25

Using online quizzes for active learning and constructive alignment in a blended learning setting

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Introduction

In this project on university pedagogics I have experimented with very different types of online quizzes and investigated how they can be used to support different aspects of active and visible learning on a research-based master level course in Physics. The quizzes were not part of the formal assessment of the students but the students were nevertheless very engaged in the quizzes and in most cases felt they achieved deep learning of the topic by working with the quizzes.

Active learning

Approaches to learning can be divided into four categories (Entwhistle 2009).

- Surface passive (level of understanding = mentioning)
- Surface passive (level of understanding = describing)
- Deep passive (level of understanding = relating)
- Deep active (level of understanding = explaining)

Most students vary between these different approaches depending both on the type of teaching and the individual assignment but usually a deep active approach is desirable, especially in research-based teaching.

Active learning is a model of instruction that focus the responsibility of learning on learners and implements this by students working actively and directly with the material (Bonwell & Eison 1991). In pedagogical practice

active learning is sometimes connected with the so-called flipped classroom where the teacher is more of a "guide on the side" than the "sage on the stage". This is usually achieved by implementation of blended learning i.e. a combination of e-learning and class room learning. In a recent study of teaching within the disciplines of science, engineering and mathematics it has been proven that implementation of active learning reduces the percentage of failed students drastically as well as improve scores within science, engineering and mathematics (Freeman et al. 2014). In this project I will implement active learning by online quizzes used in a blended learning setting.

Central pedagogical concepts

In pedagogical constructivist theory learners use their own activity to construct their knowledge as interpreted through their own existing schemata (Biggs & Tang 2011). Three central concepts in pedagogics theory are teaching and learning activities (TLAs), intended learning objectives (ILOs) and assessment tasks (ATs). The ILOs specify not only what is to be learned but also how it is to be learned. In constructive alignment the TLAs adress the ILOs intrinsically and the ATs are aligned with the ILOs (Biggs & Tang 2011).

In terms of assessment two major types are distinguished: Formative feedback which is provided during learning, telling the students how well they are doing and what might need improvement. Summative assessment informs the students after learning how well they learnt what they were supposed to (Biggs & Tang 2011).

It is well established in pedagogics research that only formative feedback improves the learning outcomes for the students (Hattie & Timberley 2007).

What is a quiz

The Wikipedia definition of a quiz is as follows:

> *"A quiz is a form of game or mind sport in which the players (as individuals or in teams) attempt to answer questions correctly. In some countries, a quiz is also a brief assessment used in education and similar fields to measure growth in knowledge, abilities,*

> *and/or skills. Quizzes are usually scored in points and many quizzes are designed to determine a winner from a group of participants - usually the participant with the highest score."*

Even though this definition is quite broad allowing quizzes to have a lot of different forms, the quizzes in focus in this project go even beyond the Wikipedia definition in that they are not necessarily brief and there are no scores in points or a winner being determined i.e. no summative feedback. The reason for making this choice in the quiz construction is explained well in the following quote:

> *"Quizzes can be developed in ways that they play less of an assessment role, and more of a teaching role. They assist learning by utilising teaching techniques that determine where students have their current understanding, and then taking them forward from that point"*(Quinn & Reid 2008)

One important pedagogical aspect of an online quiz is the possibility for the quiz constructor to implement immediate feedback based on previous replies or teachers experiences with pitfalls:

> *"The empirical result that possible misconceptions are few in number reflects the experience of most teachers that the student errors they encounter in tutorials, assignments and examinations are the same every year. It is rare for a student to come up with a wholly new way of getting it wrong. So if the forms of error are relatively few in number, why are they not documented so that we can address them in future teaching?"*(Laurillard 2002)

In the quizzes implemented in this project there are right, partially right and wrong answers and immediate feedback is implemented accordingly. The phrasing 'not correct' was avoided and phrasing such as 'we do not agree' was preferred in order to stress the formative nature of the assessment.

Online quiz tools

Surprisingly little seems to have been written about the use of online quizzes as a TLA, especially lacking is literature with specific focus on analysing the use of feedback quizzes and formative feedback. I did however find the discussion of various types of feedback quizzes based on analysis in Laurillards' conversational framework (Quinn & Reid 2008), as well

as the chapter on feedback in (Rienecker & Bruun 2013) quite interesting for contextualisation of the present project.

In this project I have used the quiz modules of two separate learning management systems (LMS) to create the quizzes for my pedagogics experiments since they had different features:

Absalon is the LMS of University of Copenhagen which is produced by the company *It's learning*. It features a good guide to quiz construction but automated or adaptive immediate feedback on student replies is not possible.

Moodle is a very versatile open source LMS. It features immediate adaptive feedback on some quiz question types but the quiz modules are not very user-friendly and guides to quiz construction are mostly posted by users and scattered on the web.

The neutron scattering course

The quiz experiments in this project were implemented in a blended learning setting in the Neutron Scattering course. It is a project- and research-based course targeted for master-level students in Physics and Nano-science. The course has been running at the Niels Bohr Institute on a yearly basis since 2005. Each run features approximately 20 students, and the course runs for 8 weeks + 1 week hand-on experiments in Switzerland. Each week there is 12 hours class-time and the workload is nominally distributed as

Lectures 28
Practical exercises 56
Excursions 60
Preparation 62
Total 206

The practical exercises are distributed on written exercises ('regneøvelser'), simulation projects, and quizzes with the majority of hours on simulation projects. The course is formally assessed by pass/fail based on 3-4 reports, of which 2-3 are based on simulation projects and 1 on hands-on experiments. In 2014, 16 students started the course, 6 of which were foreign students. 14 students completed the course and they all passed the exam (reports).

Problem formulation

One of the challenges in research-based teaching in a 8-9 week course is to enable students to quickly familiarise with basic concepts and skills which they should use actively when learning about and participating in active research topics and activities.

In the neutron scattering course this means that the students have to read roughly 100 pages covering 6 chapters before the end of the second week of the course. As the course is also (simulation-)project based the students are furthermore required to get acquainted with the simulation software during the first weeks. We have noticed that students which lack behind at this point have a tendency not catch up later in the course which could hinder their deeper learning in the research-based and/or more complex part of the course. It is therefore important to motivate and engage the students to prepare for the first lecture by learning the contents of the first 28 pages before arriving at the first lecture (in order to remove this part of the workload during the next two weeks). This is the target of the first experimental quiz-type in this project.

It is equally important to engage the students in deep learning of the basic concepts of all 100 pages during the first two weeks of the course which is the target of the second experimental quiz-type in this project.

Another feature of the research-based nature of the course is that the lectures are given by 7 different lecturers, of which 5 are partaking specialised topics only in connection to their own research. This requires a high amount of coordination both in terms of curriculum in order to avoid overlaps and gaps, in terms of planning a natural flow of topics as well as a uniform level of constructive alignment. The risk of involving specialised guest-teachers is loss of coherence for the student learning, in particularly since each guest does not have the time-resources to participate in the daily/weekly planning and discussion of progress in the class. This could be mitigated by simple template framework allowing constructive alignment of each lecture/topic as well as for communication of learning goals between teachers and course responsibles and between teachers and students. This is the topic of the third experimental quiz-type of this project.

Defining clear learning objectives and corresponding learning activities which ensure deep learning is also essential when constructing individual modules in an e-learning course and this is a major pedagogical interest for me since I'm leading the construction of an e-learning platform: Virtual Neutrons for Teaching (Udby et al. n.d.). The portal is specialised for teach-

ing and learning scattering techniques and we are currently constructing an introductory course in neutron scattering which will follow best principles from the classroom course at the Niels Bohr Institute including the experiments with quizzes in this project. The classroom will be used to test most of the online tools in a blended learning setting.

Method

In this project on university pedagogics I will investigate the potential impact of quizzes as active learning tools with formative assessment. I have introduced three very different quizzes in a blended learning setting at the Niels Bohr Institute with the purpose of

1. improving student preparation level
2. promoting student engagement level and deeper learning
3. enabling a framework for constructive alignment of a lesson

All quizzes implemented automatic online feedback on student replies and in addition feedback in class was given. The quizzes were mandatory but not part of the formal evaluation of the students, Student assessment in connection with quizzes was purely formative.

Finally data for evaluation of the effect of implementation of the three experimental quiz types was gathered in a focus group interview after the course ended.

Preparation quiz

I constructed a quiz designed to improve the preparation level of the students already from the first lesson. The students were given notice 5 days in advance of the first lesson with deadline just before the first lesson. The three parts were constructed in the quiz module of the Moodle LMS and separately targeted to

a) motivate the students to read the first two chapters of the course notes before even arriving at the first course day
b) give them warm-up calculation exercises while familiarising with some of the concepts and tools in the first two chapters of the course notes
c) engage them in deeper learning of those two chapters

Part a) consisted of a simple question 'What is neutron scattering used for?'. Student replies were in the format of multiple choice with several possible answers and with automated feedback on their replies as seen on Illustration 4 in Appendix A: Quiz questions and feedback.

Part b) consisted of 5 questions regarding 'neutron properties'. The students had to use tabulated conversion factors in the course notes as a tool in order to calculate the correct answers. Student replys were a mixture of multiple choice and numerical answers with automated feedback on their replies. The quiz questions and example feedback is shown on Illustration 5 in Appendix A : Quiz questions and feedback.

Part c) consisted in a single question 'What the differential cross-section of the sample?'. It requires the student to reflect on the central concept of chapter 2 but is not mathematically difficult. The question is of a conceptual nature since the students have to relate the information prior to the question to concepts in the notes and to find the formula which to use in order to calculate the differential cross-section. The quiz question and example feedback is shown in Illustration 6 in Appendix A : Quiz questions and feedback. The deadline for this part of the quiz was extended to the next day after the first lecture in order to see the effect of the lecture on the replies.

Reflection quiz

The reflection quiz was constructed by the students themselves in Absalon as a follow-up and reflection on Chapters 3 and 4 of the course notes at the end of the second week. The reason for this was to experiment with visible learning ("when teachers see learning through the eyes of students and help them become their own teachers")since according to (Hattie 2009) the biggest effect on student learning occurs when students become their own teachers (and teachers become learners) and most people learn 95% of what they teach someone else (Biggs & Tang 2011).

Preparations for quiz construction
The quiz design was performed in the last lecture of the second week. As preparation for the quiz-design lecture the students were asked in advance to read chapters 3+4 and reflect on

- which parts or specific expressions did you think were particular important? Pick at least one example that you haven't worked with actively in class (e.g. in exercises or quizzes).

- which parts or specific expressions did you have a hard time understanding?

In class I gave a ~20 min lecture about various formats of quiz questions and answering types in Absalon and which are suitable for what purpose. I used the information in the Absalon quiz help pages as the main source. Straight after the lecture the quiz was designed.

Quiz design
The design of the quiz question was done in class (using approximately 1 hour in total) from the following steps:

- Each student wrote 1-3 points they found important in the textbook but which they hadn't worked actively with in problem or simulation sessions. The points were written on separate oversized post-its and put on the whiteboard.
- Each student wrote 1-3 questions regarding the textbook contents. The points were written on separate oversized post-its and put on the whiteboard.
- The students then went to read the post-its and collect/group similar ones coached by the teacher who recorded the points/questions and coordinated overlap reduction.
- Each student formulated one quiz question from the ideas of the important or not understood points on the post-its.

The next step was that each student designed a question which should take at most 5 mins to answer, decided on the answer type and finally implemented it into a unified quiz template that I had prepared in advance in Absalon, deadline was the day after the lecture.

Quiz completion
Finally all the students should answer the full quiz. They were supposed to do it over the weekend but due to technical problems the deadline was extended by one week.

Constructive alignment quiz

The Learning Objectives (ILOs) of a particular lesson were made openly available to the students before the in-class lesson and formulated as quiz questions designed in Absalon. Since constructive alignment is a well-established pedagogics practice I chose to experiment with the motivation

and autonomy of the students in the way that I let them decide how or if they would prepare for the lesson for instance by looking up keywords in the ILOs.

In class, the 4 ILOs were repeated as the first slide of the lecture and consecutively addressed in TLAs during the lecture by

- dialogue on learning goals 1-4
- 'summeøvelse' in small groups connecting learning goals 3+4

The ATs consisted in the ILOs posed as questions which the students were asked to answer at the end of the lesson. All student replies were in the 'short open answer' format.

Since it is not possible to give immediate automated formative feedback in Absalon the formative feedback was given as a plenum discussion in the following lecture.

Results

The students were only given formative feedback but the LMSs of course record their summative results in terms of grades which I will also include here for completeness of data and basis for discussion in section 4. The students were allowed an unlimited amount of attempts to take the quiz.

Preparation quiz results

The student participation and summative results in the preparation quiz are shown in Illustration 25.1. The quiz was constructed so that the student had to express how sure they were of each answer. If they were sure on a wrong answer or unsure of a right answer they were given a penalty.

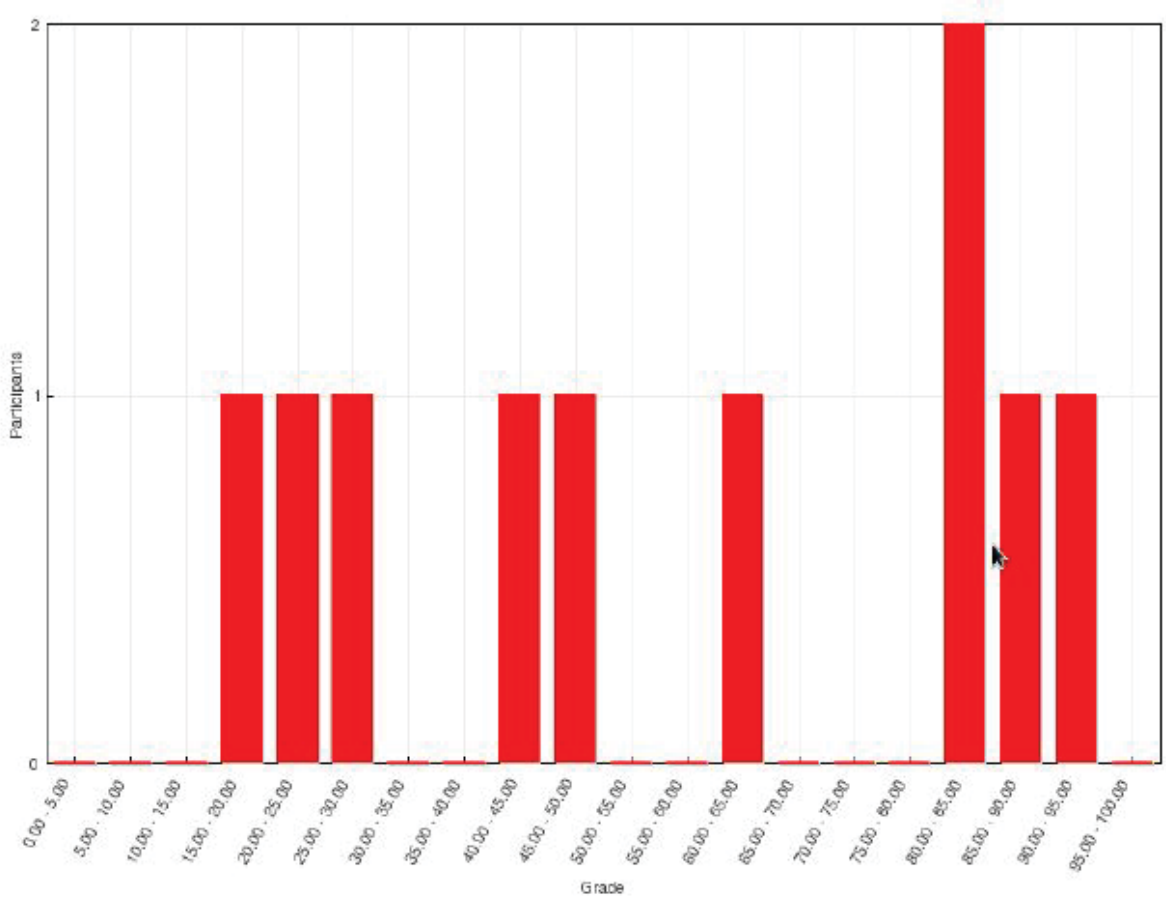

Fig. 25.1. Distribution of student grades in the preparation quiz after all attempts. One student obtained only a negative grade of -5 (due to penalties on 'sureness') which is not shown.

The participation and summative results in each part of the preparation quiz are summarised below

a) "What is neutron scattering used for ?", 19 attempts (11/15 students replied), average grade of first attempts 81%.
b) "Neutron properties", 22 attempts (11/15 students replied), average grade 26%, no 100% correct answers.
c) "The neutron differential cross-section", 31 attempts (11/15 students replied), only one correct answer before lesson. 9 students repeated the quiz attempt after the lecture 4 of which answered correctly at that point.

Reflection quiz results

The summative student results are shown in Illustration 25.2. In one of the quiz questions the 'correct answer' as typed in by the student responsible for the particular quiz question was actually not correct, hence the student replies to this question should be neglected which would shift the distribution slightly to the right.

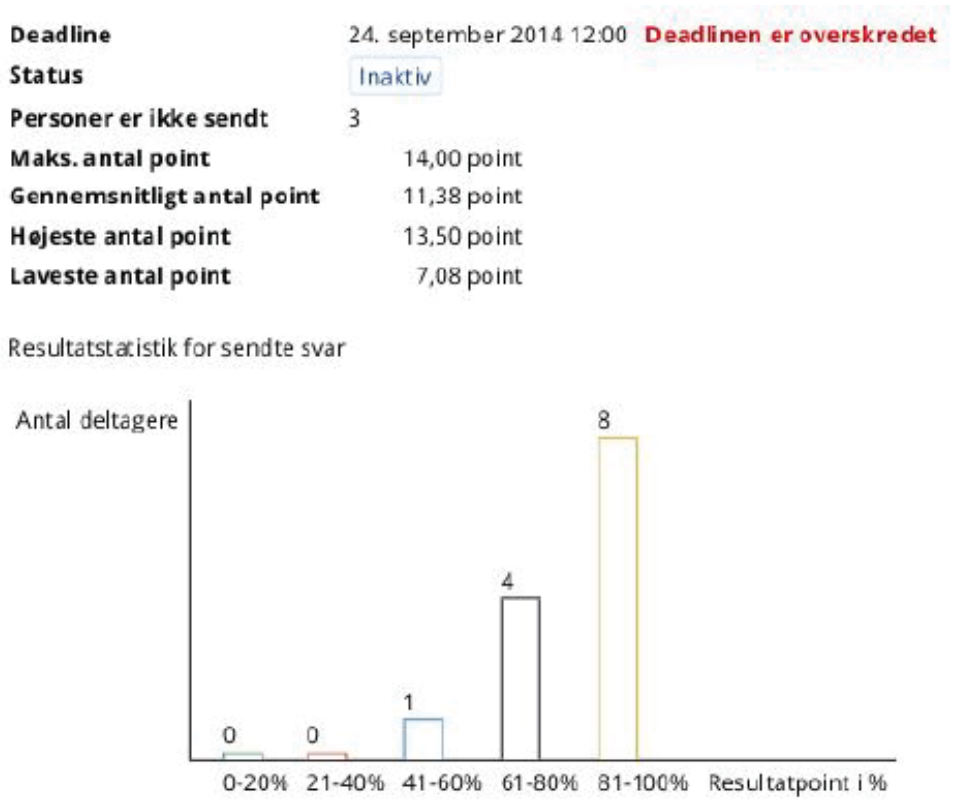

Fig. 25.2. Distribution of student grade in the reflection quiz. No students had less that 50% correct answers.

Constructive alignment quiz results

11 students made each one attempt at the quiz (4 students were not attending the lecture but one of them still attempted the quiz trying to guess the contents of the lecture). The summative results are shown in Illustration 25.3 below.

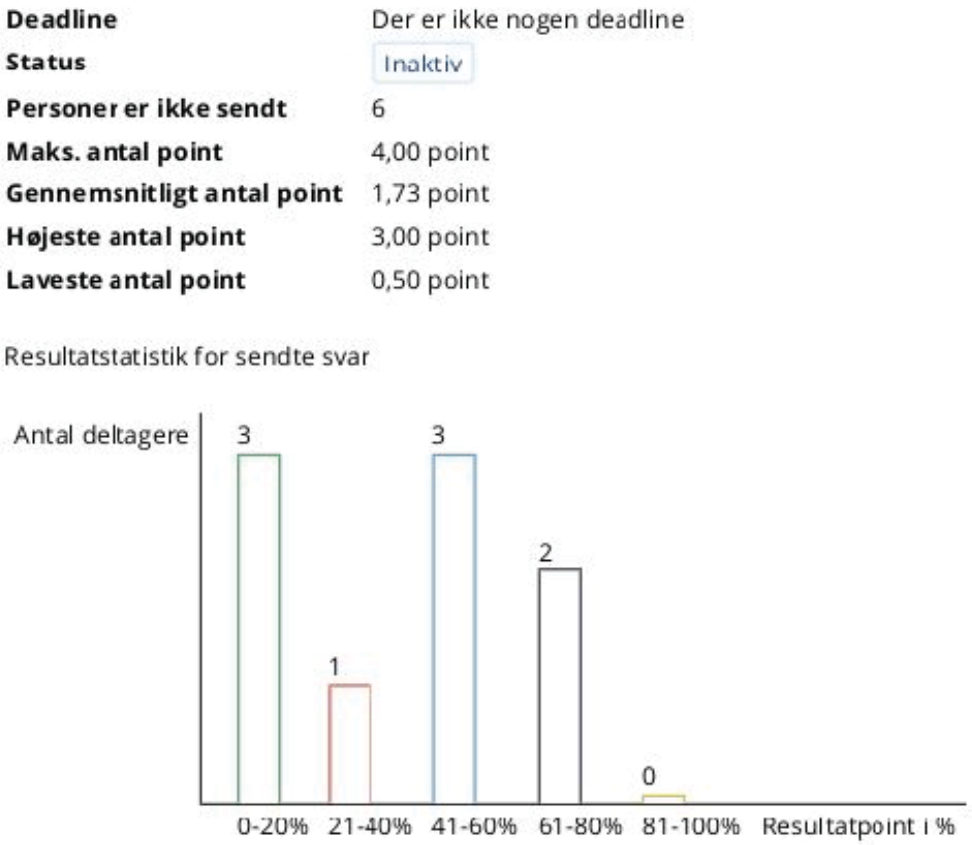

Fig. 25.3. Distribution of student grades in the 'constructive alignment' quiz. It is seen that 1/3 of the participants had less than 21% correct responses.

Analysis/Discussion

In order to discuss the impact of the three quiz experiments I invited the students to a focus group interview a couple of weeks after the course ended offering them coffee and cake for their troubles. 9 out of 14 students showed up and a couple more wanted to come but were not able to. The interview was recorded on a dictaphone and I showed the explicit quizzes on my computer screen. The interview was structured as a discussion with some general open questions regarding the course in the beginning and end of the interview and more specific questions in the middle. In general I tried to steer the discussion from specific quotes rather than giving the full agenda directly. The full transcription of the interview is shown in Appendix B: Transcription of interview. In the analysis below I've selected specific points and quotes (both marked by [time]) from the interview in order to illustrate and discuss specific points in the problem formulation.

Improving student preparation level

The students in general seem to check the weeklies before arriving at the first lesson on a course and some will also read in advance given there is enough time after the weekly has been posted. [16:30-17:20]. Even though some did find the quiz motivating for reading the course notes others didn't seem to think they needed motivation to read the material although in practice they don't always actually read the material

> *[18:30] (E) most of the time I would anyway be motivated to read in advance in order to understand what's going on in class. But in this course I actually didn't do much reading ...*
> *[20:15] (K) I read all the material before even seeing the quizzes so they couldn't motivate me but if I know I have to answer questions I would find it motivational. But in general I always prefer to read beforehand, but life is not always turning out that way.*

Most of the students did the preparation quiz (with parts a-c) in advance of the first lecture and in general it made them work more deeply with the material as was intended

> *[17:25] . . . [it made me work more deeply] because you have to understand what is written in order to solve the quizzes. Normally I would just read it through and be done but to do the quizzes you have to revisit the material sometimes.*
> *[18:00] ... it is a nice way to make sure you've understood the main parts of the chapters you've read.*

In terms of the types of quizzes they seemed to especially like the shorter ones that 'made them think' but it was also pointed out that the combination with 'warm-up' calculation exercises was good after the summer-holidays

> *[22:05] (D) I like the ones that make you think. (several) yeah...*
> *[22:15] (Z) I like the shorter questions without too much calculations because that's what exercises are for. Quizzes are better for checking whether I got the point.*
> *[22:35] (J) Yes I'm also thinking that if it's a long quiz that has a lot of questions you can just go and find the answer to type them in without a lot of reflection, but if it's a short question which makes you think then it's better.*
> *[23:00] (K) I think it's a good thing to have a combination like you*

had in the three quizzes. . .
(Z) Yes ...
(K)...but you could also merge them into one quiz where you have some thing which are conceptual and some things to calculate. It's good to have calculations as a warm up exercises, because maybe it's been a while since you had a theoretically based course and this is the first course after the summer holiday so maybe it's been a long time since you did calculations

It is interesting that the students did not perceive the preparation quiz as too hard even though the grades distribution (Illustration 25.1) was actually very flat with half the students achieving less than 50% even after several tries. Part of the reason for the low grades might however be unmatched expectations of the student to the level of correctness of his reply for which there was a penalty in this particular quiz. It was especially surprising that part c) which none of the students successfully solved before the lecture was not perceived as being too hard.

[26:30] (K) If I recall it correctly you had all the information you needed to plug into the equation, but the hard thing is to understand what is what in this text of informations. It was not too hard but I had to think about it a little and read the text and figure out what referred to which symbol and so on.

This perception might however be due to the time of the interview (after the course was successfully passed by all students and thus looking back they did not find contents hard to understand), or perhaps because the students were allowed to answer the question again after the lecture with more success.

Providing deep learning through reflection

My main concern about the design process of the reflection quiz was to which degree it should be anonymised between the students in order to conceal which parts of the text each student had a hard time understanding. It however turned out they did not feel uncomfortable putting their questions on a post-it on the whiteboard:

[27:55] (F) I didn't mind ... (several) no, that was fine
[28:10] (J) And we weren't saying particularly 'I didn't understand that' which could be embarrassing, we just put up this piece of paper. So it feels a bit anonymous (several agreeing).

The objective was to make the students feel responsible for reading the notes and work with them deeply even though there is a lot of material during that week of the course and the quiz seemed to achieve this goal

> *[28:50] (J) I remember that the question I had was particularly difficult and I don't know if I was the right person to answer that or making a question out of it because I wasn't sure of my understanding so maybe I looked in that part of the notes in more detail.*
> *[29:25] (A) But I think you have a bigger responsibility when you have to make the question...*
> *[33:08] (Z) If you are answering a question you are just searching for one particular information but if you are creating a question you need to first understand everything, then select something good and even double-check it makes sense.*

It was however entirely the responsibility of teaching the other students well and making sure they had a deep understanding themselves which motivated their work:

> *[34:20] (A) It is embarrassing to ask a question there is no answer to. It is more embarrassing to ask a bad question than give a bad answer. (several) yes, that's true!*
> *[34:48] (D) yes and if you teach something that is wrong, if your answers are wrong then there's a bigger responsibility to that.*

The element of competition in terms of voting for 'best quiz question' had no effect on their motivation and the fact that they were not graded seemed only to be a positive motivation:

> *[41:20] (several) yes, it was still motivating [to make the quiz even though we were not graded]*
> *[41:25] (Z) I think it was a very good thing that we were not graded... [41:40] (D/J?) Although I must confess that the total lack of pressure sometimes made me forget to finish the quiz...*

The students' own perception of deep learning through the reflection quiz is further supported by their summative results; as shown in Illustration 25.2 all students obtained more than 50% correct answers when taking the quiz.

A template for constructive alignment

The idea was to do constructive alignment for a single lecture in order to clarify the learning objectives both for teacher and students in a simple tem-

plate format: A few clear intended learning objectives for a single lecture was defined and posted openly before the lecture in quiz question format, the TLAs during the lecture ('summeøvelse' and dialogue) were aligned to the ILOs and finally the ILOs were tested as a quiz in the end of the lecture. In order to see whether the students would be motivated to seek information on their own prior to the lecture from the keywords in the ILOs no homework was specified. This experiment did not turn out very successfully as the following conversation shows:

> *[47:50] (T) yeah we got these handouts (the 2 pdf pages previously referred to) so I looked that up, what we will do and so on but nothing really specific like going though the textbook*
> *[48:20] (F) I looked in the internet because I couldn't remember which instrument was what (Morpheus and RITA). But I didn't find out when looking at the internet I only found out on the trip.*
> *[48:35] (J) I remember having read something about the materials...*
> *[48.55] (F) I'm not sure which ones were the learning goals, were they the ones just on a regular Absalon page?*
> *[49:10] Yes, did you take a look at them before you came for the lecture?*
> *[49:15] (Several) No*
> *[49:25] In my lecture I showed you the learning goals as the first slide – do you remember that?*
> *[49:29] (several) yes ...*
> *[49:35] Did you try to keep it in mind during the lecture?*
> *[49:50] (several) I don't remember/ I wasn't at the lecture...*
> *[54:15] (D) yes but it was so short that it didn't stick in my mind, maybe I just over-listened it but it just seemed really brief to me*

Since the results of the constructive alignment quiz showed that many of the students did not achieve the ILOs I decided to do a follow-up lecture where the students were specifically told to go through the handouts and note down any questions they might have. The lecture was very dialogue-based. The students found that lecture particularly useful

> *[51:58] (T) But the lecture was useful though, the last one before going to PSI*
> *[52:00] (several) I agree with T...*
> *[53:00] (J) I did try to read the information sheets rapidly and during the lecture I tried to remember what I had read and I remember*

you asked us a lot of questions so the lecture was very interactive that way.

Conclusion and outlook

Overall the student participation in the quizzes was very high even though the quiz results were not part of the formal assessment and grading of the student, contrary to experiences in our University pedagogics pre-project which also implemented quizzes (Holst et al. 2014).

The first two experiments were very successful in achieving the objectives:

1. To help the students with deeper learning of bulk material as well as getting familiar with the tools and doing calculations already from the start of the course and to
2. keep that deep learning involvement in terms of reflection of the following chapters.

The students were very satisfied with the learning outcomes of making quizzes themselves (the reflection quiz) so much that they would like to do it in more topics but maybe in shorter formats and probably the correct answers should be checked by the teacher before the quiz is taken by the students. The high learning outcomes of this type of quiz is supported in the theory of visible learning (Hattie 2009) in which self-verbalisation/questioning is highly influential on the student achievement.

Another important influential factor on student achievement in visible learning theory is teacher clarity which was the focus in the constructive alignment template quiz. Surprisingly, this experiment was not a success with the students but it seems the failure was mostly due to (intentional by experiment) lack of specified homework. I do however think it was a success with me as a teacher in order to focus my lecture as well as plan TLAs and making the TLOs easily accessible to the other teachers in the course. I would like to try a similar experiment again next year with a little more guidance for the students towards where information for preparation of the lecture could be found. Furthermore the phrasing of the ILOs should be more specific in terms of how the students are supposed to achieve each ILO. A couple of examples could be ’describe the main physical characteristics of the samples’ or maybe aim for a higher taxonomy level (Biggs &

Tang 2011) in e.g. 'compare/contrast what you will measure at the diffractometer Morpheus and the triple-axis spectrometer RITA-II'.

One obvious point for improvement in all quizzes which many of the students wanted is to make sure the students are able answer each question separately several times if they fail the first attempt instead of having to take the full quiz again. This functionality did not work in the version of Moodle which was used for the preparation quiz and in Absalon the feature is not implemented at all. A new version of Moodle has been made available after the completion of the experiments in this project and hopefully the repeated single answer functionality will work with an upgrade to this version.

Acknowledgements

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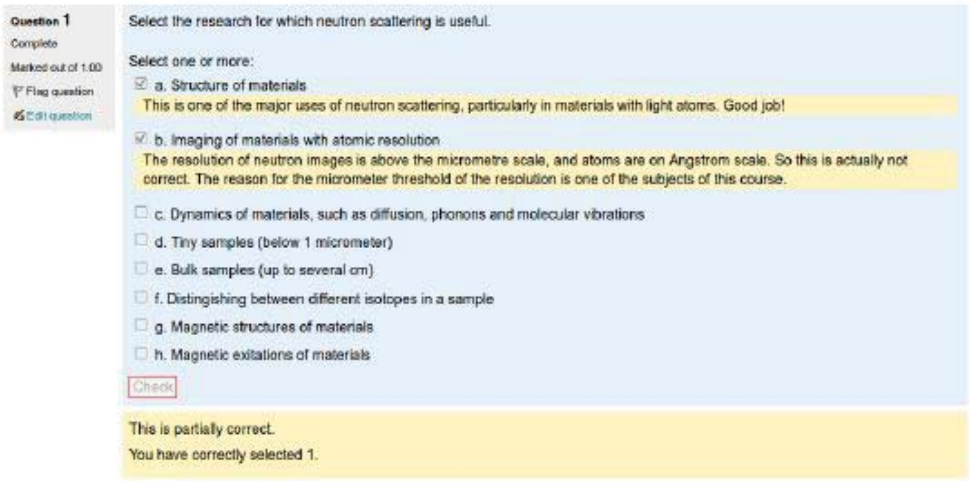
A Quiz questions and feedback



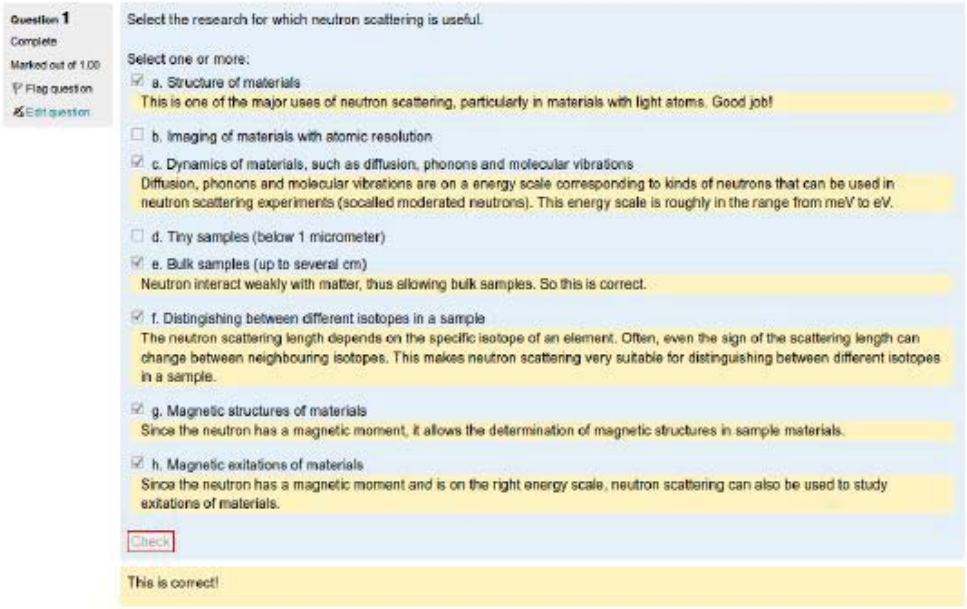


Illustration 4: Part a) of the preparation quiz showing various feedback reply formats after pressing the 'check' button.

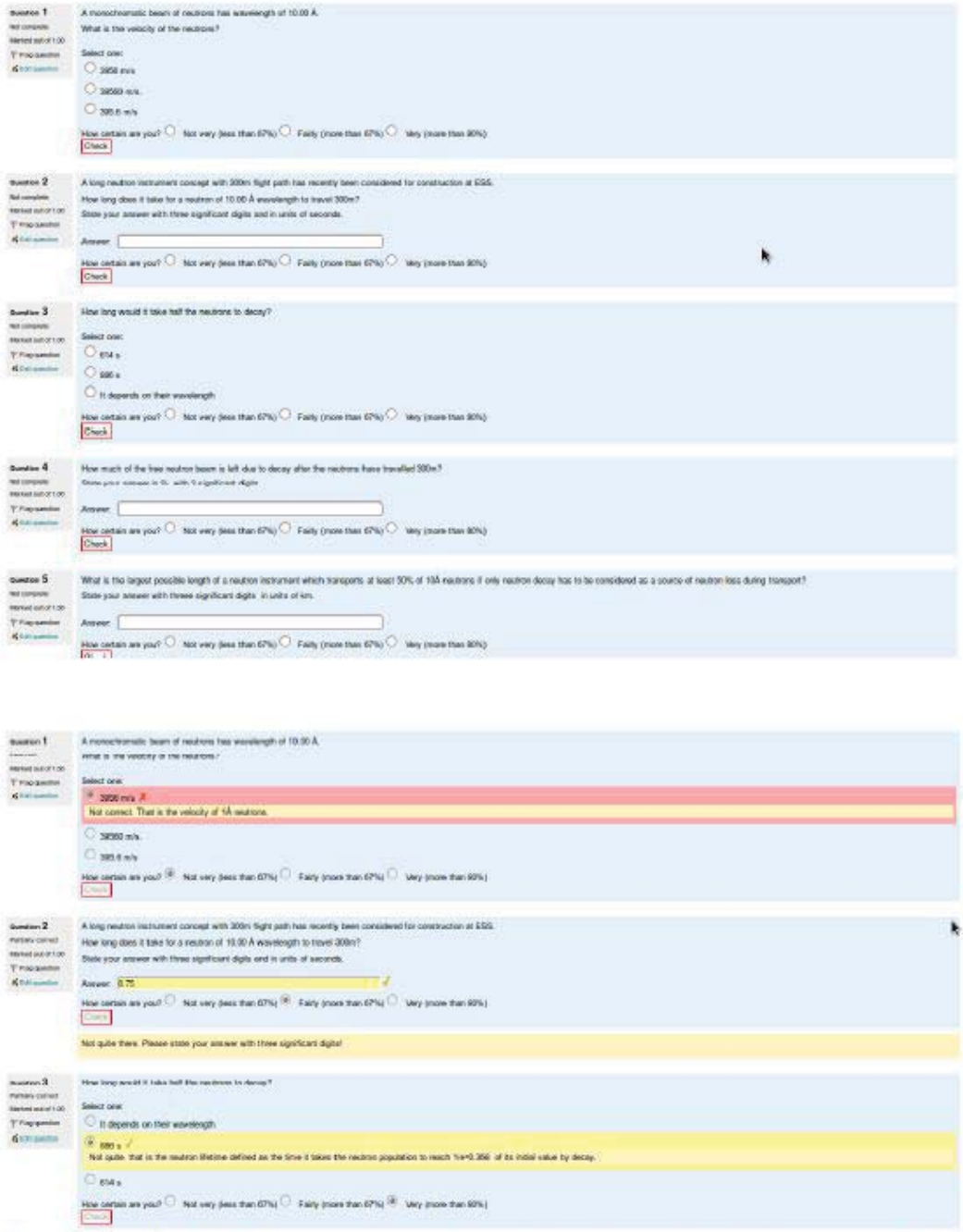


Illustration 5: Part b) of the preparation quiz. The top figure shows all 5 questions in the quiz, the bottom figure shows example response to wrong answers of the three first questions.

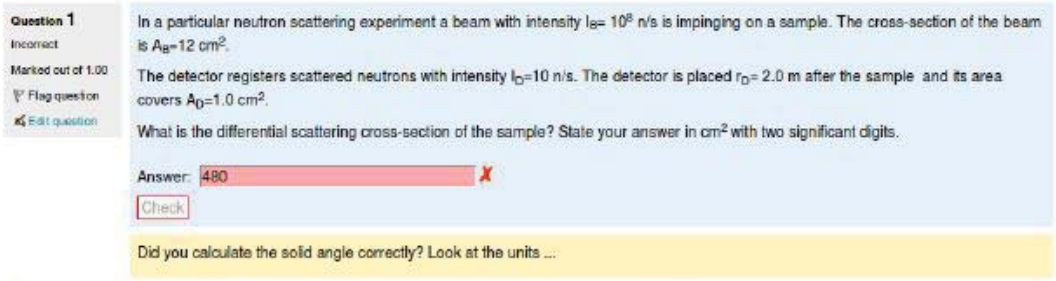


Illustration 6: Part c) of the preparation quiz including feedback to a wrong answer.

B Transcrption of interview

Transcription of focus group interview. In some places the quotes have been shortened and wording slightly changed for comprehensibility. 9 students participated and they have been anonymised here. Emphasised quotes are the interviewer (Linda Udby).

[0:10] In which ways has this course been different than other courses
[0:17] (A) All kind of ways
[0:20] (K)The trip to PSI, to visit another institute to see what they do in real life
[1:00] (Z) the simulations were great, the fact that we were simulating the same thing as in the experiments was very helpful
[1:10] (J) I must say there was a huge effort on your part so that we really learned, it was a very complete course due to the variation of the activities. In my home university I've never been in a course were we received so much attention, there were always several people making sure that we were learning and I found that absolutely outstanding.
[2:00] Which kind of activities are you referring to?
[2:04] (J) When I registered for this course I was nervous about the schedule, since I'm not used to classes that last all day long. And I was worried that it would be boring doing the same topic en entire day. But it ended up being the total opposite due to the variation of teaching methods during class, lectures, simulations and quizzes. So I ended up really enjoying it and it was not a burden at all to be here all day long (almost everyone agrees)
[2:54] (JN?) sometimes it can be too varied so each subtopic is too brief. This was especially the case for crystallography, I don't think I will recognize a lot from that part in a year, but I'm not exactly sure why. Maybe I would have preferred a smaller curriculum in that part and then having more activities and going into depth with that part.
[4:00] (Z) For me it was actually interesting to see many different topics as long as I'm not specialising in any of them. The only thing I would change in the lectures is to skip the mathematics derivations in the lectures since I don't get anything out of calculations if I don't do them myself. I would prefer them to be on the website instead.
[4:50] (F) I agree, we didn't learn from the calculations that Kim went though which we didn't do ourselves or get to use in practice. That was a waste of time.
[5:20] (K) Kim is actually one of the better lecturers to go through the calculations though in order to make them have sense for the students.
[5:40] (Z) I'm not saying it doesn't make sense to do them but I would prefer to talk about Physics concepts in class instead.
[5:45]You said that you prefer some things to be on the web-page, did you use the WIKI for example?
[5:50] [All nod] We used a mixture between web-page and printed notes.
[6:30] I think the curriculum is OK. One of the things that are different in this course though is the many lecturers and I actually felt happy when it was Linda or Kim giving a lecture because it is difficult to adjust to learning from a lot of different people. And the teachers sometimes have no clue what the other teachers have thought or who we are so both parts waste a lot of time trying to communicate and get to know each other. That has been the only frustrating thing for me in this course.
I know it is a privilege to have the researchers tell us what they do but the course is too short to have so many different lecturers. I would take out a few of them and make sure that the rest were more aware of the red line through the course and the position.
[8:55] Is that a general impression? (about half nod)
[9:00] (Z) For me it actually wasn't like that, I didn't feel that there was a big overlap, and I actually enjoyed a different point of view on the same topic.

[9:22] (A) I had the same feeling (as K)
[9:26] (F?) yeah me too
[9:39] (A) I don't think many of the lectures should be skipped but I missed to have a familiar person here all the time.
[9:50] (K) I think one of the course responsibles should always be present
[10:15] How did you work with the quizzes?
[10:20] (F) In general as you know the feedback didn't work properly but I think it will be a lot better when it does.
[10:40] Did you work alone or in groups with the quizzes?
[10:45] (several) mostly alone
[10:55](A,JN) we did it mostly in groups
[11:00] (T) we tried to do it alone and then if we didn't understand it we could collaborate
[11:10] (J) I think most of them were very well structured except for the one in crystallography ... (?) yeah it was ... (J) that was a waste of time as I think our result showed.
[11:20] Did you try to do any of them home alone or was it always in class?
[11:25] (F) I did some at home
[11:30](Z) If I couldn't be in class the I did some of them at home
[11:50] How did you work with the quizzes? Did you think about it or look it up
[11:55] (E) I couldn't remember all the answers sometimes I had to go back and look in the material
[12:00](D?) I looked everywhere, even google [laughter]
[12:11] (K) It is very nice that you have the WIKI pages right next to the quizzes in the browser, especially when you sit in class and maybe don't have so much space. It is also easier to search in the WIKI text than in the printed notes.
[12:50] (F) I mostly used the notes because sometimes the math typesetting in the WIKI was too slow, but it might just be my Linux system. (?) What? (D?) mine was also slow but my computer is also tiny. (K) there was no problems on my MAC.
[13:40] Do you think that it is in general easier to search for a particular concept when you are solving a quiz in the WIKI page than in the notes (most agree)
[14:00] (Z) I think it is nice but I'm used to just work with any material I have including my own notes.
[14:20] (D?) I find it quite useful. I don't like reading a lot on the computer screen but when you just have to search for something it is really useful.
[14:30] I think is was really useful that you also had access to the simulation projects on the WIKI, that was another tool which should be used for solving the quizzes. I used the Wiki a lot.

[15:00] I would like to ask you some specific questions about the quizzes. So in order to refresh you memories I will just show you which ones I'm talking about
[15:19] (K) I've memorised all of them ha ha ...
[15:30] For the first week you did three different quizzes as preparation. The first quiz was just a short one asking you what neutron scattering can be used for, the second one was longer and you had to do calculations,and the third one was a single question but a little more complex in terms of understanding the answer. (showing each quiz as they are explained). Did you actually do the quizzes as preparation?
[16:20] (most people nodding or saying yes)
[16:25] So how so you normally prepare for the first lesson of a course lesson?
[16:30] (Z) I check the weeklies
[16:40] (K) ... but sometimes they are only uploaded the day before, and then there is too little time to prepare.
[17:20] Did the quizzes make you prepare differently than what you normally do?
[17:25] (J?)yes it did because you have to understand what is written in order to solve the quizzes.

Normally I would just read it through and be done but to do the quizzes you have to revisit the materiel sometimes.
[17:45] How about the rest of you, did you also prepare more deeply than what you would normally do?
[18:00] (A) yes, it is a nice way to make sure you've understood the main parts of the chapters you've read.
[18:10] Did you find the quizzes motivating for you to read beforehand?
[18:15] (K) yes, otherwise you couldn't answer the quizzes
[18:20] Did it actually help you get started or was it just another thing you had to do before turning up for class?
[18:30] (E) most of the time I would anyway be motivated to read in advance in order to understand what's going on in class. But in this course I actually didn't do much reading ... sorry!
[19:05] Don't be sorry I'm glad you are honest about it.
[19: 30] Can you tell me what you liked or disliked about the short versus long quizzes?
[19:48] (several) It's a very long time ago ...
[19:55] The first one was very general - what can you use neutron scattering for.
[19:58] (several) that one was fine ...
[20:00] But did it help you to read the notes or did you just browse for the answer?
[20:08] (F) Well you browse but then you also read to make sure you understand it
[20:15] (K) I read all the material before even seeing the quizzes so they couldn't motivate me but if I know I have to answer questions I would find it motivational. But in general I always prefer to read beforehand, but life is not always turning out that way.
[21:16] How about the rest of you how do you prefer to prepare?
[21:10] (about half) No ... (about half) yes
[21:30] (E) I read the notes beforehand and when I do the quiz I then go back to the point
[21:40] Do you have any preference to the length of the quiz? The single question ones versus the longer ones including calculations?
[22:05] (D) I like the ones that make you think. (several) yeah ...
[22:15] (Z) I like the shorter questions without too much calculations because that's what exercises are for. Quizzes are better for checking the whether I got the point.
[22:35] (J) Yes I'm also thinking that if it's a long quiz that has a lot of questions you can just go and find the answer to type them in without a lot of reflection, but if it's a short question that makes you think the it's better.
[23:00] (K) I think it's a good thing to have a combination like you had in the three quizzes (Z, yes) but you could also merge them into one quiz where you have some thing which are conceptual and some things to calculate. It's good to have calculations as a warm up exercises, because maybe it's been a while since you had a theoretically based course and this is the first course after the summer holiday so maybe it's been a long time since you did calculations, so it's maybe a good thing to force yourself to get in the 'zone' again before you sit there with everyone in class and you risk that things go over your head.
[23:46] Did you feel that any of these quizzes was a warm up exercises and which one?
[24:10] (K) yes the ones where you had to calculate length of the guide and use table 1.1. It's a useful way to get familiar with the tools of the course.
[24:29] Is this kind of warm-up useful to some other of you?
[24:30] (several) yes, yeah
[24:35] You said that the useful quizzes are the ones that make you think. Do you remember if any of these quizzes made you think?
[24:40] (F) Something with the flux
[24:48] The one about the differential cross-section?
[24:52] (F) yes that one because I didn't know what that was before I read the quiz so I spend a very

long time on it because it was a very small section of the notes.
[25:10] Did you read the full chapter 2 or just that section?
[25:15] (F) I read what I was supposed to read but I don't know which part it was in. I think you shouldn't be afraid to give more material – I would like that.
[25:35] (K) I also think that one was good because you learned to translate what was in the notes from something theoretical to something experimental related.
[26:00] Do you think this particular question which is quite conceptual was too hard to have before the lesson?
[26:20] (F) No that was fine ...
[26:30] (K) If I recall it correctly you had all the information you needed to plug into the equation, but the hard thing is to understand what is what in this text of informations. It was not too hard but I had to think about a little and read the text and figure out what referred to which symbol and so on.

[27:10] The next quiz I'd like to discuss is the reflection quiz that you did yourselves – do you rember that one? (explaining the process in class and showing the quiz on the computer-screen, and people nodding familiarly).
[27:50] How did you feel about posing your questions openly in class?
[27:55] (F) I didn't mind ... (several) no, that was fine
[28:10] (J) And we weren't saying particularly 'I didn't understand that' which could be embarrassing, we just put up this piece of paper. So it feels a bit anonymous (several agreeing)
[28:35] Did you work differently with the chapters 3 & 4 which you used as a basis for the reflection quiz?
[28:50] (J) I remember that the question I had was particularly difficult and I don't know if I was the right person to answer that or making a question out of it because I wasn't sure of my understanding so maybe I looked in that part of the notes in more detail.
[28:05] Did you pick your own question?
[29:10] (J) No I picked someone else's question
[29:15] What made you pick this question?
[29:20] (J) I think it was the last one left, ha ha
[29:25] (A) But I think you have a bigger responsibility when you have to make the question ...
[29:30] (J) Yes of course that made me work with that part of the notes in greater detail
[29:40] (F) I took the one with least amount of work in it because we got in on one day and had to submit it next day and since I had to work that evening I was quite stressed about it. So I had pick a short one, maybe if you give one more day or something ...
[30:25] (T?) yeah I didn't know how to formulate the question or to make it a good one so I just ended up making an easy one that I don't think helped anybody at all because it was just so easy
[30:38] (A) I felt the same ...
[30:40] So it sounds like formulating the question was a bit difficult?
[30:50] (Z) Yes but it was so useful because the I spend more time making the question than I else would have so I think that asking questions on our own is very useful for understanding.
[31:00] I made a walk-through of the different possibilities for answer-types you have in Absalon. Was that helpful or did you already know this in advance?
[31:20] (Z) Yes it was helpful
[31:25] (J) I didn't know there were so many different ways that allows you to be creative in your formulation of the question
[31:50] (Z) yes but I don't like long answers because I'm not sure if anybody are reading them., I would rather like to put in a number and check whether it is correct. From my point of view formulating the long answers are stressful to formulate and not so useful.
[32:30] Do you think that it is a general thing that you work deeper or differently with the topic when formulating questions on your own?

[32:35] (several nodding or saying yeah)
[32:44] What did you do that was different when making your question?
[33:00] (J) You feel that you fully have to understand it and therefore go deeper into it. (several 'yeah')
[33:08] (Z) If you are answering a question you are just searching for one particular information but if you are creating a question you need to first understand everything, then select something good and even double-check it makes sense.
[33:37] How about the voting on the best quiz questions? Was that motivating?
[33:44] (several) No, not at all
[34:00] What was then motivating for you?
[34:20] (A) It is embarrassing to ask a question there is no answer to. It is more embarrassing to ask a bad question than give a bad answer. (several) yes, that true1
[34:30] So do you feel responsible for the other students?
[34:40] (A) yes because then I spend their time
[34:48] (D) yes and if you teach something that is wrong, if your answers are wrong then there's a bigger responsibility to that
[35:00] Do you think it would be a good idea to make this kind of reflection quiz in more topics during the course?
[35:04] Mmmh (several nodding)
[35:10] (F?) But then you should keep it short, so that we didn't have to solve questions from all the students because some of the questions took a long time. Especially if you have to answer it twice ...
[35:50] Oh yes there was a technical issue so you had to type it in again ...
[35:55] (F) yes and I didn't write my answers down
[36:13] (J) you should also make sure there are no wrong answers in the quiz before you send it out
[36:30](F) I also had a problem to insert an equation, it though it was a virus so maybe you could check that ...
[36:55] How long did you use to solve the quiz?
[37:00] (F) Between one or two hours I think
[37:10] When you posed your questions did you think about that it should not take more than 5 mins to answer?
[37:13] (D) yes but when there is 17 it takes 1-2 hours to answer
[37:15] there were just 14 ...
[37:23] (F) OK but some took more than 5 mins to answer
[37:25] (?) but some also less, maybe like 20 sek...
[37:40] (A) But I think the main problem is what J said, first you have to spend one hour to make the question, then another on doing the quiz, then another hour in class on feedback so we end up spending a lot of time on it.
[37:50] Was the walk-though useful at all?
[37:55] (A) I don't think so ... That's a general thing about the quiz walk-throughs I think we spend too much. I prefer if 2-3 questions with a general trend in wrong answers are taken out and walked through.
[38:28] (F) I agree
[38:30] (J)Yeah I agree, I got the feeling that some of the questions we walked through were answered correctly by almost everyone. Of course I couldn't see the answers but I though like 'most people can answer this question'
[39:00] Well as you say you didn't see the answers ...
[39:05](laughter)
[39:10] ... but it is definitely a good point
[39:20] (Z)I was surprised that there was no time limit in the quizzes, it could be important to know whether we could solve a simple question in three minutes or twenty minutes. Maybe that's way to

make it shorter and more effective.
[39:50] (T) I wouldn't put a time limit (several) No...
[40:00] (D) It makes it really stressful you cannot concentrate at all
[40:10] (Z) I agree with that in relation to exercises, it was very nice that we could you as much time as we wanted but when we are talking simple questions i would put a time limit just to make it shorter
[40:40] (D) that was one of the great thing about the quizzes, that there was no grading, no timelimit,no stress at all ...
[40:45] (Z) But I felt stress with the quizzes (several laughing), if it was over after one hour I wouldn't have to think more about it ...
[41:15] So you think it was worthwhile doing the quizzes even though you would not be graded?
[41:20] (several) yes, it was still motivating
[41:25] (Z) I think it was a very good thing that we were not graded ...
[41:40] (D/J?) Although I must confess that the total lack of pressure sometimes made me forget to finish the quiz ...
[41:50] Was it motivational for you if I sent out a reminder?
[41:55] (several) yes of course ...
[42:00] (D/J?) yes but sometimes I just forgot about it, it was not because i didn't want to do it. Maybe there should be a due date, three days should be more than enough
[42:35] (Z) But I would prefer to have deadlines related to our schedule, maybe the day before the lecture ...
[42:55] Do you prefer to have the deadlines before or after the weekend?
[43:00] (a few) after the weekend ...
[43:10] (F) It depends on the simulation projects. If you put the deadline on the same day I wouldn't do the quiz but just the project so you should put some time in between.
[43:25] So you would in general do the mandatory things for the course first?
[43:30] Yes if then I didn't finish the simulation project I would just continue working on that and never get to the quiz.

[43:50] OK, then talking about quizzes with timelimit, there was actually one quiz with a time limit and that was the last one (showing). This one had something to do with the learning goals. Do you remember that? (they don't seem to remember). Just before we went to PSI I was giving a lecture and in that lecture there were some learning goals
[44:22] (several) Ah yeah ...
[44:27] You might not have thought of it as a quiz but it actually was
[44.29] (several) Oh ! On Absalon... we had like 10 mins after the lecture to finish it
[45:15] I posted the learning goals on Absalon before giving the lecture and these learning goals also figured in the beginning of the lecture and then in the end they were posted as a quiz that you had to answer before leaving class. I would like to ask you how you prepared for this lecture?
[45:48] (F) I'm not sure I found the material for preparation ... Well we had these 2-3 pdf pages that we had available prior to the lecture but if you posted something else I didn't see it. so I only read those and I didn't quite understand them because they were too short to understand for a person not knowing anything about RITA and Morpheus ...
[46:20] (T) I read those two things as well ...
[46:28] Did you recognise any keywords in the formulation of the learning goals?
[46:45] (Z) Hmm .. try again?
[46:50] OK, I'll try to read them aloud. The first one was 'what is the characteristics of the samples you will study at PSI?'. And the second is 'what has previously been find' ...
My question is whether you recognised any keywords in those learning goals that you actually looked up in advance in order to prepare for the lecture.

[47:20] (F) Recognise keyword compared to what? Compared to the articles?
[47:30] Some words in the learning goals that you might recognise or maybe want to look up?
[47:40] (D) Like 'What is a triple axis spectrometer' ?
[47:44] Yes did you look that up for example?
[47:50] (T) yeah we got these handouts (the 2 pdf pages previously referred to) so I looked that up, what we will do and so on but nothing really specific like going though the textbook
[48:20] (F) I looked in the internet because I couldn't remember which instrument was what (Morpheus and RITA). But I didn't find out when looking at the internet I only found out on the trip.
[48:35] (J) I remember having read something about the materials...
[48.55] (F) I'm not sure which ones were the learning goals, were they the ones just on a regular Absalon page?
[49:10] Yes, did you take a look at them before you came for the lecture?
[49:15] (Several) No
[49:25] in my lecture I showed you the learning goals as the first slide – do you remember that?
[49:29] (several) yes ...
[49:35] Did you try to keep it in mind during the lecture?
[49:50] (several) I don't remember/ I wasn't at the lecture ...
[50.00] (F) I think I didn't know much about the experiments so in the lecture I had a hard time relating to that stuff. Maybe we hadn't started the RITA simulations at that point?
[50:30] I was trying to just understand what we would do at PSI at all, because I couldn't distinguish between what we would do at RITA and Morpheus. So the goals for me were not clear at all...
[51:10] During the lecture or?
[51:20] (D) Well I got the basic idea but I wouldn't be able to do the experiment, it wasn't clear
[51:31] (E) well the goals in the material was not so clear
[51:35] (D) It wasn't helpful to me at all these handouts. I got to see how the sample was connect, I could imagine that, but that was all
[51:45] (A) Before I went to PSI I couldn't understand the handouts at all, but then the second day down there when we started and I read it again a lot of stuff made sense. But I don't know if it is possible to give you a feeling in advance of what it will be like ...
[51:58] (T) But the lecture was useful though, the last one before going to PSI
[52:00] (several) I agree with T ..
[52:10] So having a dialogue about the handouts was useful?
[52:23] (several) yeah ...
[52:35] (D) I do think it is important to make an introduction before you go to PSI though even if it doesn't answer all your questions
[53:50] Did you feel that you worked actively with you own knowledge during the lecture?
[53:00] (J) I did try to read the information sheets rapidly and during the lecture I tried to remember what I had read and I remember you asked us a lot of questions so the lecture was very interactive that way.
[53:30] (D) For me personally it would very quick, there was doping and this and that ... I would like to start more slowly and the accelerate
[53:40] Are you talking about the first or second lecture?
[53:42] (D) The second lecture where you introduced RITA and Morpheus, and then we would measure doping and magnetic structure ...
[54:10] In the first lecture we talked about what we were going to use RITA and Morpheus for, do you remember that?
[54:15] (D) yes but it was so short that it didn't stick in my mind, maybe I just over-listened it but it just seemed really brief to me
[54:25] Do the rest of you feel the same way?
[54:30] (?) I don't remember ...

[54:40] (T?) When I went to PSI I knew which experiments we would do at least that was clear
[54:50] (J) I think what happened was that my simulation group was lacking a bit behind in the end so all other thing were a bit too quick.
[55:15] (Z) yes it would be very nice if we could first finish all the other work first and the just focus on what we were going to do at PSI.
[55:45] (T?)Yes if felt a bit rushed in the end ...
[56:00] is that a general thing that you would like to spend more time talking about PSI?
[56:03] (D)Yes it was too short to become clear
[56:06] (Z) It's hard to say because I cannot not imagine that it is possible to really understand it before you see it.
[56:30] (A) I think in general we were well prepared to pick up stuff quickly at PSI
(several) Mmmh. (A) You can only understand it up to a certain point before but for the last understanding you have to be there.
[56:50] What do you think has prepared you well to go there?
[57:00] (several) the simulations. (Z) And also the theory of course, but the simulation when you came there it was just like 'ah now I get it'. Mostly the creation of the simulations, writing the reports was not so crucial for me. (several Mmmh). I would have liked more preparation for processing the data though. I'm not so used to working with Matlab and I had to learn it at PSI so we could have saved the time by preparing in advance.
[57:55] Do you think you could be just as well prepared not writing a report but just playing around with the simulations?
[58:00] (Z) Yes
[58:15] (T) Well I still think there should be some analysis of what we have done. Not that you got the angle or intensities right, but that you really understand what you got, to interpret it. But writing the text, putting the theory etc. I think it's useful but not so much.
[58:54] (Z) well I think if we can answer the questions it could absolutely be enough for me without the reports
[59:00] So would a discussion in class be adequate?
[59:05] (Z) The fact that we wrote the code it makes it quite clear whether we know what we're doing
[59:20] (A) I would keep the first report and disregard the second report. But we should have a discussion about the third report to come to a conclusion.
[59.40] (D) yes the third simulation project was really important for PSI
[59:45] (A).... so if we skipped the second one then maybe we could start earlier on the third project
[1:00:10] (Z) About the the second I think we had very little feedback, I was expecting something that had to do with the understanding but it was just more formal things like not whether there should be space between the number and unit but more like if we could have made more efficient simulation.
[1:01:00] (K) I would maybe leave out the IMRAD method for the reports because you spend a lot of time when you're asked to make a nice report because you don't want to hand in a nice report so you spend a lot of time on making things look nice in LaTeX which I don't learn anything than LaTeX from.
I know how important it is that you can read the labels in scientific papers and stuff like that but I think that maybe that can be left for the last report. I would have learned just as much Physics from just answering the questions. Like handling in a sheet of paper with just 'question number' and the showing the graph from McStas and commenting and making the calculations that are needed to move on. Making comments like 'we see a peak here what does that mean?'. That would put more focus on the Physics part and not so much on the formalism and discussing with your group whether a particular part should go in the discussion, the conclusion or maybe actually in the method ... that's useful if you have to publish a paper, but not for this.

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