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Flipped Learning in Organic Chemistry for Life Sciences – Experiences and Considerations

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Background

*Organic Chemistry for Life Sciences*is a 1st year course at the Faculty of Life Sciences, aiming at introducing key aspects of organic chemistry including chemical reactions, physiochemical properties and metabolic pathways. The course has approximately 200 course participants and as always in these big lectures, there is a risk that students sit with unanswered questions which they do not dare ask – this can particularly be the case for 1st year courses. I got involved in this course with the purpose of developing short 'essentials of' videos supporting the first 8 lectures as these make up a large part of the foundation for understanding organic chemistry. Another name for distributing educational video material is *vodcasting* which is a key part of the concept of flipped classroom. Although I have not had the opportunity to implement this educational technique, I will in the future build upon my experiences with development of video material with the aim of flipping my lectures. Thus, this will be the emphasis of this project.

Introduction to the concept of 'Flipped Classroom'

The flipped classroom is a teaching model developed with the purpose of optimizing the student-outcome of the face-to-face time with the teacher. Jonathan Bergmann, one of the founders of the flipped classroom, explains the *flip* as 'moving the direct instructions from the group to the individual space'. In practical terms, the flip means that the classroom/homework

paradigm is “flipped”. What used to be classwork (the “lecture”) is done at home via teacher-created videos and what used to be homework (assigned problems) is now done in class. Besides freeing up class time for students to engage in hands-on learning, collaboration with peers and being guided rather than instructed by the teacher, the flip also introduces a shift from passive to active learning to focus on the higher order thinking skills such as analysis, synthesis and evaluation (Bloom taxonomy).

Another huge benefit of the flipped classroom is the possibility to personalize the lectures. In the flipped classroom, all students can see the lecture in the pace that suits them, and review difficult parts if necessary. This means that the ‘A students’ will not be bored and hence inactive during class time (as could be the case in the traditional lectures) while the struggling students will not give up due to too high pace. In the classroom, the time is then devoted to guide and educate at the level they are currently on.

There are evidently many benefits from flipped learning but it is a big leap from traditional lecturing. To get some experiences with vodcasts to build upon in the future, I used the ‘essentials of’-videos to try out different forms of presentation and through interviews evaluate what is good and what is not

Vodcasting in Organic Chemistry for Life Sciences – my experiences

Below I have summarized some of the general considerations behind the production of the vodcast made for Organic Chemistry for Life Sciences

- With the videos I aimed at presenting one essential subject from each lecture. These subjects were chosen based on my own experience and through discussions with the lecturer.
- As the videos were not meant to replace the lecture, but rather to complement it through going further into details, I decided not to upload the videos before the lecture. This would also give me the possibility to change subject if the lecture showed this to be nessecary.
- I speculated that through engagement of the students (volunteers) in the production of the video material I would be able to transfer ownership of the vodcasts and through this facilitate learning at a higher level.
- I tried different presentation forms: Powerpoint, blackboard-type presentation, pen-and-paper, and cartoon-like presentations. This would al-

low me to evaluate the efficiency of the different formats from both the student and teachers point-of-view.

At the first lecture given in the course, I asked for volunteers for participation in producing the educational videos – this however proved to be more difficult than expected as only 3 students were willing to assist. Having a focus group, I had planned to interview the students after a lecture to verify that the selected topics were indeed the ones causing trouble. This, however, was omitted as I found it unrealistic that the students had time for this as well.

Production

Before going into a discussion about the outcome of the video material I would like to discuss how the videos were produced and distributed. As already described, I had selected 4 different forms of presentation which I will go through individually in the following. Please refer to Appendix A for examples.

Powerpoint: Microsoft has since Microsoft Office 2010 (PC) and Powerpoint 2011 (Mac) included an option to record a slideshow with narration and save this as a video to be distributed. This is very straight forward and it really lets you as a producer perfectly time your slides and narration in a professional way. For flipping your lectures – which you most likely already have as powerpoint presentations – this is a simple and efficient way of doing it. However, the clear cut presentations – which works very well for short videos – tends to lack the aura of personality I would like to have in my lectures. Jonathan Bergmann recommends a tool called screencast-o-matic (http://www.screencst-o-matic.com) from where one can record a desired section of your screen (or whole screen) together with audio *and* webcam. In addition, screencast-o-matic does not limit you to powerpoint but allows you to change to other programs while recording. The online version of the tool is highly intuitive and allows for direct upload to e.g., your Youtube account but lacks the ability to edit the video. Both approaches to convert powerpoints presentations to video material is easy and fast.

Blackboard: Blackboard videos are very simple to record as all it requires is a camera or smartphone. I imagined that this would be an obvious student activity why I let the three students be in charge of this video under

my supervision. It, however, became clear that if you want to produce a video with at proper audio quality you either need a very good camera, a microphone connected to the camera or, as we ended up doing due to hardware issues, add the soundtrack after recording through video editing. If one has the hardware available, the blackboard video is an easy way of making engaging teaching videos – especially for the experienced lecturer. A big pitfall with blackboard videos is that the lecturer potentially speaks for 30-45 minutes on camera without the natural breaks for questions and small exercises which you normally have in traditional lectures. A way of ensuring a high degree of engagement in these types of videos is to engage into a discussion with a colleague rather than traditional lecturing. This has successfully been done by Jonathan Bergmann and Aaron Sams and was also the approach used in the video produced for Organic Chemistry for Life Sciences.

Pen-and-paper: Recording pen-strokes against a piece of paper – be it analog or digital – can be perceived as a combination of a blackboard lecture and a powerpoint presentation. Recording writing on a piece of paper can prove difficult with a fixed camera, which make the digital pen-and-paper the most obvious choice. Digital pens require some training but can be quickly mastered and also allows for making notes on prepared material such as textbook figures when recording with e.g., screen-o-matic. While I find that this presentation form might not be suitable for 30 minute lectures (even though it is often done by experienced flipped teachers such as Jonathan Bergmann) it has great potential for shorter, instructive videos such as spectral interpretation/problem solving for which I used it.

Cartoons: Cartoon based teaching videos can be highly engaging and dynamic but are also time-consuming to create. The cartoon type video I find least time consuming to make (unless you are a skilled cartoonist) is based on cutout drawings which can be combined and moved around on a table, recording only the drawings and your hands. All that is required is paper, pens, and a camera on a tripod. From my experience, the raw footage requires a great deal of editing and thus it is practically impossible to record narration along with the video. Due to the labor intensiveness of this presentation form I find it unlikely that it can be used for long lectures. It could, however, be of valuable use together with other presentation forms such as the blackboard or powerpoint to create variation in these.

Distribution: When spending time on producing vodcasts one should make sure that the material also reaches the students. Internet access should not be a limiting factor, as it was when the flipped classroom was introduced in 2007, so I started out by using the course website. Hosting the videos on the university servers would ensure full ownership of the videos as well as circumvent possible copyright problems when using e.g., textbook figures and sharing videos publicly. It quickly became clear that the university was not geared to handle this kind of material so I opted for youtube (hidden with the need for direct links to handle copyright) with a lot of added benefits such as ability to annotate videos, review usage statistics, and engage in dialogue in the comments section. When new videos were uploaded, it was posted on the course webpage, but during the evaluation I found that to be able to reach the students one should consider facebook or other social network sites used at that particular university.

Outcome of videos

To evaluate the produced material I conducted an interview with volunteer students. Again it proved to be difficult to get the students engaged so the feedback is based on the students who had also volunteered for creating the video material – I asked them therefor to get opinions from their friends prior to the interview. From this it was clear that the most important parameter for an engaging video is that it is not static. This meant, as I had expected, that the powerpoint presentations were the least inspiring videos. The cartoon and blackboard videos were more entertaining and engaging and were, according to the students, better. When asked if they felt they learned more from the entertaining videos they were unsure. Based on the feedback I have received throughout the course, the videos which were most helpful were interestingly enough powerpoint-based, indicating that this is not the case.

While I also find the powerpoint presentation less entertaining than the other formats I believe that this is a highly suitable technique for making vodcasts – both in terms of time-consumption and dissemination. What this has shown me is that to adapt to the flipped classroom methodology one should preferably use a combination of different presentation techniques. This could be executed in a way so that the backbone of the lecture is made up of powerpoint slides – preferably with webcam video embedded for a personalized touch – where the more ‘entertaining’ presentation forms can be used throughout the video present key subjects or for instructional pur-

poses. This not only introduces a variation in the vodcasts but also allow for adaption of the powerpoint part from year to year while re-using the small, more time-consuming video segments.

Considerations for future implementation of Flipped Classroom

I have no doubt that the flipped classroom teaching style introduces many advantages over the traditional lectures – for both teachers and students. Some of the most important being that the students can follow the lectures in the pace that suits them – with the possibility to revisit a given lecture if needed – and that it frees up time in the classroom for student activation which can facilitate higher learning such as analysis and evaluation. For the teacher, I find that the biggest benefit is that you can use your face-to-face time guiding and helping on an individual level.

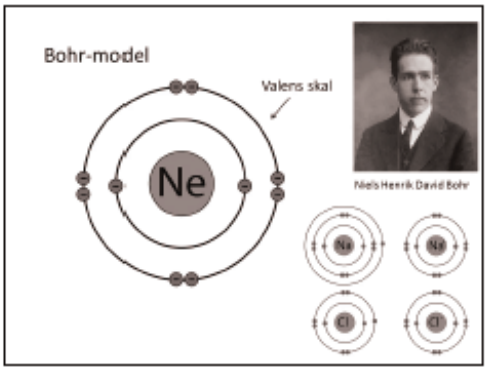
The Flipped classroom was originally introduced at High School level and for successfully adapting it to my teaching at University of Copenhagen, and I believe that several things have to be considered. *First of all*, to implement flipped classroom I think that it is imperative that the entire course is flipped to make the teaching style consistent. If this is not possible for various reasons, the use of 'essentials of'-videos is an alternative which allows the students to revisit particular subject (or get it explained in an alternative way to the textbook if made available before the lecture) but it does not free up time for student activation in the classroom. *Secondly*, in high school, lessons are often in a timespan of around two hours while with the block structure at the University of Copenhagen, the course days are much longer which, with reasonable course planning, should allow for several student activities besides lectures. These longer days might even result in the need for very long lectures/vodcasts to cover all the material for such a day. Based on my experience from this project it could potentially be difficult to keep the students attentive to a vodcast this long resulting in ill-prepared students and hence sub-optimal classroom sessions. For me, the key would be to make short (about 30 min) vodcasts covering only essential subjects which, together with the reading material, would prepare the students for more engaging classroom activities which in turn prepares for the more traditional problem solving. Vodcasts leads me to the *third consideration*: time consumption. This project has shown me that students prefer dynamic, 'fun' vodcasts while as a teacher, none of the presentation styles

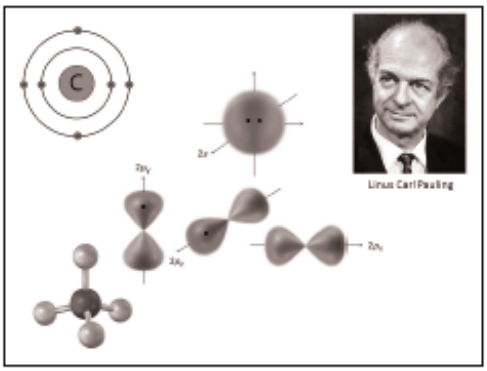
I have tried in this project can compete with the static powerpoint presentation in terms of time consumption and presentation of several subjects. Thus, as mentioned earlier, combining the static and dynamic presentation styles are key to having the best ratio between time and benefit.

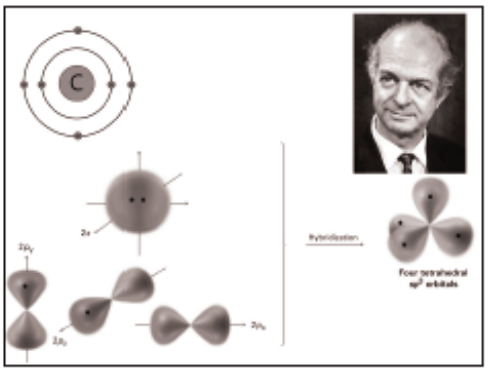
Even though the transition from traditional to flipped learning requires careful considerations and is initially labor intensive, I believe that the benefits gained fully outweighs this. Thus, I am convinced that flipped learning will become more widely used in the universities in the future.

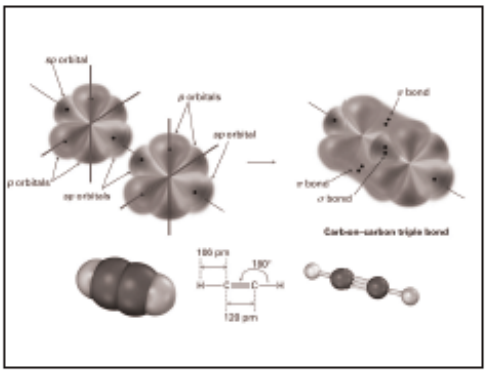
A Screenshots from videos to exemplify the different vodcasts.

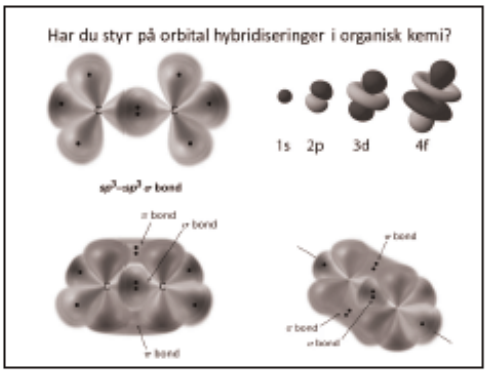
Essentials Of Orbitals - Powerpoint



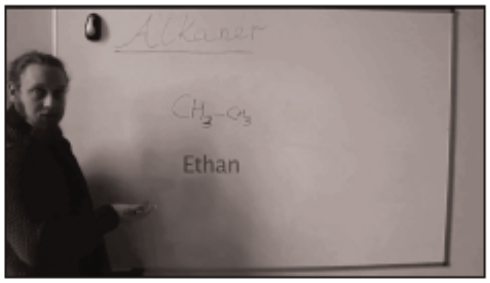


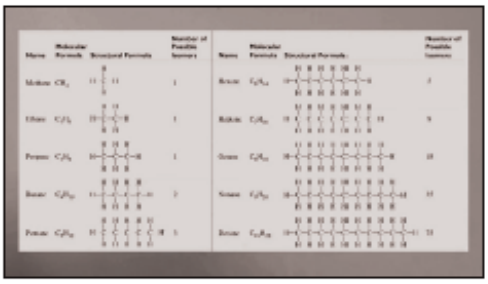


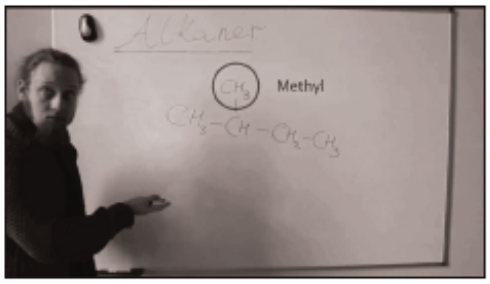


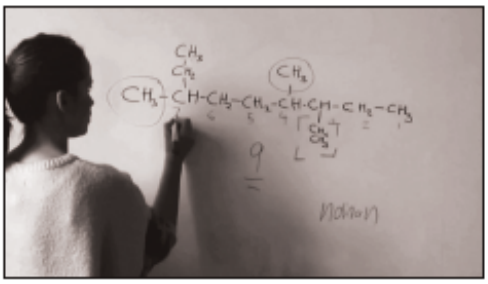


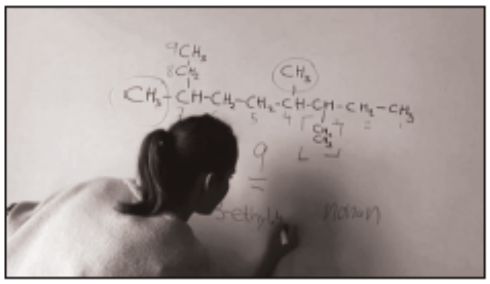
Essentials Of Alkanes - Blackboard

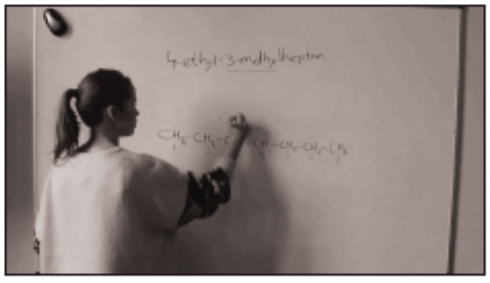




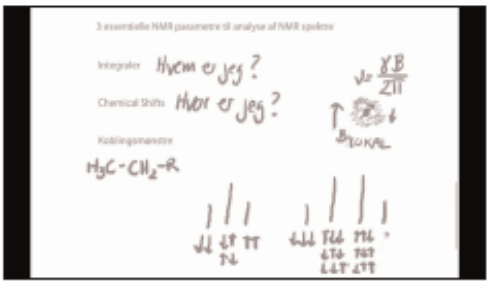


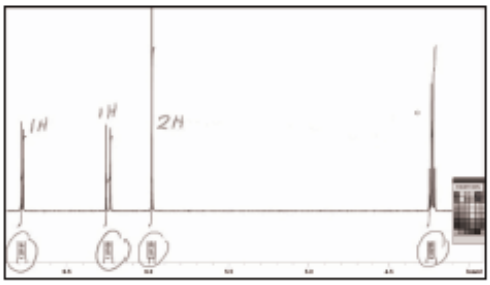


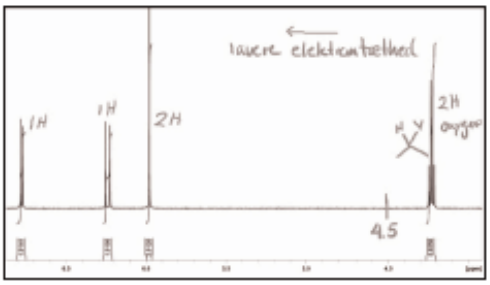


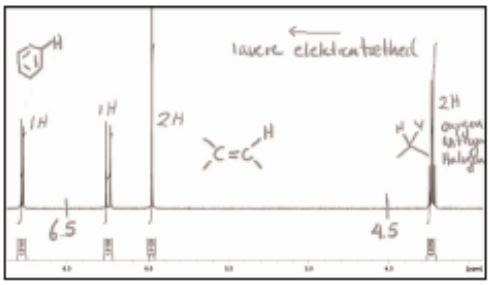


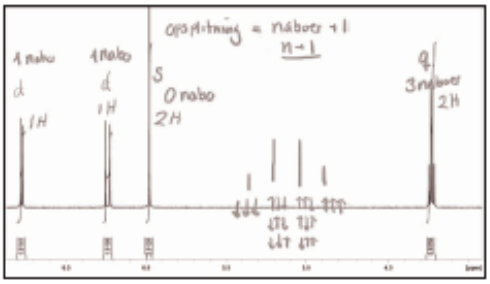
Essentials Of NMR 2 - Pen-and-paper

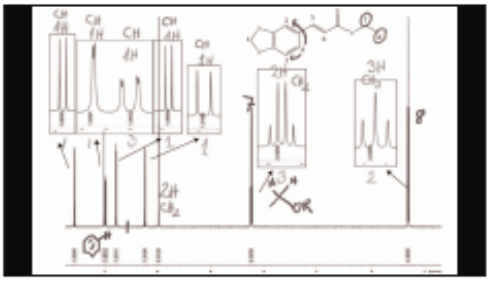


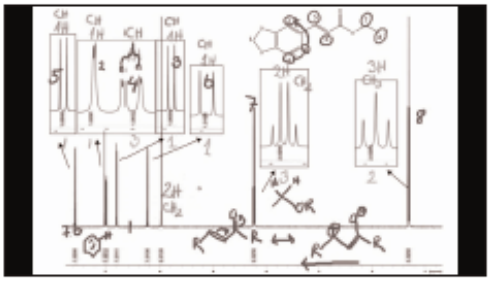












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