is also the most commonly known way of sorting. When analyzing the algorithm the first subject had a hard time understanding why it was a suboptimal solution. This was clarified when the second subject presented his solution.

Figure 1: The playing cards the students needs to sort by existing knowledge.

MAIN POINTS

1. **Main problem/challenge:** The theoretical abstraction of sorting.
2. **Teaching activity**: Working in small groups to build on prior knowledge.
3. **How did it go?** The presentations were a huge success in aiding the learning.
4. **What to do next?** Try it out on real students and have them implement the sorting algorithm they came up with.

It seems like the presentation part of the exercise was crucial for certain students to understand the connection between their existing knowledge of sorting and the more theoretical end of it. Furthermore it seemed like everyone had an easy time getting started and by slowly increasing the theoretical level of abstraction it was not too overwhelming for the students.

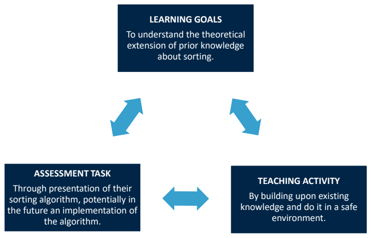


Figure 2: **Constructive alignment**
We want to make the students understand the theoretical abstraction of something they already know, namely how to sort a deck of cards. The teaching activity will be to sort the deck of cards in small groups and they are assessed by presenting their solution in front of the rest of the class.

4. Looking forward

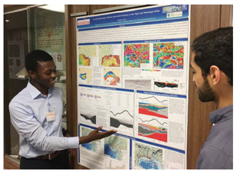
The major issue is that I did my exercise on proxy students. I would very much like to try this out on real students in the fall, when we are all back at the university. Furthermore I think the assessment could be extended with a home assignment where they need to implement the sorting algorithm. When doing the exercise on real students, it will also give me some real feedback which I can incorporate into the exercise.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Rasmus Killmann
Theory and Algorithms
Computer Science

ROSter's Poster

Student poster session to encourage active learning



Abstract: This session is scheduled for the beginning of a Master's level class in Fall 2020, where students will learn about ROS - a development framework for robots. Previously in Fall 2019, students reported that it was difficult for them to learn these confusing concepts in a short time. In this class activity, we tackle this problem by organizing an interactive student's poster session to encourage active learning that, in theory, should boost students' understanding while also engage them more to the class in order to achieve the course outcomes. Assessments will be achieved by students' feedback in the form of an exit survey for future teaching improvements.

COURSE FACTS

- Course name: Control of Mobile Robots
- Level: Master
- ECTS credits : 5
- Language: English
- Number of students: 5
- Your role: TA – help deliver practice class & lab sessions.

TEACHING IN PRACTICE

1. Identifying a problem

At this point, the students have just started a course in Robotics. It is overwhelming for them as we try to teach them many new basic concepts that they will need for their upcoming homework and projects. The theory lectures and practice sessions are a little disconnected. But they need to put them all together in order to move forward. This session will teach them a development framework (the **Robot Operating System – ROS**). They need to master this for their homework, and they can also use *this* exact framework to link all the so-far-confusing concepts together.

2. Planning a teaching activity

Students will be informed to prepare for the **poster session** a week before, together with a detailed requirements for the poster. They will also receive an email containing resources and web links about ROS, and will be encouraged to research more. On the teaching day, they will present the poster to the instructors and their peers, and give answers and discussions, including their own questions, to other students and the instructors. All participants will receive a class **exit survey** and a relative score for their poster. Obviously this session aims to help them reorganize their knowledge and link them with their own experience. It also offers instructors opportunities to correct any misconceptions. Additionally, it will help students engage more to the class.

3. Detailed Teaching plan

1) 14 days before the class: prepare class materials. Instructors make a prototype concept map (Figure 1). Finalize content and requirements

2) 7 days before the class: Send an instruction email to the student: setting up the goal, expectation and requirements of the session. Also include useful resources (papers, books, helpful links).

3) 1 day before the class: send a last-minute reminder to get attention.

4) On class day: help students roll out their posters.

- Go to each student's poster with other students and ask constructive questions, such as: why you think this concept connect to this? How this node transfer information to that node …
- Handout an exit survey for each students for peer-reviewing.
- Showing your concept map for students and reflect it with students

5) After the class: send to each student the summary of the exit survey, their relative score (from their peers + instructors). Include the instructors' concept maps for their references.

MAIN POINTS

1. **Main problem/challenge: Solving overwhelming concepts at the beginning of a course**
2. **Teaching activity**: A concept-map poster session
3. **What to do next?: A detailed teaching plan**

Assessment Plan: An exit survey

1) **Peer review**: (Student Input)
- Rank others' posters

2) **Discussion review**: (Student Input)
- Rank group's clearest answers

3) **Instructor review**: (Instructor input - hidden from the class)
- Rank each poster session objectively

4) Get Feedback from group about the session (Student Input)

5) Get their additional questions (Student Input)

6) Summarize and get a **relative score** (50% instructor score + 50% average peer score)

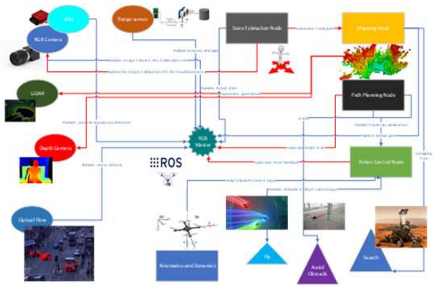


Figure 01: a concept map for **Robotics** on **ROS** Framework

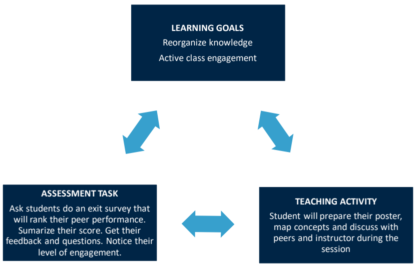


Figure 02: Constructive **alignment**

4. Looking forward

This teaching is scheduled for the Control of Mobile Robots course in Fall 2020. It is hopefully helpful for the participate students to quickly understand difficult concepts of Robotics, and be able to leverage them for their homework and final project to achieve the ultimate goals of the course.

References

Silberman, Mel. Active Learning: 101 Strategies To Teach Any Subject. Prentice-Hall, PO Box 11071, Des Moines, IA 50336-1071, 1996.

Novak, Joseph D. "Concept mapping: A useful tool for science education." Journal of research in science teaching 27.10 (1990): 937-949.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Huy Pham
Artificial Intelligence in Robotics
Department of Engineering

Good quantum numbers

- Learning to identify good quantum numbers and reflect on the importance of these.

Learning Lab

Abstract:

In atomic and molecular physics the used quantum numbers depend on the dominant terms of the Hamiltonian. Generally, when solving a quantum mechanical problem identifying symmetries and good quantum numbers greatly simplifies the problem. Identifying these are, therefore, a significant tool which the student will learn through this teaching activity. The activity consists of a set of problems, going from easy to identify quantum numbers to difficult edge cases, which they will solve and discuss. Afterwards, the students learning with be evaluated through a ticket out of the door type activity.

TEACHING IN PRACTICE

1. Identifying a problem

The way quantum mechanics is taught puts emphasis on the wave function formalism. This means that the linear algebra is pushed to the background and some important concepts are, therefore, not learned. One of these concepts, which are of immense importance to the course of atomic physics, is the notion of good quantum numbers.

From discussion with the TAs of the course, it has become clear that this is indeed a problem for the students.

2. Planning a teaching activity

The teaching activity is planned to first give the students a simple way of identifying good quantum numbers, as well as introducing the ambiguities that can arise. Here group discussions are used to force the students to reflect on these border cases and why good quantum numbers are useful in the first place.

Finally, the students learning is evaluated through a set of carefully crafted evaluation question.

COURSE FACTS

- Course name: Atomic and molecular physics.
- Level: 2. year
- ECTS credits : 5
- Language: Danish
- Number of students: 20
- Your role: Teaching assistant

3. Trying it out in practice

The teaching activity consists of several parts. First, a brief introduction to good quantum numbers is given. Next, a problem set is solved by the students individually where they are to identify good quantum numbers. An example of such a problem can be seen in figure 1. Afterwards the problem set is discussed in groups, discussing the different solution strategies used and the edge cases.

Finally, the students will answer three discussion questions in the same groups.

$$H = \omega\hbar \begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix} + \Omega \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \qquad \Omega \ll \hbar\omega$$

$$\sigma_x = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}, \quad \sigma_y = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}, \quad \sigma_z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$

Figure 1: Example Hamiltonian and set of operators that will be a part of the problem set.

MAIN POINTS

Main problem/challenge:
Learning to identify good quantum numbers as well as understanding the importance of these.

Teaching activity:
A problem set consisting of different Hamiltons with a set of operators each. This is solved first individually and then in groups.

How did it go?
Has yet to be implemented

What to do next?
Implement it.

These questions allow for different layers of answers and will be used as evaluation of the students learning. This is done as a ticket out of the door type activity.

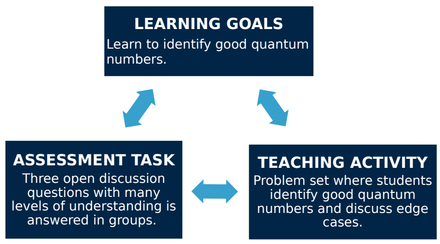


Figure 2: Constructive alignment of the different parts of the activity.

4. Looking forward

The teaching activity has yet to be implemented, which would be the first thing to do looking forward.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Kasper Poulsen
Department of Physics and Astronomy

Published, not Perfect!

- Improving critical evaluation skills of scientific literature

Learning Lab

Abstract: It can be hard to critically evaluate scientific literature, especially when you first encounter it. This, however, is an essential skill for a researcher to have, both in evaluating others and their own work. The activity presented here attempts to improve the critical evaluation skills of its participants through working with tailored examples taken from real scientific papers, where the authors have e.g. presented suspect data or made dubious claims about the applicability of the results ect. Peer discussions in pairs is combined with in plenum discussions to facilitate participation and learning as much as possible.

COURSE FACTS

- Course name: Nanosynthesis and nanomaterials
- Level: 3rd year BSc
- ECTS credits : 5
- Language: English/Danish
- Number of students: 14
- Your role: Teaching assistant conducting journal club-esque exercises

TEACHING IN PRACTICE

1. Identifying a problem

The students are having a hard time critiquing the articles they read, likely because it's the first course in which they work with published scientific literature. As a result they use most of their preparation just trying to understand the paper leaving little time and energy for evaluating its contents.
Approaching results critically is a core part of being a researcher and recognizing problems with others' work it should help improve their own scientific savvy and -practice.

2. Planning a teaching activity

The aim of the teaching activity is to get the students used to taking a more critical approach to the contents of scientific papers, such as data quality, presentation, and analysis, and the conclusions drawn by the authors.
By allowing the students to work through problematic examples from real papers they will hopefully get a feel for the thought process and mindset required, and thus be able to more easily incorporate it into their normal reading, and thought processes.

3. Trying it out in practice

The students are initially split up in pairs and handed a problem sheet containing:

- An excerpt from a article such as a paragraph with dubious conclusions/extrapolations, or suspect data/figures
- A brief description of the study in question for necessary context
- Questions to facilitate thoughts and discussions as to why the excerpt is or isn't problematic

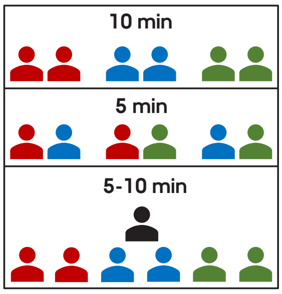


Figure 1: Outline for working through each problem; first they work in pairs for 10 min, subsequently the pairs are mixed and they are given 5 min to discuss their results in the new pairs, finally the problem is discussed in plenum for 5-10 minutes.

The process goes as shown in Figure 1. The pairs are given 10 minutes to answer the questions and discuss the content, after which they are split up and arranged into new pairs. These pairs are then given 5 minutes to compare notes and discuss their findings. During both of these steps the TA is walking around listening to the discussions and offering assistance when deemed necessary. Lastly, the problem is discussed in plenum to catch everybody up and potentially find problems not uncovered in the previous steps.
Depending on the length of the discussions, this will be repeated for 4-5 different problems to help develop their critical thinking muscle memory.

MAIN POINTS

1. **Main problem/challenge:** Critically evaluating data/figures/claims in published scientific literature
2. **Teaching activity**: Working through tailored examples from real scientific papers
3. **How did it go?** Has not yet been implemented
4. **What to do next?** Implement the activity

4. Assessment of student learning

The students learning is continually assessed by the TA during the exercise in the curse of listening to and potentially guiding the students' individual discussions.
Additionally, a mentimeter quiz could be prepared to get feedback from the students themselves of their perceived learning, allowing for a more quantitative evaluation of the activity

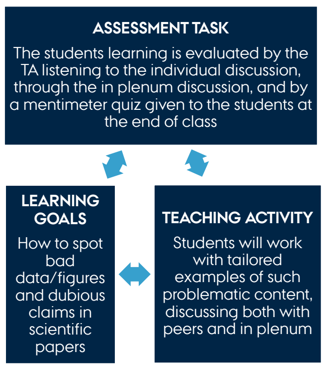


Figure 2: Constructive alignment

4. Looking forward
The teaching activity has not been implemented as of yet, so looking forward the goal would be to actually try it out.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Jonas Ruby Sandemann
Center for Materials Crystallography
Department of Chemistry & iNANO

Characterizing Arctic marine ecosystems

- Identifying differences between high-Arctic, sub-Arctic and Atlantic species

Learning Lab

Abstract: During the course in "Arctic marine ecosystems in a changing climate" the students will learn about the differences between high-Arctic, sub-Arctic and Atlantic marine ecosystems, and learn to differentiate species adapted to these different environments and what their characteristics are. They need to be able to identify different organisms by species (Latin names) and know which environmental conditions they are adapted to. As the exam is an oral examination without notes, it is very important that the students memorize the different topics. The aim of this teaching activity, using a quiz on mentimeter and a ticket-out-the-door, is therefore to help them memorize, identify important terms, species and characteristics. It will also help the TA in identify what the students find most challenging to understand, and which topics that needs more in-depth explanation.

COURSE FACTS

- Course name: Arctic marine ecosystems in a changing climate
- Level: Master
- ECTS credits : 10 ECTS
- Language: English
- Number of students: 15
- Your role: TA during short lectures and theoretical exercises

TEACHING IN PRACTICE

1. Identifying a problem

During this course, the students must learn many things by hearth to be able to pass the oral exam. They need to learn to identify and separate between Arctic, Sub-Arctic and Atlantic species among other algae, copepods and the characteristics of arctic marine ecosystems. They also must be able to describe species and remember the Latin names of different organisms and describe the characteristics of the different marine ecosystems. They should be able to describe the role of marine terminating glaciers, and adaptations in organisms to the Arctic marine environment. So it is many things that they need to memorize to be able to pass the exam, and that may be the most challenging thing during the course.

2. Planning a teaching activity

This teaching activity will help them memorize these different subject and identify challenging areas that needs more in-depth explanations. The teaching activity will consist of a mentimeter quiz, which will also help in identifying subjects that the students find most challenging. Before submitting their answer to the questions, the students can discuss with the person next to them. If there are many wrong answers the students will be given a second chance to discuss in small groups, and answer the quiz again, which will be followed by a discussion and an explanation by the TA. This will hopefully help the students identify the correct answers and help in memorizing Latin names, species descriptions, and what characterizes the Arctic, sub-Arctic and Atlantic marine ecosystems. In addition, a ticket-out-the-door will be given, containing two questions, one about which topics that were easiest to understand, and another about which topics that where more difficult to understand.

3. Trying it out in practice

This course is taking place in Nuuk, Greenland where the students will also conduct their own fieldwork and lab work, and the initial plan was that I would teach during a whole week, but this was no longer possible due to the corona situation, and I instead gave a 45 minute online presentation, and therefore had no change to do this in practice. But I will hopefully do this next year where the course is held again, so I haven't had the change to try it out yet. But the goal is to have at least 10 questions with four optional answers provided for each question, covering the most important topics in the curriculum, and some important species.

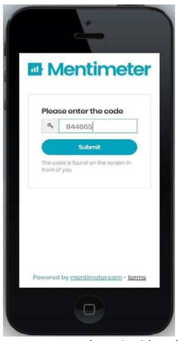


Figure 1: students can answer the quiz either through their phone or laptop. The results will be shown on a projected screen, followed by discussion and explanation by the TA.

In addition to the quiz a ticket-out-the-door will be given, in which the students will be asked to describe in few words about what was easiest to understand in the curriculum, and which topics were the hardest to understand. This will give the students a chance to influence the next class, as I will explain the topics that the students found most challenging in a different way and hopefully make it easier to understand and remember. This would help both students and I, as the students will learn about the challenging topics from a different angle and give me a chance to improve my teaching.

MAIN POINTS

1. **Main problem/challenge:** Difficulty in remembering Latin names, species characteristics, and characterizing differences in marine ecosystems
2. **Teaching activity**: Mentimeter quiz and ticket-out-the-door
3. **How did it go?** It was not implemented due to the corona situation
4. **What to do next?** The teaching activity will hopefully be used next year, as the course is offered each year during the spring.

The students will identify topics that they might have misunderstood and give them a chance in understanding the subject better, while correct answers to the questions will reassure their learning. The quiz will help with their learning and help in identifying challenging topics in the curriculum, while the ticket-out-the-door will give the students a chance at expressing what they would like to understand better, and also present a dialog between students and TA, as TA will be given a chance to improve the teaching and come with elaborations to the most challenging topics.

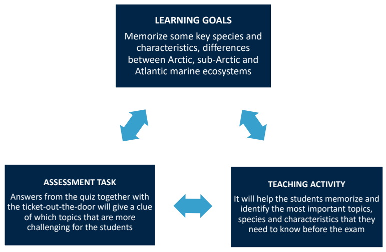


Figure 2: **Constructive alignment**

4. Looking forward

This semester has been challenging due to the corona situation, and this course is taking place in Nuuk, Greenland where the students are taking an Arctic semester, which requires the lectures, guest lectures, and TA's to be in Nuuk during the week they are teaching, and this is not currently possible due to the requirement of quarantine rules (two weeks isolation) when arriving to Greenland. But the course is also taking place next year, where I will hopefully participate as a TA and try out the teaching activity. But as I took the course some years ago, I remember that it would have been nice to have a quiz to see if we remembered correctly, as there where many things to remember by hearth, and a quiz is a good tool to assess own progress and identify challenging areas. It also gives the TA a chance to explain in-depth about subjects the students have a harder time remembering or understanding.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Bioscience

Three student groups, two rooms & one teacher

- A laboratory exercise in form of circuit training

Learning Lab

Abstract: Laboratory exercises are often constrained in time and space, especially, when multiple groups have to share the same equipment in a time series experiment. The aim of this teaching activity is find a solution to make best use of available time and space in laboratory exercises. Here, I propose a coordinated workflow in form of a "circuit training" which will be demonstrated based on one laboratory exercise of the course "Microbial Ecology". A combination of tools, such as a precise time table, Strip-chart-sequence, Think-pair-share, Student-teach-Students and discussions, will be employed to achieve an improvement of coordination. When this will be tested out in practice, feedback should lead to further improvement, so that the laboratory exercise can eventually run alone by one TA.

COURSE FACTS

- Course name: Microbial Ecology
  Level: Bachelor
- ECTS credits : 10
- Language: Danish/English
- Number of students: 18
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying issues

In this specific laboratory exercise, which involves the analysis of laughing gas by gas chromatography (GC), in total three groups have to continuously measure using the same instrument during a limited period of time in a small laboratory room. Recent experience shows that three challenges emerge, which are common to many laboratory exercises: (1) Time pressure demands coordination, because otherwise the groups which don´t measure cannot use this time efficiently. (2) Limited laboratory space physically separates groups. (3) Good planning and coordination would allow the exercise to be run alone by the teaching assistant (TA). The aim herein is to address these challenges because if they are not successful handled they will affect student learning.

2. Planning the teaching activities

The following tools will be employed to solve the issues: (1) Detailed time table. (2) Rotation between two laboratory rooms including in total three stations, i.e. GC measurement, Strip-chart sequence and Data analysis. (3) Think-pair-share, Students-teach-students and discussions among groups as well as with TA.
The learning goals (practical & theoretical GC measurement, as well as data analysis) will be clearly detailed at the beginning of the laboratory exercise and in the time table which will be handed out all students.
After the introduction and practical induction to the GC measurement in Block 2-4, the other stations should be able to be completed by students alone. The TA plays then a passive role but students are strongly encouraged to ask the TA any time if in doubt or encountering an issue.

3. Theoretical planning

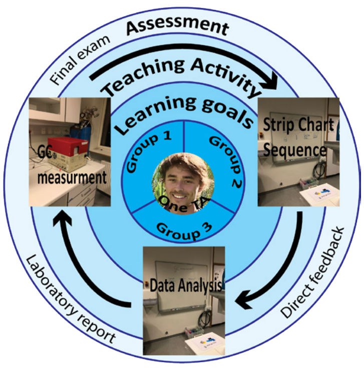

Figure 1: Constructive alignment of circuit training.

MAIN POINTS

1. **Main problem/challenge:** Coordination in time & space
2. **Teaching activity**: Strip Chart Sequence, Think-pair-share, Students-teach-students
3. **Risks:** Time schedule too tight, students cannot use time efficiently, TA overwhelmed resulting in limited help & supervision .
4. **What to do next?** Improvement of time schedule and adaption of teaching activities according to feedback.

Table1: Circuit Training. Time table for group rotations. Asterisk marks activities in which assessment and feedback will occur.

Time:	08.00.00	08.30.00	09.00.00	09.30.00	10.00.00	10.30.00	11.00.00	11.30.00
Block:	1	2	3	4	5	6	7	8
Introduction	1,2,3							
GC measurement I		1	2	3				
Strip Chart		2	3	1				
Data Analysis I		3	1	2				
GC measurement II					1	2	3	
Data Analysis II*					2,3	1,3	1,2	
Plenum discussion*								1,2,3

Description of activities & learning goals

Introduction: Brief repetition of background (What are the microbial processes and the principles of GC measurements, how to analyse the data?) and explanation of the time table as well as the teaching activities.

GC measurement I: First measurement on the GC, which requires practical induction by TA. Learning goal: Students learn how to operate the GC on their own.

Strip Chart: Strip-chart-sequence detailing the different steps in GC analysis. Learning Goal: Understand the different steps of the GC measurement.

Data Analysis I: Discussion within the group in form (similar to Think-pair-share) about how to analyse data. A protocol will be handed out prior to the course day which details the most important steps. Learning goal: Analysis of the data from calibration to flux calculation.

GC measurement II: Second measurement on the GC, without practical guidance by TA.

Data Analysis II: Analysis of first measurement point. Students help other students to overcome misunderstandings, analyse the data for their report, and also discussions among groups are encouraged.

Plenum discussion: Active dialogue between students and teacher pointing out critical steps in data analysis and report writing.

4. Looking forward

This proposed time & space-coordinated circuit training could be tested in the next course taking place in spring 2021. However, this tight time schedule also risks to cause delays of rotation and that the TA is overwhelmed, resulting in poor supervision and an unsuccessful experiment. Feedback and new ideas should be incorporated in future courses and the ultimate goal is that the laboratory exercise can eventually be run alone smoothly by one TA.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Vincent Valentin Scholz
Center for Electromicrobiology
Department of Biology

The Flash™ to the Rescue

applying "flash review" as a course prerequisite check and recap method

Learning Lab

Abstract: In order to kick-start the semester, a "flash review"[2] is utilized to check and refresh the students' recollection of course prerequisites. The activity will give an assessment of the students understanding of the topics and be used to adapt the following lectures to an adequate learning rate. The activity and all required material is fully prepared but will first be implemented the next time the course is taught. It is anticipated that some refinements are necessary before repeating it the following years.

COURSE FACTS

- Course name: Fluid Dynamics and Turbulence
- Level: Master
- Department: Mechanical Engineering
- ECTS credits: 10
- Language: English
- Number of students: around 32
- Your role: a standard teaching assistant with some added lecturing responsibility.

TEACHING IN PRACTICE

1. Identifying a problem

Every year, we observe that a large part of the students struggles with elementary mathematical definitions and theory. Since this is a prerequisite for the course these students have a hard time to follow in class and we hence offered some extra lessons on a broad range of mathematical topics. This is not the most efficient way since we need to go though a lot of content in short time. If we could know what parts of the prerequisites the students struggle the most with, we could focus our attention to these parts.

Hence, the problem was identified long time ago. However, no ideal mitigation strategy was investigated. With the introduction of the proposed teaching activity this is going to change.

2. Planning a teaching activity

The teaching activity is not intended as a form of lecture from which the students directly learn but rather an activity that maps out gaps in their knowledge. Both for the students to adjust their learning efforts and the lecturers to adjust the teaching. It is hence a guiding tool for future learning.

References

[1] Flash illustration: http://www.pngall.com/?p=6408

[2] Active-Learning-and-Adapting-Teaching-Techniques, TATP1

Figure 1: subsection of the questions as seen on the **question slides**. The slides are kept simple to let the students focus on the essential part.

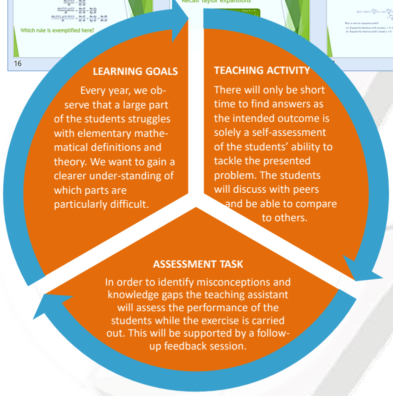

Figure 2: showing the **constructive alignment** that illustrate how the connection and alignment between 1) what students are intended to learn, 2) how the activity is carried out, and 3) how it will be evaluated.

3. Trying it out in practice

The activity will be implemented the next time the course is taught. The complete material is prepared and ready for the first real life test. The experience will be evaluated by having a group discussion with the students about it directly after.

MAIN POINTS

1. **Main problem/challenge:** some students struggle to recap the fundamental methodology.
2. **Teaching activity**: a "Flash Review" is an activity where a series of questions are shown to at a predefined interval. The students discuss their immediate answers pairwise.
3. **How did it go?** The activity will be implemented the next time the course is taught.
4. **What to do next?** Try it out in practice, get feedback and adapt. It is anticipated that this activity becomes an integral part of the course in the future.

4. Looking forward

The teaching activity will be tried out later this year. That will be the first real test of the concept. I anticipate that this concept will be refined and become part of the course every year. Most likely there will be some changes even beforehand, alongside the preparations of the other teaching material for the next time the course it offered.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Science Teaching Course Training Material

Leon J. Schwenk-Nebbe
Sustainable Energy Systems Group
Department of Engineering

Learn Microbial Physiology Through Real-Life Processes

Make your own sauerkraut!

Learning Lab

Many times, microbial physiology experiments do not particularly hook students up – they are laborious, require a lot of calculations, and meticulous note-taking. Through my experience as an instructor, I noticed that on the long term – the course lasts a full semester – this might challenge the motivation and the focus that the student keep during the course. With this experiment, the students enjoy learning an important microbial physiology – fermentation – by making their own edible sauerkraut, and exploring the microbiological aspects of the process. The students can relate the study of a common, known process with a variety of microbiological techniques; at the same time, the knowledge acquired is very relevant for the course, and the variety introduced with this experiment help them maintaining interest and motivation.

COURSE FACTS

- Course name: Microbial Physiology and Identification
- Level: BSc / MSc
- ECTS credits : 10
- Language: English/Danish
- Number of students: 20-25
- Your role: Laboratory Instructor

TEACHING IN PRACTICE

1. Identifying a problem

Microbiological experiments, in particular for the study of physiology, can be very laborious and challenging for undergraduate students. Experiments need to be carefully planned and calculations need to be made. Students do it as they know it is necessary to proceed with the course, but many times they are not motivated, or they do not thoroughly comprehend what the calculation is for or the practical purpose of the experiment. This mines the student's understanding and might result in a decreased bulk of knowledge acquired by the end of the course. This teaching activity aims to address motivation and focus drop by doing a fun and useful hands-on.

2. Planning a teaching activity

To spice up the course, the 'make your own sauerkraut' activity provides an easily understandable experimental proxy to a known process - fermentation. Students can immediately relate their work to something they see (sauerkraut, or any type of fermented good) and understand their usefulness in the every-day life. The teaching activity aims at showing students something different, providing variety, without nicking the knowledge which should be acquired as per the learning goals of the course. This results in students being excited, motivated, more collaborative and aware of their work, and in a jar of sauerkraut that is perceived as a tangible outcome of the experiment.

3. Trying it out in practice

The teaching session starts with the instructor giving a short overview of the fermentation processes, both from a historical and a microbiological point of views. The importance of the process is explained, and students are accompanied through the technical protocols. Students then follow the methods, cutting and salting the cabbage, and transferring it into glass jars.

Figure 1. Students engaged in the practical.

CFU group 6 - Alexander, Rosa & Lærke

unit = CFU/mL

Day 1

	HIAS	PCA	MAC
10^-1	41200	54000	
10^-2	70000	106000	8000
10^-3	100000		40000
10^-4	400000		
10^-5			

Day 2

	HIAS	PCA	MAC
10^-2			
10^-3			
10^-4		1,24E+08	51400000
10^-5	2,04E+08	2,94E+08	70000000
10^-6		4,4E+08	80000000
10^-7		2E+08	

Figure 2. Example of data from CFU counting.

Students sample the juice released from the cabbage twice a week for the next 4 weeks, and run a variety of experiments, among which HPLC, pH measurements and cell plating and counts. Relating the overall activity to something tangible – i.e., with a physical outcome, students engage more, ask more questions and show interest.

MAIN POINTS

1. **Main problem/challenge:** Students motivation is sometimes low
2. **Teaching activity**: Make your own sauerkraut
3. **How did it go?** In the past the activity proved to be extremely successful. This year the activity was not run due to Covid-19.
4. **What to do next?** Implement the teaching activity with new vegetables to ferment and provide even more variety.

As an instructor, I gather data so that different groups and I compile them in a common file so that students can compare their results, I collect the samples for HPLC analysis, and I evaluate the engagement during the lab sessions. The students will hand in a report on the activity as part of the final report of the course, which is evaluated by the professor. The instructor will prepare a questionnaire to evaluate the student's engagement during the teaching activity, and whether the variety provided helps in keeping the motivation up.

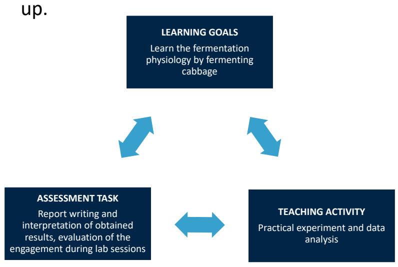

Figure 3. **Constructive alignment**

4. Looking forward

I look forward to teach this course again and implement the same activity but with new vegetables. This will provide variety and it will be slightly more challenging for myself as an instructor and for students alike. This would be followed by a more thorough data comparison among the different vegetables. Also, it would be nice to implement a short questionnaire to ask students how their engagement and motivation was affected by this experiment, as a mean to 'quantify' the change.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Center for Electromicrobiology
Department of Bioscience

A game of network
- Learn with fun

Abstract: In Distributed Storage course, both theory and practice are identically important, hence, finding a good middle ground between the two aspects is the biggest challenge. This challenge becomes more challenging when there is no intuition on the systems that the students are supposed to learn. I decided to implement a "game", in which the students learn the functionality of the system they are supposed to work with and analyze with the theory they have learned throughout the course. I feel that this activity will help students to understand the systems better and help them in practice sessions as well as the final assessment. This activity ahs not been implemented yet, but the feedback shows that this is a promising activity with many possible advantages.

COURSE FACTS

- Course name: Distributed Storage
- Level: Master
- ECTS credits : 5
- Language: English
- Number of students: 12
- Your role: Laboratory TA

TEACHING IN PRACTICE

1. Identifying a problem

When teaching in Laboratory, a main challenge is to make the students actually "understand" how each part of a system works. According to my experience, the students have little to no intuition on how the computer systems actually "work" or communicate with each other. As an example, as you can see in this figure, many people do not know the simple aspects of internet. Although we are teaching graduate students in this course, the same thing can be said for master students and a distributed storage system.

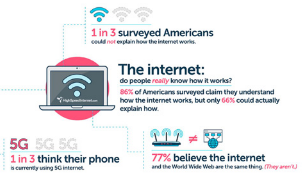

Figure 1: Many people do not have enough understanding of technology[1]

Due to this problem, even if the students have mastered the theory, they can not relate the theory and practice and analyze a system using the theory they have learned, which are the important learning outcomes of this course. Therefore, presenting an activity to give an intuition of the practical system can help the students to achieve the desired learning outcome.

References

[1] uk.pcmag.com/1-in-3-americans-cant-explain-how-the-internet-works

[2] Hadefield J. Immediate Communication Games, 1990

2. Planning a teaching activity

One of the best intuitive activities that can be implemented in order to familiarize students with the aspects of the system is communication games [2]. In these type of games, participants learn through team interaction. In this activity, the students form a group of 5-6 people. Each team will then play a distributed storage, where each student plays as a "node" in the storage system.

Each student is provided with a note by the TA, in which the "information" that the node has is written. Then the students will communicate with each other based on the information that they have in order to reach the system's goal. This way, the students learn how the whole system and the individual nodes work.

3. Trying it out in practice

After the students have formed their groups of 5 or 6 people, as TA, I provide each group with materials. For example, in a session where the topic is routing in a Chord system. In the game, each student in a group will receive his/her node ID and his/her neighbor's ID, which is the node that he/she can communicate with. Then I choose one of the students and ask him to find me an ID, which belongs to another student in the group. The student will communicate with his/her neighbor and asks him to find the mentioned ID. This cycle continues until the ID is found, the same way Chord works. This way, all the students in the groups are engaged in a fun game and can learn the routing method used in Chord.

MAIN POINTS

1. **Main problem/ challenge:** Having intuition on computer systems and communication
2. **Teaching activity**: An interactive and communicative game
3. **How did it go?** The students Learned the desired aspects while having a good time
4. **What to do next?** Learn about the aspects that students have problem with the most and address them in the game

After the activity, one of the groups will present how they played the game. For example in the Chord routing game, one of the groups will present the route until they have found the requested ID. The assessment of this "game" is done by a questionnaire after a game, in which students give feedback on how the game was, and how much it helped them to learn the system.

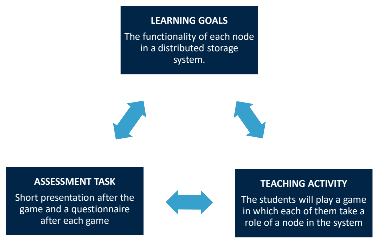

Figure 3: **Constructive alignment**

4. Looking forward

I have not actually implemented this in practice, but when talking with other people about this activity, I got a lot of positive feedback that this activity can help mitigate the big challenge of having intuition and understanding of a distributed system and how its communication works.
One of the feature that can be improved is to focus on the aspects that the students do have problem understanding, not the aspects that I, as the TA, think they would. This could be understood by a questionnaire before a practical session or after a theory session. This way, the game will be designed to focus on the mentioned problem.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Network Computing, Communications and Storage
Department of Engineering

Peer-feedback for article presentations

- Use of feedback templates for improving 1st year students' scientific article presentations

Learning Lab

Abstract: It is a challenge for the first year students to understand and present scientific articles in an appropriate manner. There are several requirements that are needed to be familiarized and considered for the scientific presentations that needs to be introduced in order to improve their presentations. In this poster, a feedback-template assisted peer-feedback exercise was ran for approximately half of a class prior to a final article presentation session. The groups who participate in the activity was compared to the non participating groups, and the assessment indicates an improvement in the presentations for the participating group.

COURSE FACTS

- Course name: Introduction to biology for nanoscience and introduction to nanoscience
- Level: 1st year Bachelor course
- ECTS credits : 10
- Language: Danish
- Number of students: 19
- Your role: Theoretical exercises and lab TA

TEACHING IN PRACTICE

1. Identifying a problem

When the students are presented with a scientific paper and asked to present it to their peers they feel very uncertain about how this should be done. The format and requirements are unknown for them and their understanding about the research paper's topic is very limited. It is a challenging task for them to figure out the essence of the paper and make a coherent presentation at an appropriate level. The goal here is to improve these presentations by providing a set of predefined criteria about the presentations to the students and allow peer-feedback prior the final presentation for the whole class.

2. Planning a teaching activity

Providing specific guidelines for recognizing the main points of the articles and following the university presentation formalities will improve the presentations and enhance outcome of the presenting group and the audience.

Beyond the above, the goal of this activity is to introduce peer-feedback to the students and enable the students to self-asses their presentations based on a set of predefined criteria.

3. Trying it out in practice

In addition to individual supervision meetings with the groups, 4 out 7 groups were randomly chosen for the exercise and were assigned to a peer-group, where they would use the provided feedback template to give feedback to each other during a rehearsal presentation done on Zoom™, which was the same platform the final presentations were done at.

The students arranged these rehearsal presentations outside the allocated time slots of the course.

The exercise was assessed by scoring all 7 groups at the final presentation based on the provided feedback template and comparing the scores between the groups, which did the peer-feedback exercises and didn't (figure1).

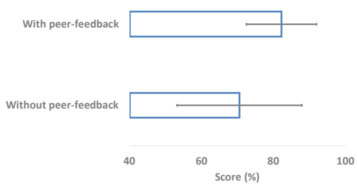

Figure 1: Comparison of the scores for the final presentations between the groups who did participate in the peer-feedback exercise 82.2% ± 9.7% (n=4) and the groups which did not 70.5% ±17.4% (n=3). The error bars are based on standard error of the mean.

It is hard to conclude that the exercise had an effect due to the low number of participants, however the results could indicate a more consistent higher score for the groups which did the peer-review exercise compared to the ones who didn't.

The activity was finally evaluated by the participating individual using an anonymous questionnaire. The majority (8/11) of the students used between 1-2 hours on the exercise, and 45% of the students believed the exercise greatly improved their presentation, while 55% thinks the exercise had a slight positive impact.

Interestingly, only 40% of the students used the feedback template with the evaluation criteria to correct their presentations prior to the peer-feedback rehearsal presentation.

The alignment principle was followed for this exercise (see description in figure 2 bellow)

MAIN POINTS

1. **Main problem/challenge:** Making a coherent scientific presentation for 1st year students
2. **Teaching activity**: peer-feedback and feedback template
3. **How did it go?** All of the participants believe that their presentation was improved.
4. **What to do next?** Optimize the feedback form and try out in a larger class.

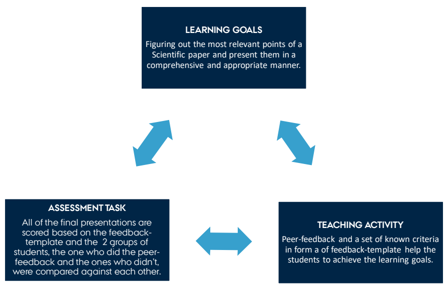

Figure 2: The learning goals and outcome are described in the flow chart above. The teaching activity has helped to achieve the goals and there is a clear alignment between the goals and activity. In the final assessment, there are indications that the goal is reached via the activity.

4. Looking forward

There are some positive indications that the activity can improve the presentations. Applying the principle to a larger group of students might help prove and optimizes the exercise. Based on the final evaluation and feedback received from the students, the students can implement the formal presentation requirements if they are presented with the feedback-template earlier in the course and not after they have already have the draft presentation slides ready.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Ali Shahrokhtash
Nanobiointerfaces
iNano

How to master an unsolvable puzzle

Designing a protocol for solving NMR spectra

Learning Lab

In organic chemistry one thing is to conduct organic synthesis in the laboratory, another thing is to identify if you have obtained the desired compound. NMR is often used for this identification of organic compounds, but it can be a tricky task to solve these type of spectra. Many students in *Organic Chemistry I* encounter this problem when being introduced to NMR spectra, as it can seems as a unsolvable puzzle with too many pieces. Often the challenge is to figure out where and how to start. This have been tried to be solved by utilizing a strip sequence to help the students create their own protocol, which they can use in the future and for the exam to solve assignments regarding NMR spectra. The evaluation showed that the activity mainly improved the students who were not familiar with NMR spectra. This can be improved in the future by changing the activity, so it stimulates the learning of students with different level of knowledge regarding NMR spectra.

COURSE FACTS

- Course name: Organic Chemistry I
- Level: BA
- ECTS credits : 10
- Language: Danish
- Number of students: 18
- Your role: Teaching assistant

TEACHING IN PRACTICE

1. Identifying a problem

When it comes to analyzing spectra in organic chemistry, it often seems like a puzzle with too many pieces, which often can lead to frustration especially if you don't know where to start.

This is the case for many students as they have barely touched organic chemistry before the university. Therefore, the challenging part is to help the students to structure the analysis and thereby gain a better starting point.

2. Planning a teaching activity

The teaching activity is focused to help the students to structure the analysis of NMR spectra to predict which molecule they are looking at.

This is done by letting the students come up with a specific protocol, which they can use in the future and at the exam to solve these spectra.

To design their own protocol the students will work with the strip sequence shown in figure 1. Subsequently, the students will utilize the self-made protocol for solving NMR assignments at the session.

Strip sequence

1	Connect functional groups and draw the final compound
2	Write down ppm values for peaks in H-NMR
3	Determine multiplicity and integral (#H) for peaks in H-NMR
4	Evaluate if the expected compounds fits
5	Make an table for H-NMR with ppm, multiplicity, #H, coupling constants, functional groups
6	Write down ppm values for peaks in C-NMR
7	Measure coupling constants in H-NMR
8	Write functional groups in H-NMR
9	Determine integral (#C) for peaks in C-NMR
10	Make a table for C-NMR with ppm, #C, functional groups
11	Write functional groups in C-NMR

Correct sequence: 5 – 2 – 3 – 7 – 8 – 10 – 6 – 9 – 11 – 1 – 4

Figure 1: **Teaching activity**
Strip sequence used in the teaching activity.

3. Trying it out in practice

The teaching activity was performed in the following listed sequence:

1. Introduction to NMR spectra and explanation of the teaching activity by TA.
2. Strip sequence handed out to students in group of four.
3. Two groups presented their solution followed by a discussion in plenum ending with the correct solution.
4. Students solved NMR spectra in groups of two, while using the strip sequence as a guide.
5. Two groups presented their solution based on the strip sequence.
6. Evaluation of the session by the students.

By giving a small introduction the students know what to do and what to focus on. Hereby, the students also gain a small knowledge, which can help them during the work with the strip sequence.

The group work was good for discussion between the students, while the TA could walk around and assess (in silence) how well the students did.

The group presentations gave the TA opportunity to assess if the students have learned, while it also opened up for a discussion in plenum. The discussion was used to guide the students in the correct direction to come up with the correct solution.

At the final evaluation, the TA could learn if the students liked the activity and what could potentially be better for the students to gain more knowledge from the teaching activity.

MAIN POINTS

1. **Main problem/challenge:** NMR spectra can be a tricky puzzle to solve.
2. **Teaching activity**: strip sequence for designing a protocol to solve NMR spectra.
3. **How did it go?** Most of the students liked the activity, although some of them already knew some of it.
4. **What to do next?** Optimize the activity to also challenge students with a broad knowledge about NMR spectra

The evaluation showed that students who already were familiar with NMR spectra, at times, found the activity a little bit tedious.

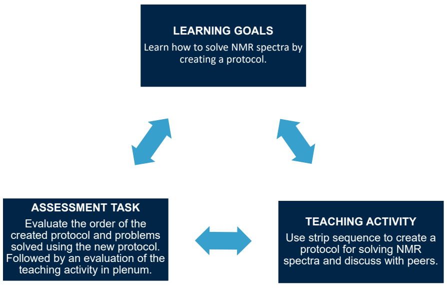

Figure 2: **Constructive alignment**
1) The students will learn to structure solving NMR spectra 2) The students will learn through group discussion and implementation of a self made protocol. 3) Presentation of assignments will be used to assess the students' learning and with a final evaluation in plenum the students will give feedback.

4. Looking forward

The activity worked fine especially for the students who were not familiar with NMR spectra, while the students who already new how to solve NMR spectra found the teaching activity a little bit tedious. Hence, the next step would be to see if the activity could be alternated to stimulate students with different level of knowledge about NMR spectra. This could for example be done by asking the students to make their own protocol before giving the strip sequence. Hereby, the students will see how much they know about solving NMR spectra in the beginning of the session.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Mads Koch Skaanning
Gothelf Lab
iNANO

Chemistry behind the math

-pHun with chemical calculations

Learning Lab

Abstract: Problem solving and reflection on the results is an essential part of science. In general chemistry, new students often find it difficult to link the chemistry to their calculations in e.g. pH problems. To help students create this link, a teaching activity have been created, where the students are giving a solved pH problem and their task is to label the different step in the calculation with a list of terminologies provided. The activity was not performed in practice, but was to be performed in groups of two, and compared with different groups answers in an additional step. A follow-up in the class would be performed to correct misconceptions and assess the activity. The activity was designed to help students understand the chemistry behind the calculations.

COURSE FACTS

- Course name: Basic General and Organic Chemistry
- Level: 1 year, bachelor
- ECTS credits: 10
- Language: Danish
- Number of students: 16
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

In the course "Basic General and Organic Chemistry", one of the challenges the students face is to relate the calculations of an assignment to the chemistry it represents. One example of this is pH calculations where the math can confuse new students. The aim of this exercise is to make the students reflect upon the chemistry behind approximations in a calculation and to help them to understand the chemistry behind.

2. Planning a teaching activity

In this teaching activity, the students will be provided an already solved pH calculation with some of the steps marked. In addition, the students are provided a list of terminologies, that correspond to the marked steps.

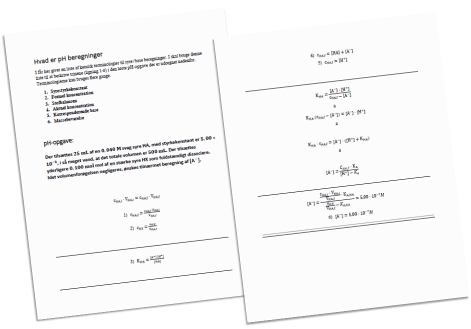

Figure 1: Activity sheet with the solved pH calculation and list of terminology.

The task for the students is to arrange these terminologies to the marked steps in a "Strip Sequence" inspired manner. The activity will be done in groups of two, after 5 minutes the groups will be shuffled around to compare answers. In doing so the students get a change to explain and compared. Lastly, a short follow-up to correct potential misconceptions and assess the teaching activity will be performed in class.

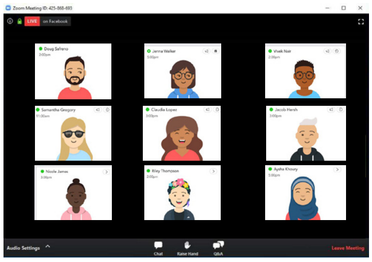

Figure 2: The teaching activity could have looked something like this.

This teaching activity will give the students an example of preforming a pH calculation, but instead of letting the students focus on the calculations, the student are focusing on using chemical terminology to describe the different step in the calculations. In doing so students will immediately focus on solving strategies and approximations
The activity tries to connect problem solving and chemical terminology, which is both part of the learning outcomes of the course and part of the assessment of both the exam and mandatory assignments.

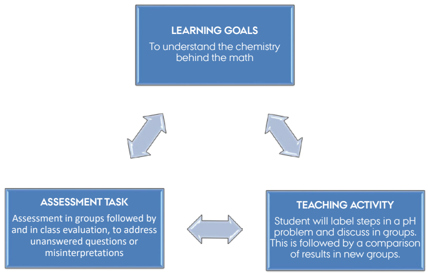

Figure 2: Constructive alignment

3. Trying it out in practice

The teaching activity was not performed in practice, but could be done as described above. The assignment would be solved in groups of two, which are shuffled around when comparing the answers. This together with the follow-up on the class, provides a build-in assessment for the TA and students of the their understanding of the problem solving and terminologies. An example of the pH assignment can be seen, Figure 1. In Figure 2, we see an example of how the teaching activity could have looked in practice.

MAIN POINTS

1. **Main problem/challenge:** pH calculations
2. **Teaching activity:** "Strip Sequence" inspired pH problem with focus on understanding and approximations
3. **How did it go?** NA
4. **What to do next?** Can easily be adapted to other problems

4. Looking forward

Next step would be to try in practice. I would expect this activity to be received well, as this math-to-understanding link is often difficult for students. It would also be easy to implement in other topic or courses.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Lasse Skov
Supervisor: Torben R. Jensen
iNANO and Department of Chemistry

Speedy Spectral Prediction

Getting it right at the exam – fast!

Abstract: In the regular curriculum the students get a lot of exercises where they analyze given spectra and come up with the corresponding molecular structure. However, when verifying the found molecule the students often struggle to do this quickly. This exercise lets the students practice reverse thinking and enables them to quickly get an overview of how a spectrum will look for a given molecule. The students found the teaching activity fun compared to the regular assignments and 86% of the students would like to have more exercises of this kind. In the future the relevance of this exercise should be put in context of the exam.

Learning Lab

COURSE FACTS

- Course name: Organic Chemistry I
- Level: Bachelor (first year)
- ECTS credits : 10
- Language: Danish
- Number of students: 21 (on my team)
- Your role: Teaching assistant in laboratory exercises

TEACHING IN PRACTICE

1. Identifying a problem

During this course, students get a lot of practice in analyzing spectra and finding the corresponding molecule. However, they do not get any practice the other way around – predicting how a spectrum of a given molecule might look (see fig. 1). This is a very useful skill at the exam, since it allows students to quickly verify the final structure they have come up with. The students tend to spend a lot of time on this verification during class, but with a bit of practice this can be done quickly.

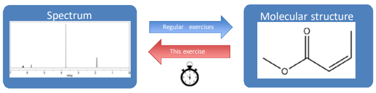

Figure 1: Idea behind teaching activity
The students will try to do the spectral analysis the opposite way and with a time limit.

2. Planning a teaching activity

This teaching activity lets the students practice their skills in quickly predicting a spectrum from a molecular structure. This skill can be used at the exam to evaluate the final structure found. The activity aims to be fun and different from the normal activities but still relevant for the exam. The exercise will be done with a time limit and will therefore naturally be a bit competitive and challenging. It is therefore important to make a fun and friendly athmosphere with low stakes so the students will not feel stressed if they make a few mistakes. After the speed exercise the students get time to casually discuss the results with their group before the exercises are presented in plenum.

3. Trying it out in practice

The teaching activity was carried out in Zoom[1] and can be split into four parts. The exercise was inspired by the Think-Pair-Share collaborative leaning strategy.[2]

- **Individual speed spectral prediction**

The students were presented with the exercise and told to have pen and paper ready. They were now presented with a molecule and had **1 minute** to come up with a guess on how the ^{1}H-NMR spectrum of this molecule might look. This was **done for 3 molecules**. The molecules were chosen so they spanned a range of common functional groups that the students had been working with during the course.

- **Group discussion**

After the 3 minutes the students were put into their regular study groups (**groups of 2-3**). The students were asked to **discuss and compare** their results for 10 minutes and come up with a common solution.

- **Group presentation in plenum**

All the students came together and 3 of the groups **presented their common solution** for the 3 exercises. After this, the other groups could ask questions or give comments and the TA would then present the real experimental spectrum of the molecule (see fig. 1).

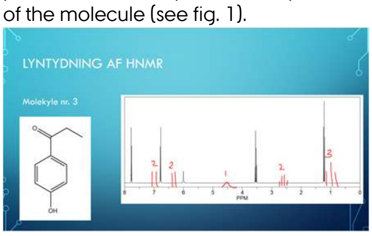

Figure 2: Screenshot of the group presentation in Zoom
The TA showed a power point with the molecule and a blank spectrum. The students have drawn their solution with red. Afterwards the TA revealed the correct spectrum. As can be seen, the students had a good guess for how the spectrum should look.

- **Evaluation of teaching activity**

The activity was assessed by the students through a **poll on Zoom**. The questions and answers can be seen in figure 2. Overall the students found the exercise **fun** and **86% would like to do more exercises like this**. Students were not too sure how the exercise would help them at the exam but most of them found the group discussion helpful in making a better solution.

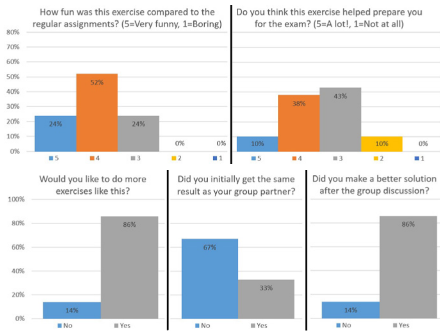

Figure 3: Evaluation of teaching activity
Students evaluated the activity with a poll in Zoom. (n=21)

MAIN POINTS

1. **Main problem/challenge:** Slow verification of final molecular structure found from spectra.
2. **Teaching activity**: Speed prediction of a spectrum from the molecular structure
3. **How did it go?** Students found the activity fun but not all could relate it to the exam.
4. **What to do next?** Make the exercise more applicable for the exam or stress how to use this skill at the exam.

4. Looking forward

The students found the exercise fun so it could maybe be implemented more frequently. Generally the group discussions seemed to lead to better solutions so this should be kept in the exercise. From the evaluation, it can be seen that many of the students were a bit unsure on how this exercise would help them at the exam although none of the students found it completely unhelpful. In the future it would be a good idea to relate this exercise more to the exam. This could be done by showing the students how this skill could be used in the exam or try the exercise with an old exam set.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

References
[1] https://zoom.us
[2] TATP, *University of Toronto*, "ACTIVE LEARNING AND ADAPTING TEACHING TECHNIQUES".

Speedy Spectral Prediction
Jakob Smidt
Gothelf Lab
iNANO

Experimental planning

- Improving students' ability to plan an experiment

Learning Lab

Abstract:

Proper planning is a necessity when doing experiments. Unfortunately, students often do not spend their time planning, but jump straight to doing measurements. By doing so, the students often end up with unusable data or sets of data that are severely lacking. By making a thorough concept map of the theory relevant to the experiment as well as the experimental setup the students are better prepared to make a measurement plan.

COURSE FACTS

- Course name: Experimental physics and statistical data analysis
- Level: First year
- ECTS credits : 10
- Language: Danish
- Number of students: 20
- Your role: Teaching assistant

MAIN POINTS

1. **Main problem/challenge**: Students do not do sufficient planning for experimental work
2. **Teaching activity**: Concept map for experimental planning
3. **What to do next?** Implement

TEACHING IN PRACTICE

1. Identifying a problem

Many physics students have a bad experience with experimental courses. This is in many cases because the data they acquire is incomplete due to improper experimental planning. They lack an overview of the theory they are exploring which leads to the data they acquire to be insufficient or unusable. This is often realized far too late when there is not enough time to do any more experiments. Since the most important learning outcomes of such experimental courses are to plan and carry out experiments this suggests a lack of alignment in the usual teaching activities. If the students had a better grasp of the theory and spent more time planning the experiment, they would end up with more satisfactory experimental results, a deeper understanding of the theory, and it would give a better view of how actual experimental work is carried out.

2. Planning a teaching activity

To solve this problem, the students work together in their usual groups of three. In preparation for the experiment the students will make two separate concept maps on a single piece of A3 paper. One concept map includes all the relevant theoretical knowledge that the students have and one includes the knowledge of the experimental setup. Based on these the students create a measurement plan. From their concept map they should have available to them, a thorough list of all the relevant theoretical expressions as well as a list of all the things they can measure. They create their measurement plan on a separate piece of paper. Included in the plan are also drawings of the graphs they want to make and what they expect them to look like. Before working on the experiment, the students present their plan to the TA and together they discuss it and the TA can require the students to make changes to the measurement plan. Once the measurement plan is accepted by the TA it is uploaded to the students' labbook.au.dk page which is accessible by both the students and the TA.

This teaching activity forces the students to do proper planning and thus supports the learning outcomes of the course.

3. Teaching in practice

Unfortunately, the teaching activity was not carried out in practice due to the COVID-19 lockdown. Figure 1 shows an illustration of what such a concept map could look like.

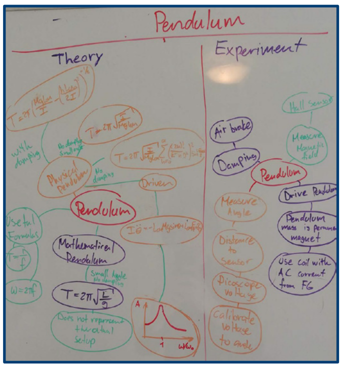

Figure 1: Concept map
An example of a concept map made for an experiment with a pendulum. The left side includes most of the relevant theory while the right side has the relevant knowledge of the experimental equipment.

4. Assessment

The teaching activity is assessed in several ways. First, the initial measurement plan is assessed by the TA who will give feedback on their work and might ask them to redo parts of the plan. Second, the teaching activity itself is assessed by sending out a questionnaire to the students asking them 1) if they made a measurement plan and 2) how much of the plan was carried out on a scale of 1-5. Based on the logbook that the students hand in after finishing the experiment and data analysis they get a percentage score of how well they did. This could be included in the assessment of this teaching activity.

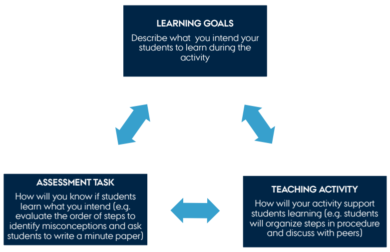

Figure 2: **Constructive alignment**
This figure illustrates the concept of constructive alignment which has been built into this teaching activity.

4. Looking forward

The teaching activity can be implemented next year in the Spring semester. Before this the professors of the course should be notified such that the activity can be carried out in the beginning of all three experiments in the course. Also a different TA should be prepared to give questionnaires to different students to see the effect of the teaching activity. The other TA should also carry out assessment of the student logbooks in the same way in order to see the effect of proper experimental planning on these.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Peter Sørensen Sneftrup
The semiconductor group
Department of physics and astronomy

A preparation “toolbox” for oral exams

- Tips and tricks on how to prepare for an oral exam

Learning Lab

Abstract: First year chemistry students face their first oral exam in this course, therefore, they need to learn how to properly prepare for this type of exam. Besides that it is also their first physics course, where the connection to chemistry can be hard to see for them; often making them forget what they have learned shortly after the end of the course. These problems are tackled by helping the students to make a “toolbox” with tips and tricks on how to prepare for an oral exam, and also to make relevant perspectivations of the material to chemistry. A mentimeter quiz about the teaching activity indicated an overall positive outcome from the exercises, based on the students opinions, but to improve it further “hands-on” examples of their tips and tricks could be implemented in the future.

COURSE FACTS

- Course name: Mechanics and Modern Physics for Chemists
- Level: 1st year 2nd semester
- ECTS credits : 10
- Language: Danish
- Number of students: 16
- Your role: Theoretical exercise instructor

TEACHING IN PRACTICE

1. Identifying a problem

For the first year chemistry students this is the first course with an oral exam at the university, meaning that many of them will not know how to properly prepare for it. On top of that it is also their first physics course, and with the challenging numerical exercises such a course presents, they tend to shift their focus to the numerical solutions rather than the concepts and theory behind it. However, the oral exam in the course is focused on the underlying concepts and theory. Additionally they also tend to forget the material quite fast after ending the course, typically because they do not feel that it is relevant in their chemistry studies.

2. Planning a teaching activity

For the students to be ready for the oral exam, it is important that they know how to prepare properly, otherwise the preparation time is too short. Besides that, their main focus has to be shifted from the numerical exercises to the theory behind them, and preferably in a way that makes them remember more of it in the future. The teaching activity will, therefore, be focused on giving them a “toolbox” with ideas, tips, and suggestions on how to prepare for an oral exam in general, but with focus on this course. On top of that, a second activity will also be carried out learning them to couple concepts and theory from this course with things relevant in chemistry. This is intended to increase their understanding of the concepts in the course, but also to increase their interest and by that their memory of the material. In addition to this it will allow them to show a deeper learning of the material at the exam, by perspectivation of the concepts to relevant things in chemistry.

3. Trying it out in practice

To create the “toolbox” for the students, they were told to think about tips, tricks, and ideas on how to prepare for the exam as an out-of-class activity. They should think about it alone first, and afterwards meet in their groups of 3-4 persons to discuss it, but without removing any suggestions - only perfecting them.

In-class the groups would then take turns presenting their ideas for the “toolbox”, after which the TA presented his/her suggestions. All ideas were included and collected in a google docs, since people benefit from different strategies when preparing for an exam.

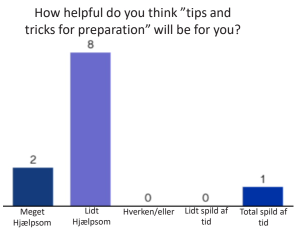

Figure 1: Mentimeter quiz regarding the tips and tricks exercise.

For the other activity, the students were asked to do a perspectivation of the exam questions to something in chemistry. They were allowed to do it alone and in groups, and they were told to prepare as much as time allowed them. At the class most of them wished for some time in groups to discuss it, before presenting it for the entire class. Therefore, they were told to discuss it in groups and fill in their notes under each exam question in a shared google docs. After each group had filled in their ideas for couplings to chemistry, they presented their ideas by explaining what their notes meant for the rest of the class. Here, the TA contributed with clarifications or extra ideas when all groups had finished explaining their ideas for a specific exam question.

MAIN POINTS

1. **Main problem/challenge:** They have never tried to prepare for an oral exam before.
2. **Teaching activity**: Making a “toolbox” with tips and tricks for preparation, and perspectivation of exam questions to chemistry.
3. **How did it go?** The evaluation was positive from the students, now only their exam will tell.
4. **What to do next?** Include more “hands-on” examples.

3. Assessment

To assess the activities the students answered a short mentimeter quiz right after each of the activities – that were carried out on different days.

In figure 1 the quiz regarding the tips and tricks exercise is shown, indicating that the students found the exercise helpful. A similar positive result was found in the quiz about the other exercise. This is shown in figure 2. Generally it seemed like the exercises were “well received” by the students and that they found both of them helpful for their exam and future studies.

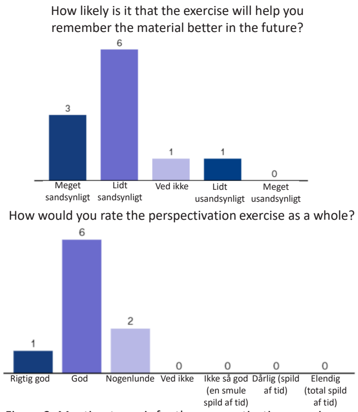

Figure 2: Mentimeter quiz for the perspectivation exercise.

4. Looking forward

Both activities went well and the evaluation was positive, but it might be a good idea to include some “hands-on” examples of their ideas for exam preparation. Showing the ideas in more detail will probably increase the number of people that find a specific suggestion useful. Besides this, suggestions for improvements of the exercises from the students would be good, but they did not give any, even though a question was dedicated for this in the mentimeter quiz for both activities.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Nicolaj Brink Søgaard
Semiconductor group
Interdisciplinary Nanoscience Center and Institute of Physics and Astronomy

Documentation while coding

- Bridging the gap between physical problems and computational implementations

Abstract: It is not an easy task for students to write good documents while coding for solving physical problems. To address this issue, I have designed a teaching activity based on strip sequence. Students were asked to connect steps for solving physical problems with two sets of codes (with and without explanations or documents). The documents would help students bridge the gap between physical problems and computational implementations. Afterwards, students worked individually to finish computational implementations step by step. They all got the expected results and their comments in codes were clear.

COURSE FACTS

- Course name: Materials simulation: Introduction to Density Functional Theory
- Level: PhD
- ECTS credits : 5
- Language: English
- Number of students: 4
- Your role: TA in computational exercises

TEACHING IN PRACTICE

1. Identifying a problem

It is a challenge to write efficient and readable codes and split a big problem into small fragments for materials simulation which often include solving sets of complex equations. Good documentations will make codes more readable and maintainable. Most of the time, students think it is important to make codes running correctly, but a waste of time to write comments/documents because they are not directly linked to the outcome of a program. They may easily get lost and stuck somewhere when solving a complex physical problem on computers if comments are not well written.

2. Planning a teaching activity

To address the mentioned issue, my teaching activity has been designed to solve a 1D Schrödinger equation by writing python codes step by step.

The teaching activity will start with two quizzes about connecting steps for solving the equation with predefined code snippets. One quiz is code snippets without explanations while the other has good documentations. By doing so, they will understand the importance of documentations and how to divide a big physical problem into small steps on computers. Then students will finish each step by themselves and combine these steps to solve the 1D Schrödinger equation. Students are expected to reproduce analytical solutions and write codes with good comments.

The teaching material will be deployed in the jupyter notebook, an open-source python application that allows students to create and share documents that contain live code, equations, visualizations and texts.

3. Trying it out in practice

The teaching activity was carried out in week 19 this semester. At the beginning of the class, I gave a short introduction to how to solve the 1D Schrödinger equation mathematically and basic usage of python. Afterwards, students needed to connect mathematical steps with code snippets with/without documents, as shown in Figure 1.

Figure 1: **warm-up quiz in the jupyter notebook**

Students did the quiz better when documents were present. After finishing the quiz, I asked students to finish each step by themselves while discussions with me and other students were encouraged if they got stuck for any possible reasons. For example, one student failed to get the correct electron density distribution (plotted in Figure 2) and did not know which parts were wrong. I looked through his code and found out where the bug was.

MAIN POINTS

1. **Main problem/challenge:** Importance of documentation
2. **Teaching activity**: Strip-sequence activity and learning by doing
3. **How did it go?** It went well and received positive responses from students
4. **What to do next?** Explain more when helping students debugging and introduce peer review.

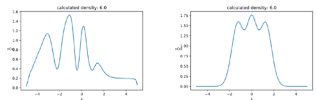

Figure 2: **comparison of wrong (left) and correct (right) solutions for electron density distribution**

The bug was a wrong type of input. This mistake could be avoided if he wrote comments about input type in the beginning. A large mount of time for the teaching activity had been dedicated to similar debugging. Students were learning by doing.

The teaching activity went very well. Students all succeeded in reproducing analytical solutions on computers and their codes were well documented. The evaluation of this teaching activity was performed by an online survey. All students found the teaching activity well organized and useful. They agreed that writing documents was as important as getting expected results from a program. Meanwhile, they had a better understanding about the difference between physical problems and computational implementations.

4. Looking forward

The students enjoyed the deployment of teaching materials in jupyter notebooks where they can write codes, notes, math equations and plots. All of them realized the importance of documentation while coding. However, the online teaching was less productive than I expected, especially for debugging. Face-to-face communications would be better for helping students debugging. I will try to say more about what I am doing behind the screen when demonstrating something so that students will find it easier to follow. Besides, I will introduce peer review to let students comment on each other's codes.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Department of Physics and Astronomy

Quizzin' your way through

- An online quiz helping students through definition based learning

Learning Lab

ABSTRACT Climate and Environmental Chemistry is a definition based course, where many different definitions are presented. Students struggle to identify and locate the definitions in the text book. This teaching activity is designed to help students identify the important definitions in combination with understanding them correctly. The teaching activity utilizes the online quizzing tool Kahoot in order to identify and understand the definitions. The teaching activity is evaluated by a mentimeter questionnaire and proves efficient in helping students recognize central definitions. However, the intention of opening up for questions were not entirely met. In future, the quiz will be modified to open up for discussions and questions, and implemented in the course.

COURSE FACTS

- Course name: Climate and Environmental Chemistry
- Level: Bachelor, 6th semester
- ECTS credits : 10
- Language: Danish
- Number of students: 18
- Your role: Teaching Assistant

TEACHING IN PRACTICE

1. Identifying a problem

Climate and Environmental Chemistry includes many definitions which are important to understanding and to fulfill the learning goals. The definitions are often difficult to locate in the text book and sometimes not well-described. The aim of this teaching activity is to focus more on the definitions and help the students identify the important definitions. The increased focus on the definitions, will enable the students to question and discuss the definitions for a better understanding.

2. Planning a teaching activity

Students struggle to comprehend all definitions and concepts in this subject. The purpose of the teaching activity is to help the students to locate and understand relevant concepts and definitions and to build their foundation knowledge on the correct interpretation of the concepts as well as to open up for a discussion on the definitions. To obtain the goal of the teaching activity, an online Kahoot quiz is prepared [1]. The Kahoot is based on important definitions from the most recently read chapter in the text book. An accuracy of 85% is hoped to be achieved to be in compliance with optimal learning for each question [2].

3. Trying it out in practice

In the beginning of the lesson, the students will answer the Kahoot individually, where the questions are phrased with four answer options. The answer time is between 20 s and 90 s depending on the difficulty of the question. Figure **1** shows an example of such a question. Immediately after the students have answered, the correct answer is revealed. After each question, a short discussion of the question is performed. This allows, the students to question and discuss the definition.

The teaching activity is assessed through the statistics from Kahoot, which reveals pitfalls and from the discussions after each question, which will reveal any misunderstandings. The immediate revelation of the correct answer will enable the students to assess their own performance as well [3].

The teaching activity will be evaluated through a mentimeter questionnaire, where the students answer four questions regarding the outcomes of the teaching activity, how the teaching activity was and can be improved. Figure **2** shows the constructive alignment of the teaching activity.

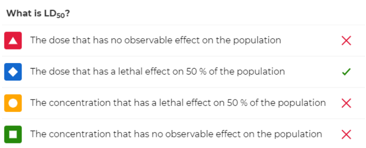

Figure 1 **Example Question** from the kahoot quiz, where the four answer options are shown along with the correct answer.

The teaching activity consisted of a Kahoot with 10 questions regarding important definitions in relation to water treatment. The students answered individually followed by a classroom discussion of the answer. If many got the question right (>85%), a follow-up question was asked. If many got the question wrong (<85%), a discussion leading to the explanation of the right answer was initiated. Figure **3** shows the answer distribution. The teaching activity was performed twice in two consecutive The questions in week 2 were altered to fit the new curriculum. 60% of the questions satisfy the accuracy goal of ~85% in week 1 and 80% in week 2.

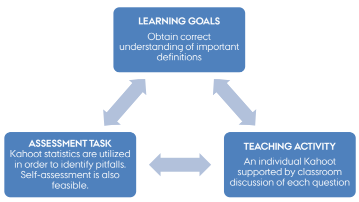

Figure 2 **Constructive alignment** described by the learning goals, teaching activity, and assessment task.

MAIN POINTS

1. **Main challenge** Identifying and understanding definitions
2. **Teaching activity** Online quiz utilizing kahoot
3. **How did it go?** Overall positive feedback with minor exceptions
4. **What to do next?** Adjust the online quiz in order to meet all wanted requirements

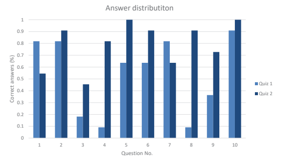

Figure 3 **Answer distribution** from two quizzes from two consecutive weeks.

The teaching activity was evaluated through a mentimeter questionnaire. Figure **4** shows how the students have evaluated the outcomes of the quiz. The quiz generally scores high in relation to identifying and understanding of the definitions. However, the quiz does not seem to open up for questions as hoped. Some students think that the answer time is too short.

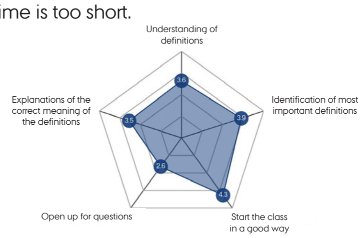

Figure 4 **Evaluation**, which reveal how the students assess the quiz.

4. Looking forward

The evaluation showed that the quiz was generally successful in helping students identify and understand the definitions. The students are also more motivated to study the text book in order to answer correctly in the quiz. In future, the quiz will be modified so it opens up for more questions and discussion about the definitions. The modified quiz will be implemented in future.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Ditte Thomsen
Department of Chemistry

[1] Salas-Morera, L., Arauzo-Azofra, A., & García-Hernández, L. (2012). Analysis of online quizzes as a teaching and assessment tool. *Journal of Technology and Science Education*, **2** (1), 39-45.
[2] Wilson, R. C., Shenhav, A., Straccia, M., Cohen, J. D. (2019). The Eighty Five Percent for Optimal Learning. *Nature Communications* **10**, 4646.
[3] Cross, K. P., & Angelo, T. A. (1988). Classroom Assessment Techniques Examples. *Classroom Assessment Techniques. A Handbook for Faculty.* (From Science Teaching Blackboard)

Small group presentations

- Increasing the number of student presentations

Learning Lab

Abstract: I present here a teaching activity which solves the problem that all but one student are relatively passive during the commonly used teaching activity – presentation of theoretical exercise in front of the whole class. By performing the presentation in smaller groups the number of student presentations is increased and simultaneously a safe environment is created. In presentations, the students directly practice the learning outcomes and are assessed through TA observation and online assignments. It has not been implemented yet, so small adjustments most likely need to be made testing it for the first time. However, I am convinced that small group presentations will be a useful tool in my teaching.

COURSE FACTS

- Course name: Electromagnetism and Optics
- Level: Bachelor
- ECTS credits : 10
- Language: Danish
- Number of students: ~25
- Your role: TA – mostly guidance in solving theoretical exercises.

TEACHING IN PRACTICE

1. Identifying a problem

One of the most typical teaching activities is the presentation of theoretical exercises in front of a small class. This is presumably based on the idea that one of the best approaches for learning new material is by explaining it to others. However, in such a typical teaching activity only one student at a time will present a solution, while the other students are relatively passive. Additionally, often the same few students present a majority of the exercises. This makes the typical approach an ineffective way of securing the learning of all students – although the main idea is still valid.

2. Planning a teaching activity

Presentations are a very good teaching activity since it is often a direct practice of learning outcomes – which in the relevant course are the ability to solve simple theoretical exercises, to argue for steps taken, to use mathematics through symbolic calculus etc. I suggest here a teaching activity which increases the number of student presentation during an exercise class and simultaneously creates a more safe and intimate atmosphere making presentations more attractive for all students (even the insecure).

The main idea is to divide the students into groups of 3-4 students and make them present solutions to each other. They have to use a blank piece of paper or a board and they should present the idea behind their procedure – just as if they presented the solution on the blackboard in front of everyone. This will increase the number of presentations at a time from 1 to 6-8 and ensure that all students present a solution in a safe environment.

3. Trying it out in practice

In the group, the members present one solution each. The presentation should be in the nature of a discussion and group members are allowed to ask questions during the presentation. After each presentation, the group briefly discuss the method used, give feedback and the result is checked with the TA if necessary.

After a session of group presentation of for instance 30-45 min, the TA ask the class for a solution they would like to see solved on the blackboard and the TA will find a group willing to present it. The group goes to the blackboard and picks a "presenter"., which presents the solution while the other group members are encouraged to add comments during the presentation. Questions from the other groups are also addressed to the group instead of just the presenter.

The presentation will both work as a teaching activity since it applies the learning goals directly but also as assessment since the other groups members and the TA observes the presentation and give feedback. The ultimate assessment is online assignments during the course.

MAIN POINTS

1. **Main problem/challenge**
   - Only one student is active during a typical presentation.
   - A few students present a majority of problems.
2. **Teaching activity**:
   - Presentations in small groups.
3. **How did it go?**
   - Not tested yet.
4. **What to do next?**
   - Implement the activity when I start teaching and fine-tune it.

The activity is evaluated through a 5 minutes Mentimeter quiz or something similar where the students anonymously can answer whether they think the benefited from the activity and whether they liked it.

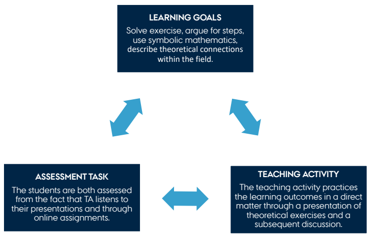

Figure 1: Schematic of the connections between learning goals, assessment and teaching activity. Good agreement between the three are what is considered good alignment.

4. Looking forward

Since the activity have not been tried out yet the next step is, of course, to implement it when I become a teacher and start fine-tuning it. Is it for instance most ideal to use easy or hard exercises for the group presentations? Should the group be formed randomly or should one form groups from already existing study groups within the class? Does it work with group presentation in front of the whole class?

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Department of Physics and Astronomy

Team work and presentations

An approach to tackle challenges in spectra analysis

Learning Lab

Abstract:

Students often struggle when analyzing spectra of organic compounds, due mostly to lack of experience. A teaching activity was designed, in which students work in pairs to solve spectra of molecules, and afterwards expose the solutions to their peers, while another team acts as opponent. In this way, the students acquire a substantial level of practice with spectra exercises, develop critical thinking and learn to defend their ideas. The outcome was successful, since they improved their spectra analysis skills and become more engaged on the discussion.

COURSE FACTS

- Course name: Organic Chemistry I
- Level: 1st year BSc
- ECTS credits : 10
- Language: Danish
- Number of students: 22
- Your role: TA in laboratory exercises

TEACHING IN PRACTICE

1. Identifying a problem

The learning outcomes of the course state that students should be able to identify the structure of simple organic molecules based on spectroscopic techniques. However, most of them have very little or none experience in spectra analysis and. As a result, this task becomes daunting and overwhelming. It is thus necessary to implement an efficient teaching activity to enable the students get enough practice on spectra analysis to properly assimilate the core concepts and generate a solid knowledge.

2. Planning a teaching activity

In order to ensure the students practice in solving spectra, the class is split in pairs to work on a specific problem. Afterwards, each team presents the solution in front of the whole class, while other group plays the role of "opponent". By orally presenting the solved problem and stimulating discussion, the students learn how to justify their approaches, improve oral communication and critical thinking is stimulated.

3. Trying it out in practice

The teaching activity is divided in two parts.

- 1st part: each pair of students work in solving the structure of the compound that matches the spectra the TA has handed to them at the beginning of the session
- 2nd part: the groups present, in turns, their detailed answers to the exercise. They must justify and explain the methodology chosen. Simultaneously, another team acts as opponent, by raising questions about the procedure employed, asking for additional clarifications, etc. The rest of the class is also encouraged to engage on the discussion.

At the end of the session, the TA explains those concepts that have resulted more troublesome and highlights the most common mistakes.

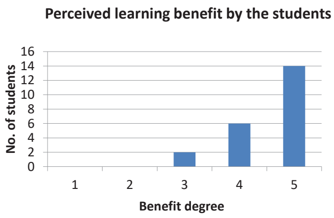


Figure 1. The students were asked to provide feedback about the improvements in spectra analysis. The degree of benefit ranges from 1 = no learning was made at all, to 5 = the activity was extremely beneficial for learning ,

The teaching activity was conducted in four problem solving sessions, during which all the student groups presented. After two sessions, all the students showed an stronger command of spectra analysis and significantly improved the quality of their presentations.

MAIN POINTS

1. **Main problem/challenge:** Students lack of experience and practice in solving spectra exercises.
2. **Teaching activity**: Work in pairs + presentation and defense
3. **How did it go?** The teaching activity resulted in an increased knowledge and self-confidence when dealing with the exercises.
4. **What to do next?** Ask the students to provide feedback on their peer presentations.

A short survey was conducted on the last session to obtain feedback about the students perception on their learning improvement through the teaching activity. As Figure 1 depicts, the majority of the students claimed that the teaching activity was "extremely beneficial" to consolidate a good basis of spectra knowledge.

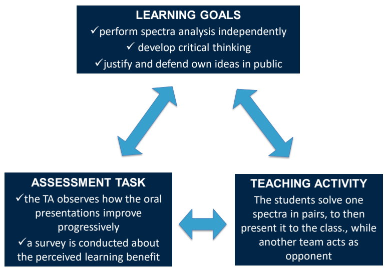


Figure 2. Constructive alignment.

4. Looking forward

The implementation of the teaching activity led to a satisfactory result, as after a couple of sessions, all the students dramatically increased their ability to interpret spectra. Namely, they were capable of tackling higher complexity complex spectra, demonstrated an increased level of self-confidence while presenting the solutions in front of their peers, as well as more critical thinking on the discussions. In regards to the future, it is suggested that the opponent team gives a grade to the presenter based on a rubric, to get an overview of the students perception of their classmates progress and improvements according to different categories.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

Jaime Moyano Villameriel
Department of Chemistry
Group of Thomas B. Poulsen

Improving the learning by pair-work

- A teaching activity to reduce the knowledge gap and facilitate the student learning

Learning Lab

Abstract: The organic chemistry I is the mandatory course for the students from chemistry-involved major, for instance medicine chemistry, chemical engineering and chemistry. For these majors, the analytical characterization is always the core of research, and hence the spectroscopic techniques (NMR, IR, Mass spectroscopy) are playing significant roles on their study. Therefore, the spectra analysis class is inevitable for our course. However, the knowledge gap among students has been observed when I took over this course first time. To reduce the gap, the teaching activity of "Think-Pair-Share" (TPS) is employed in this year. This poster comprehensively described the activity, the outcome and the future plan.

COURSE FACTS

- Course name: Organic Chemistry I
- Level: First year students
- ECTS credits : 10
- Language: English
- Number of students: 16
- Your role: Instructor of laboratory exercise

TEACHING IN PRACTICE

1. Identifying a problem

We are now in the spectra analysis section of this course. The most difficult part is the presence of knowledge difference among students. For instance, some students have experience of analysing the experimental spectra, some students only know the theory behind the analysis. Therefore, this difference bring about the difficulty on generalizing the teaching.

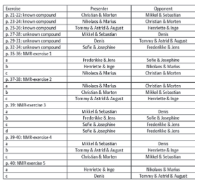
2. Planning a teaching activity

"Think-Pair-Share" (TPS) is planned to be implemented and it both fits to the online and physical teaching. The students are intended to work individually in the beginning and then they will pair with their lab partner for discussion and organize the results into slides for the following presentation to the rest of class members. Individually, , they are supposed to be trained of how to analyse the spectra. In pair, they can serve as the complementary role of each other for solving the easy questions and figuring out the most muddiest points . Some common blind sides of spectra analysis will be further raised through the presentation, which is also the tool of self-assessment.

References:
https://balqisnadiah.wordpress.com/2016/05/14/think-pair-share-padlet/

3. Trying it out in practice

The class was given remotely by Zoom. One week before the class, all the spectra in the red-booklet are sent out and hence they can prepare for the class individually. Besides, they are assigned 2-3 exercises for the group presentation, and another 2-3 exercise for being the opponent of others presentation (Figure 1) at the same time. In class, everyone works on the this spectra booklet with their original lab partner in the breakout room in the first-half, as shown in Figure 2. I joined the breakout room for solving the problem by random or their request. After the break, the second-half class started out by group presentation (15 mins for each group including discussion). The assigned opponent either asked one scientific question or at least drop a comment on their presentation.



Exercise	Presenter	Opponent
p. 21-22: known compound	Christian & Morten	Mikkel & Sebastian
p. 23-24: known compound	Nikolaos & Marius	Christian & Morten
p. 25-26: known compound	Tommy & Astrid & August	Henriette & Inge
p. 27-28: unknown compound	Mikkel & Sebastian	Denis
p. 29-31: unknown compound	Denis	Tommy & Astrid & August
p. 32-34: unknown compound	Sofie & Josephine	Frederikke & Jens
p. 35-36: NMR exercise 1		
a	Frederikke & Jens	Sofie & Josephine
b	Henriette & Inge	Nikolaos & Marius
c	Nikolaos & Marius	Christian & Morten
p. 37-38: NMR-exercise 2		
a	Nikolaos & Marius	Christian & Morten
b	Christian & Morten	Mikkel & Sebastian
c	Tommy & Astrid & August	Henriette & Inge
p. 39: NMR-exercise 3		
a	Mikkel & Sebastian	Denis
b	Frederikke & Jens	Sofie & Josephine
c	Sofie & Josephine	Frederikke & Jens
d	Sofie & Josephine	Frederikke & Jens
p. 39-40: NMR-exercise 4		
a	Mikkel & Sebastian	Denis
b	Tommy & Astrid & August	Henriette & Inge
c	Christian & Morten	Mikkel & Sebastian
p. 40: NMR exercise 5		
a	Henriette & Inge	Nikolaos & Marius
c	Denis	Tommy & Astrid & August

Figure 1: The corresponding table of the presenter and the opponent.

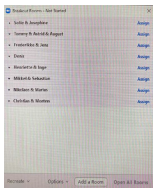


Figure 2: The list of breakout rooms in the online class by Zoom

At the final stage, before 15 mins to the end of the course, students are encouraged to share the advantages of group work and also some suggestions for the teaching activity in the way of CL . Those feedbacks can be organized into a note for the future teaching.

MAIN POINTS

1. **Main problem/challenge:** Knowledge difference among students
2. **Teaching activity**: "Think-Pair-Share" (TPS)
3. **How did it go?** In order to minimize the knowledge gap between students this teaching activity is implemented by pairing the students of different category. Therefore, some students comfortably gained experience and confidence by pair work, and the high-level student further clarify their logics of solving the problem by teaching their partner.
4. **What to do next?** Arrange a brief introduction of IR, NMR and Mass spectroscopy to minimize the gap among students

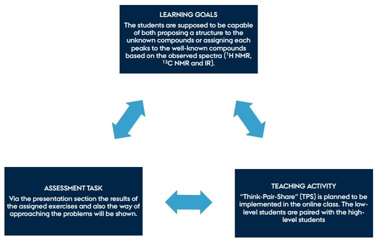


Figure 3: **Constructive alignment**

4. Looking forward

This activity worked very well, and it is even better than I expected. Some students have many questions when they are working alone before class, but most of the questions can be answered by their partner. In the presentation, I can not really see the huge gap among them, which means the knowledge gap has been efficiently reduced by our teaching activity. In the future, the more hours of theoretical lecture of spectra analysis are recommended to build-up the foundation of knowledge before the exercises, which can familiarize everyone with scientific language of organic spectra.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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Chemistry department

Think-pair-share

- A quick familiarization with vitrinite reflectance measurement

Learning Lab

Abstract: Vitrinite reflectance is one of the most important geothermal maturity parameter in petroleum industry. However, it's obtaining process is of high-demanding for the operator. It takes time for a geologist to be able to identify vitrinite correctly and find a measurable surface perfectly. Therefore, this teaching activity try to use think-pair-share activity to enhance the efficiency of students in being familiar with this procedure and reduce the possible mistake by incorrect subjective judgement. By matching graph of different maceral with corresponding description, students will quickly meet a lot of cases and gain the experience. After think-pair-share from group member and other groups, students will learn more.

COURSE FACTS

- Course name: Basin analysis and modelling
- Level: Master
- ECTS credits : 10
- Language: English
- Number of students: 10
- Your role: Expected TA in future

TEACHING IN PRACTICE

1. Identifying a problem

Have an understanding of vitrinite reflectance and measure them correctly is very important in determine the thermal maturity degree in petroleum geology. However, it is always difficult for students to identify or differentiate vitrinite from other macerals (like solid bitumen or graptolite). What's more, the measured value will be influenced a lot if a imperfect polishing surface was measured, which will influence the histogram of all the measured values and mislead the final average value. Reducing all these subjective elements are of high-demanding to students, which takes lots time to gain experience.

2. Planning a teaching activity

Here, a science teaching activity is adopted to help students have a quick meet with a lot of cases and gain experience quickly by think-pair-share. All the students can express their observation and judgements of morphology and optical surface characteristics of vitrinite and the most measurable particle. Students will be divided into groups made up of two persons and discuss their conclusion of matching microscopic graph with text description. Then a quick response will be given to each students so that they can elaborate and implement their understanding better. After that , random pairs will be selected to share their responses with the class, through which the students will have more elaboration of opinion share.

3. Trying it out in practice

Graphs taken from the microscope that illustrating different maceral type and different thermal maturity degree are prepared. Besides, several labels with description of each graphs are also prepared.

1. Matching work in group

A series of labels, which describes the maceral name, geothermal value and graphs, which showing different organic matter type and thermal maturity degree, will be exhibited to students. Then students will be divided into groups made up of two persons each and math the labels with graphs group by group.

Figure 1: Graphs and description labels for students to matching

2. Inter group communication

Different groups will discuss their matching solutions and explain it, like what lead to such judgement and what mistakes need to be pay attention to. This process can be fifteen minutes. The students will also be asked to make a survey and make some comments to this activity and the TA will also make a conclusion based on students matching solutions and expressions

MAIN POINTS

1. **Main problem/challenge:** Identify the morphology of different maceral type and general application in geothermal maturity
2. **Teaching activity**: Label matching and Think-Pair-Share
3. **How did it go?** Not yet implemented
4. **What to do next?** Self evaluation or discussion with supervisor and make adjustion

Assessment

After think-pair-share activity, each group will be asked to present their matching results and explain their reasons and whether they had made any changes after discussing with other students. TA will assess their presentation and give feedback.

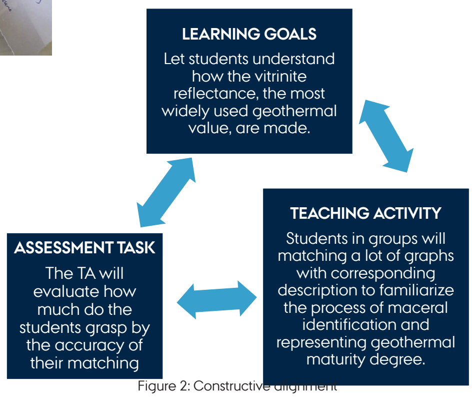

Figure 2: Constructive alignment

4. Looking forward

The evaluation will focus on whether students have really understand the thermal maturity parameter, vitrinite reflectance and their application in petroleum industry. The student were also encouraged to make a comment about their difficulties in identifying different organic matters and whether do they find this activity useful to them. The students comments will be used to adjust the teaching activity in next year.

AARHUS UNIVERSITET
SCIENCE AND TECHNOLOGY

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