Har du forberedt deg til forelesningene?
Did you prepare for the lectures in advance?
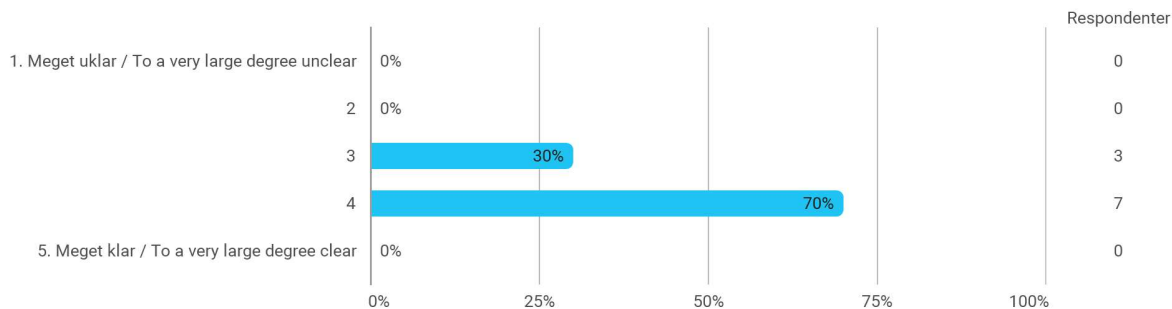
	Respondenter
Nei / No	10% — 1
Sjelden / Seldom	40% — 4
Av og til / Some times	10% — 1
Som regel / Often	20% — 2
Alltid / Always	20% — 2
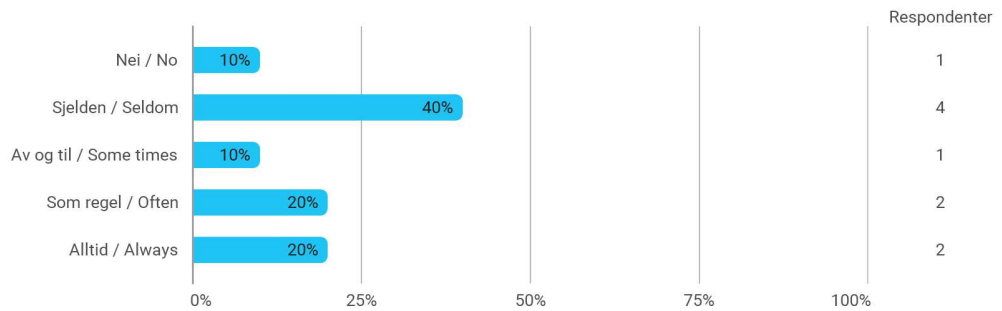
Hvor stor andel av forelesningene har du fulgt?
How many lectures have you attended?

|	Respondenter
Ingen / None	0% — 0
Færre enn 25% / Less than 25 %	0% — 0
25-50%	0% — 0
50-75%	40% — 4
Mer enn 75% / More than 75 %	60% — 6
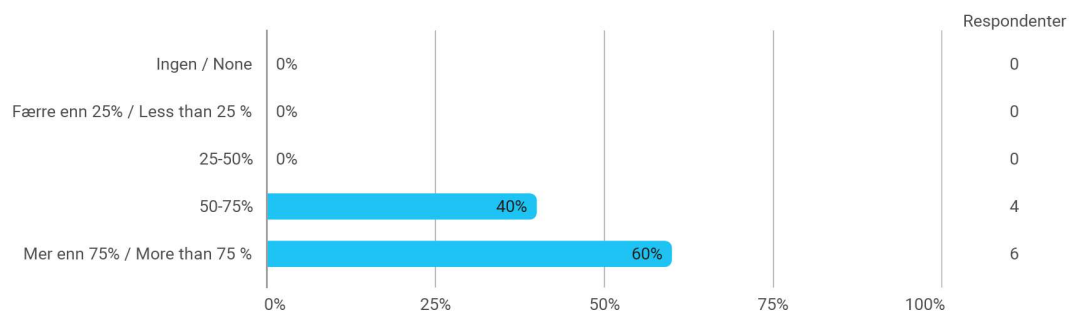
Klarhet i forelesers fremstilling av stoffet. 1 til 5, der 1 er meget uklar og 5 er meget klar.
How clear was the presentation during the lectures? Rate on a scale from 1 (=very unclear) and 5 (=very clear)

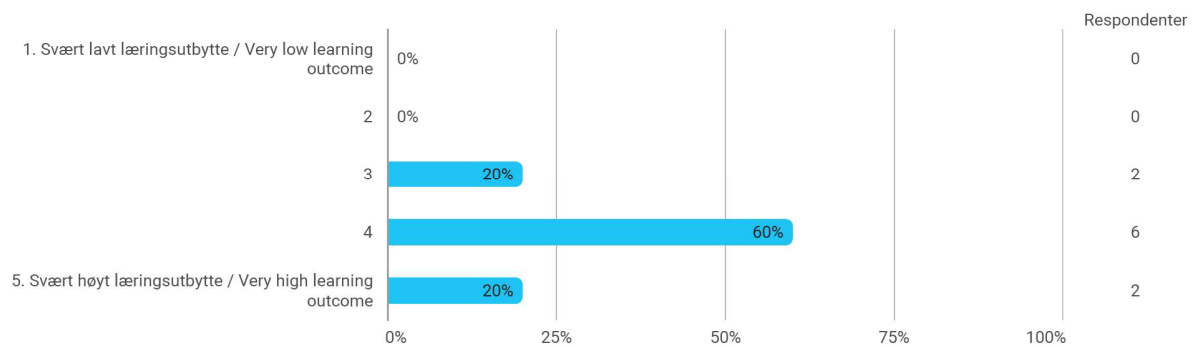|	%	Respondenter
1. Meget uklar / To a very large degree unclear	0%	0
2	0%	0
3	30%	3
4	70%	7
5. Meget klar / To a very large degree clear	0%	0

Hvordan var læringsutbyttet av forelesningene der utelukkende tavle ble brukt? 1 til 5, der 1 er svært lavt læringsutbytte og 5 er svært høyt læringsutbytte.
How do you rate the learning outcome from the lectures, when using blackboard only? Rate from 1 to 5, where 1 is very low learning outcome and 5 is very high learning outcome

|	%	Respondenter
1. Svært lavt læringsutbytte / Very low learning outcome	0%	0
2	0%	0
3	30%	3
4	50%	5
5. Svært høyt læringsutbytte / Very high learning outcome	20%	2
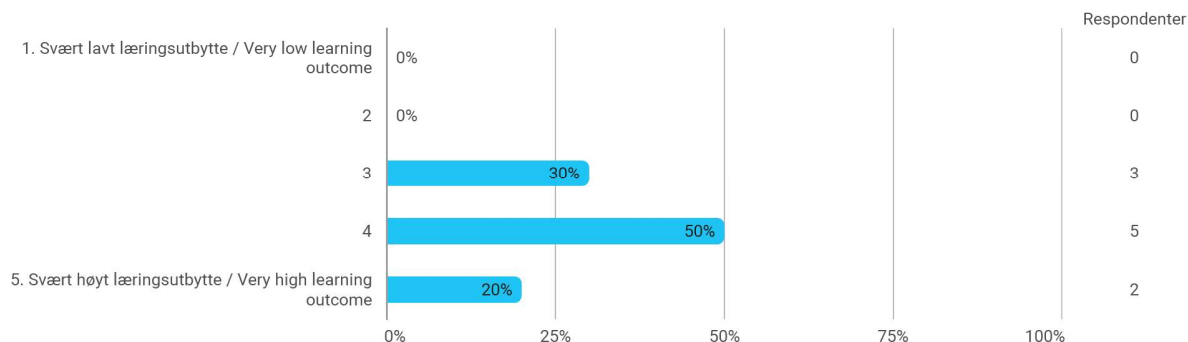
Hvordan var læringsutbyttet av forelesningene der både tavle og slides ble brukt? 1 til 5, der 1 er svært lavt læringsutbytte og 5 er svært høyt læringsutbytte.
How do you rate the learning outcome from the lectures, when using both slides and blackboard? Rate from 1 to 5, where 1 is very low learing outcome and 5 is very high learning outcome

|		Respondenter
1. Svært lavt læringsutbytte / Very low learning outcome	0%	0
2	0%	0
3	20%	2
4	60%	6
5. Svært høyt læringsutbytte / Very high learning outcome	20%	2

Hva synes du om bruk av tavle som hjelpemiddel i dette emnet? 1 til 5, der 1 er "Fungerer meget dårlig" og 5 er "Fungerer meget godt".
What do you think of the use of the blackboard only in KJEM221? Rate from 1 to 5, where 1 is very bad and 5 is very good.

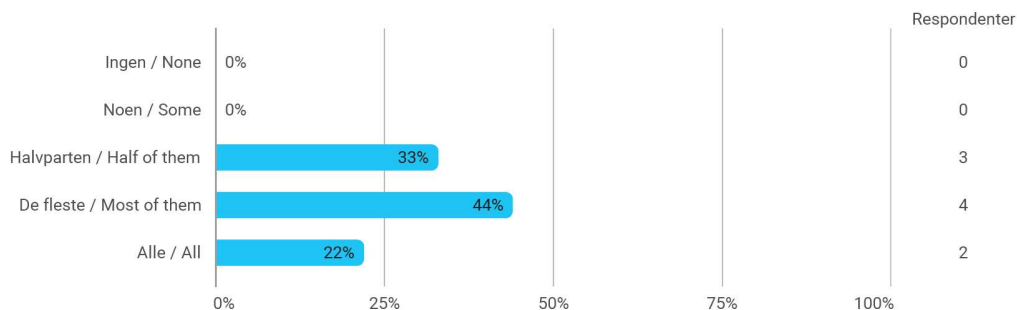|		Respondenter
1. Fungerer meget dårlig / Very bad	0%	0
2	0%	0
3	20%	2
4	50%	5
5. Fungerer meget godt / Very good	30%	3
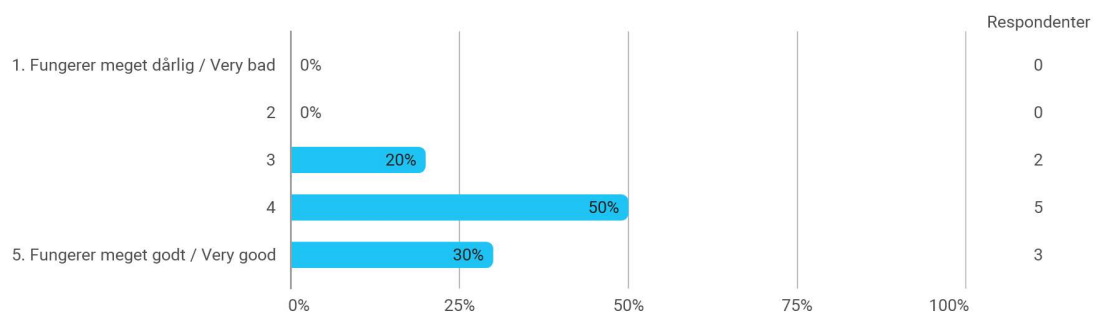
Hva synes du om bruk av tavle og slides som hjelpemiddel i dette emnet?
1 til 5, der 1 er "Fungerer meget dårlig" og 5 er "Fungerer meget godt".
What do you think of the use of the blackboard and the sildes in KJEM221?
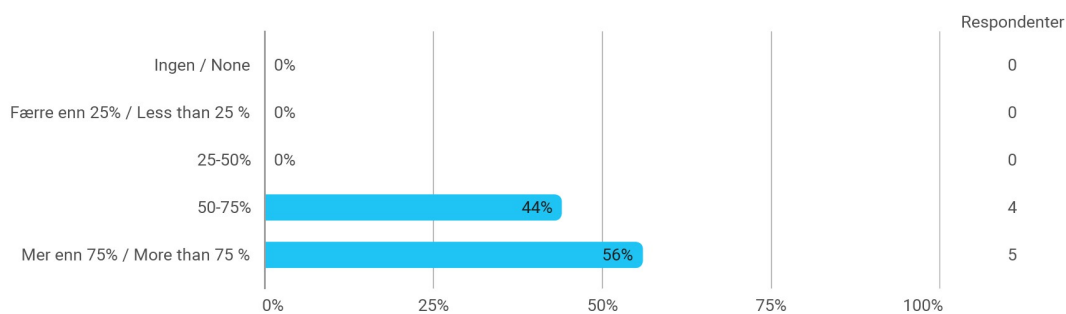Rate from 1 to 5, where 1 is very bad and 5 is very good.

		Respondenter
1. Fungerer meget dårlig / Very bad	0%	0
2	10%	1
3	10%	1
4	70%	7
5. Fungerer meget godt / Very good	10%	1
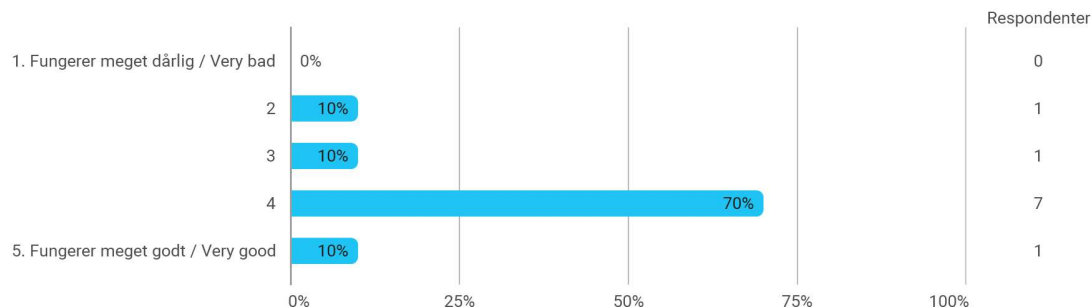
Hvor stor andel av regneoppgavene (kollokvieoppgavene) har du gått gjennom på egenhånd?
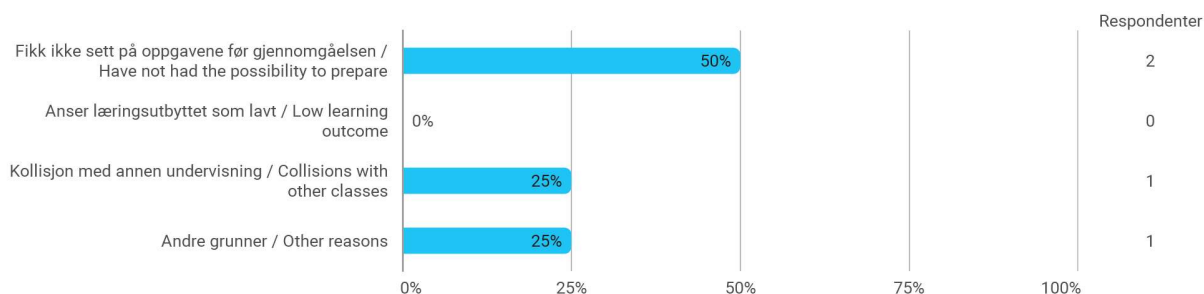How many of the exercises have you done by yourself?

		Respondenter
Ingen / None	0%	0
Noen / Some	0%	0
Halvparten / Half of them	33%	3
De fleste / Most of them	44%	4
Alle / All	22%	2

Hvor stor andel av regneøvelsene (kollokviene) har du deltatt i?
How many of the colloquia have you attended?

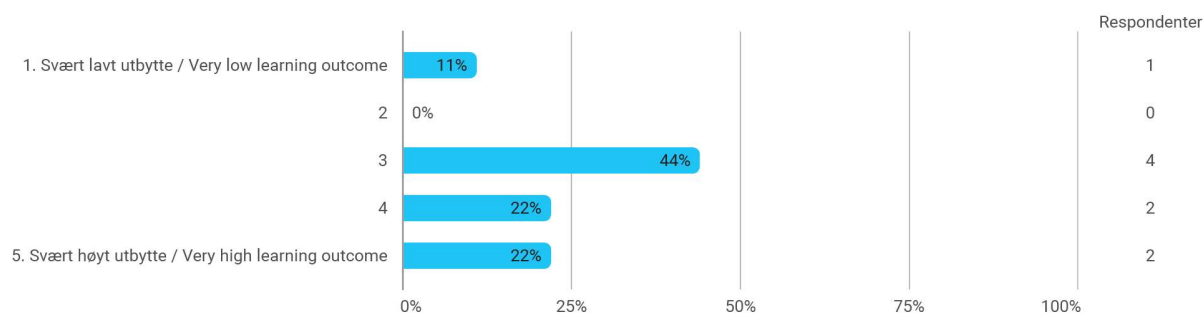|		Respondenter
Ingen / None	0%	0
Færre enn 25% / Less than 25 %	0%	0
25-50%	0%	0
50-75%	44%	4
Mer enn 75% / More than 75 %	56%	5

Hva var hovedårsaken til at du ikke deltok på (flere) regneøvelser (kollokvier)?
What is the main reason for not attending more colloquia?

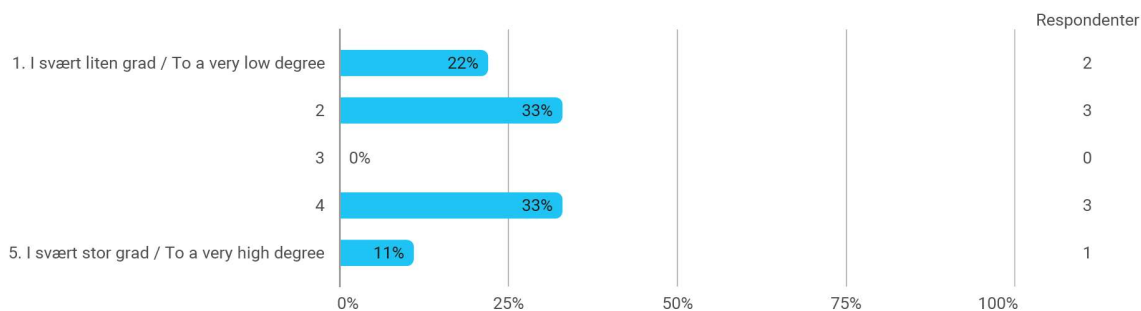|	Respondenter
Fikk ikke sett på oppgavene før gjennomgåelsen / Have not had the possibility to prepare — 50%	2
Anser læringsutbyttet som lavt / Low learning outcome — 0%	0
Kollisjon med annen undervisning / Collisions with other classes — 25%	1
Andre grunner / Other reasons — 25%	1

Hvordan har læringsutbyttet av regneøvelsene (kollokviene) vært? 1 til 5, der 1 er svært lavt og 5 er svært høyt læringsutbytte.
How do you rate the learning outcome from the colloquia? Rate from 1 to 5, where 1 is very low learing outcome and 5 is very high learning outcome

|	Respondenter
1. Svært lavt utbytte / Very low learning outcome — 11%	1
2 — 0%	0
3 — 44%	4
4 — 22%	2
5. Svært høyt utbytte / Very high learning outcome — 22%	2

I hvor stor grad lærte du av andre studenter som deltok i regneøvelsene (kollokviene)?
To what degree did you learn from other students that participated in the colloquia?

|	Respondenter
1. I svært liten grad / To a very low degree — 22%	2
2 — 33%	3
3 — 0%	0
4 — 33%	3
5. I svært stor grad / To a very high degree — 11%	1

Vi har hatt obligatorisk besvarelse av minst 6 kollokvieoppgavesett i løpet av kurset. Er et slikt obligatorisk element nyttig for læreprosessen?
The hand ins of a minimum of 6 colloquia exercises was mandatory throughout the course. Is this kind of mandatory component constructive for the learning process?

|		Respondenter
Ja / Yes	78%	7
Nei / No	0%	0
Vet ikke / I do not know	22%	2
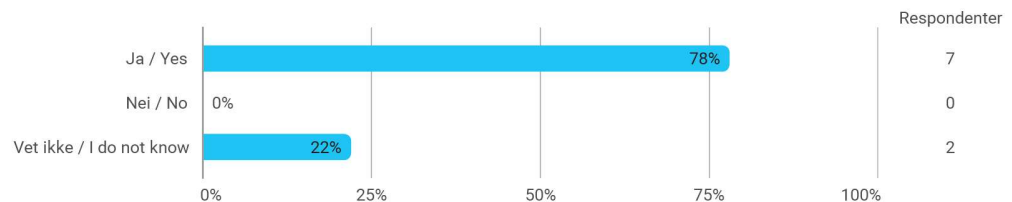
Hva syns du om læreboka? 1 til 5, der 1 er svært dårlig og 5 er svært god.
What is your opinion of the textbook? Rate from 1 to 5, where 1 is very bad and 5 is very good.

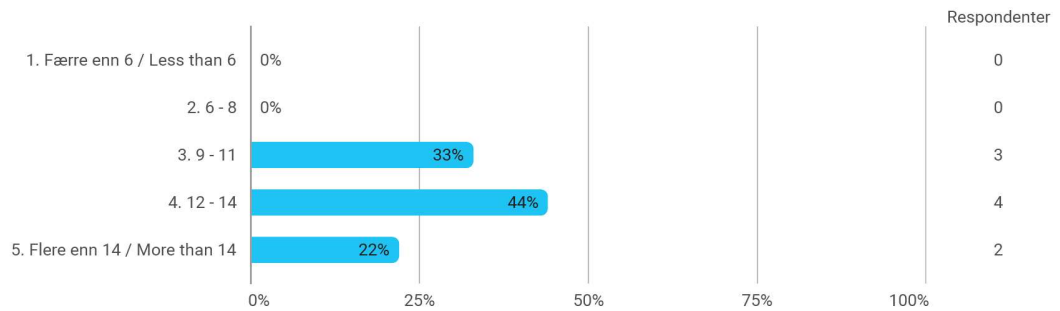|		Respondenter
1. Svært dårlig / Very bad	11%	1
2	22%	2
3	67%	6
4	0%	0
5. Svært god / Very good	0%	0
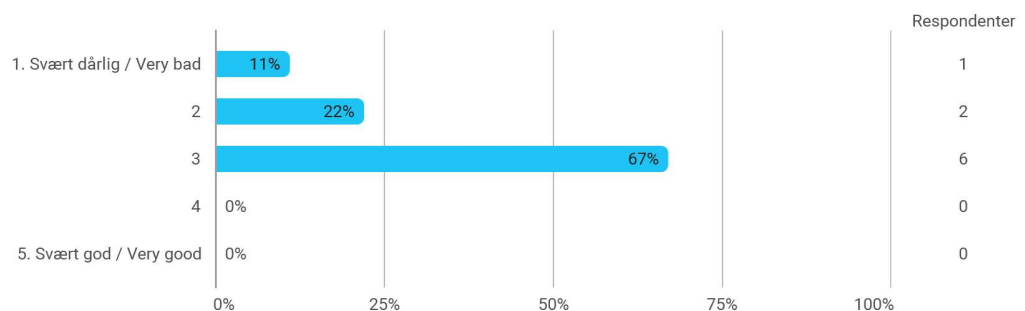
Hvordan har kontakten med foreleser vært? 1 til 5, der 1 er svært dårlig kontakt og 5 er svært god kontakt.
How has the contact with the teaching staff been? Rate from 1 to 5, where 1 is very bad and 5 is very good contact.

		Respondenter
1. Svært dårlig / Very bad	11%	1
2	33%	3
3	11%	1
4	33%	3
5. Svært god / Very good	11%	1
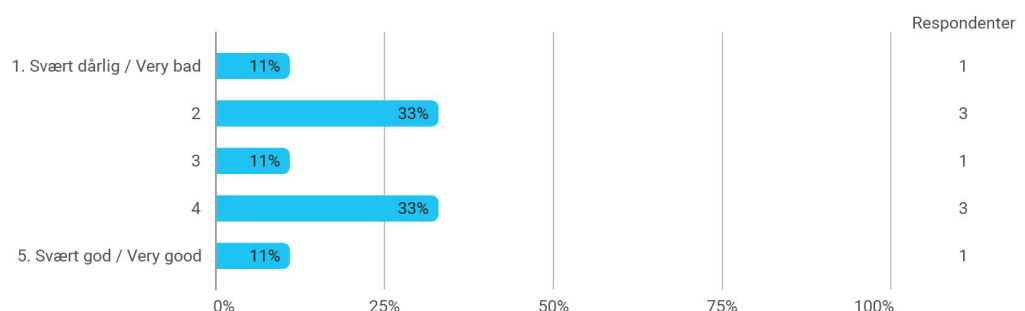
10 studiepoeng skal i snitt tilsvare ca. 13 timer arbeid (organisert undervisning + egenaktivitet) pr. uke. Hvor mange studiepoeng mener du emnet KJEM221 tilsvarer?

How do you rate the work load of this course, given that 10stp corresponds to 13 h work per week?

		Respondenter
1. Færre enn 6 / Less than 6	0%	0
2. 6 - 8	0%	0
3. 9 - 11	33%	3
4. 12 - 14	44%	4
5. Flere enn 14 / More than 14	22%	2

0%　　25%　　50%　　75%　　100%

Evaluation report 2022 autumn term

Course code: KJEM221

Faglærers vurdering av gjennomføring
/lecturer's assessment of implementation:

Praktisk gjennomføring
/practical implementation

The course was taught over 14 weeks, with two 2h lectures and one 2h colloquium per week. In sum there were 29 lectures (weeks 1 and 2 had three lectures, and week 9 had just one lecture), and 12 colloquia (weeks 1 and 2 had no colloquia).

Two lecturers, Markus Miettinen and Parveen Gartan, shared the teaching, with MM teaching the first and PG the second half of the course.

3 of each halfs' 6 colloquia had to be approved in order to write the exam. Following the previous year's example, the submission involved a personal appearance in self-formed groups of 1–5 students (typical group size was 3 students) with a simple oral "defense" of the answers. The "defense" was chiefly aimed at discussing the problems students had encountered in trying to solve the questions, giving them opportunity for close tutoring to clarify anything that they had not understood. In teachers' opinion this did not work very well. It appeared that too many students were just copying example answers from the previous years, not thinking them through on their own, and thus not understanding their logic. As thinking and solving problems on one's own is key to learning QM, a set up to encourage students to work seriously on the assignments should be put in place for 2023.

Strykprosent og frafall
/failure rate and dropout

24 students registered for the course, out of which 19 took the exam (dropout rate: 21%), and 14 passed (failure rate: 26%).

It was clear during the course that the students were struggling with the mathematics necessary to learn quantum mechanics. For example, they were not *a priori* comfortable dealing with such basic concepts as the chain rule and partial integration. Also, they generally lacked any knowledge in linear algebra. It is thus not surprising that students find that they are out of depth on the course. One might consider, if the situation would be improved if MAT121 (Linear algebra) would be required to take KJEM221.

Karakterfordeling
/grade distribution

The average grade was D. The highest grade was C, after adjusting the scale.

Notably, no candidate received more than 50% of points on the exam, which was surprising taking into account that the exam contained several questions taken directly from previous year's exam and the colloquia; this seems to suggest a lack of student motivation that should be addressed in 2023.

Studieinformasjon og dokumentasjon
/information of studies and documentation

Information (e.g., the colloquium assignments and the model answers) was provided through Mitt UiB.

Tilgang til relevant litteratur
/access to relevant literature

The students did not mention that the book would not have been available for buying. However, apparently those who did not wish to buy the book but borrow it from the libraries had difficulties finding the edition (5th) that was used on the course, and the earlier edition (4th) that they did find did not contain all the material that was discussed on the lectures.

Faglærers vurdering av rammevilkårene
/lecturer's assessment of the teaching conditions

Lokaler og undervisningsutstyr
/premises and teaching equipment

The lectures were given in Tripletten and Auditorium 3. These worked fine for the blackboard-only lectures. However, for the lectures on which slides and blackboard were combined, it would be better to have a lecture hall where the canvas for slides does not cover the blackboards; such rooms are for example the A66 Auditorium B, where the colloquia were held, and the Auditorium 4, where a few lectures were moved to.

Andre forhold
/other conditions

Some students were asking if the lectures could be recorded/streamed, but this turned out to be too complicated to organize. As a low-cost alternative, teachers suggested that the in-class students could video (and then share as they wish) the lectures on their phones; however, no students did this.

For the exercises, a single teacher's time is not sufficient to provide student-specific tutoring. This is unfortunate, as the solving and discussing problems is the best way for students to learn QM. This could be alleviated by hiring a teaching assistant or two for 2023.

Faglærers kommentar til student-evalueringen(e)
/lecturer's comments to student evaluation

Metode – gjennomføring
/method – implementation

The standard procedure of student questionnaires was followed, and the lecturers were included in designing the questions.

Oppsummering av innspill
/summary of input

It is worrying that half of the responding students prepared for the lectures seldom or never, even though it was stressed to them that in order to be able to follow effectively, one should at least glance through the material in advance.

It is interesting that 70% of the respondents found the presentation in the lectures to be rather clear (4 in clarity on a scale from 1 to 5 where is 'Clear to a very large degree'), and the remaining 30% found the clarity to be average (3). This positive response does seem to contrast the performance seen in the exam, where some basic concepts (such as reflection of a wave from an infinitely wide wall) seemed alien to all candidates.

There was surprisingly little difference in the responses to students' preference on (1) using just the blackboard or (2) using slides and blackboard on the lectures. The second approach was tried after it appeared during the first lectures that students had hard time following the standard talk-and-chalk derivations on the blackboard—even though these followed the presentation on the book, just calculating explicitly all the steps that were 'jumped over' in the book.

In the method 2, the 'jumped-over parts' were still calculated explicitly on the blackboard, but otherwise the presentation followed explicitly the book, as slides were made by taking pictures from the book's pages. The advantage from the lecturer's perspective was that when his/her back is not towards the audience, he/she can better follow if his message is met with understanding nods or just blank stares. The direct student feedback on the lectures using the method 2 was very positive: Some students even came to tell personally that they really liked this method, and were able to follow better; also, during the couple of hand-raising polls conducted during the lectures the vast majority preferred method 2. To this end it is surprising that the questionnaire respondents seemed to rate the two methods as roughly equal.

The respondents view on their learning outcome from the colloquia is somewhat worrying: Only 44% say that they learned a lot from them. In QM, solving the problems actively should be the main way of learning. Also, there is a bimodal distribution on how the students feel they learned from their peers: Some a lot, some none.

Ev. underveistiltak
/eventual measures under way

It should be considered for 2023, if students' motivation to prepare for the lectures could be raised by the use of pre-lecture quizzes on Canvas, and / or by using clicker polls (e.g., using Kahoot or Poll Everywhere) during the lectures. Rewarding performance in such pre-lecture quizzes and clicker polls with points included in the final exam could markedly raise the motivation to prepare. Furthermore, the quizzes and polls would allow assessing if the students really understand the key concepts, or if they just seem superficially clear to them.

It probably makes sense to extend the use of slides and blackboard on all the lectures in 2023, also because this method will allow the easy integration of clicker polls.

For 2023, measures should be taken such that the majority of students feel that they learned a lot in the colloquia. This probably requires increasing the obligatory aspect of the colloquia, such that using time on them will be more appealing compared to all the other things on students' schedules. Possibilities could be for example grading written responses (this would take considerable time, but possible solutions could be to hire teaching assistant(s), or to randomly choose from each colloquium just one exercise that will be graded; another downside to consider is that there seems to be much solutions in circulation...) or having students to mark the exercises they have done, and then have the instructor select students to present their solutions on the blackboard (points towards the final exam would be given based on the number of marked exercises). It is encouraging that respondents seem to support the above considerations, as they overwhelmingly agree that mandatory exercises were a good thing. While increasing the mandatory aspects, the student–student interaction in learning should also be encouraged.

Faglærers samlede vurdering,
                      inkl. forslag til forbedringstiltak
/lecturer's overall assessment,
                    incuding suggestions for improvement measures

On the whole KJEM221 was carried out satisfacorily in 2022. In 2023, it will be lectured by just one person, which probably will bring more cohesion to the course. Key improvements will be (1) to make sure early on that the students have the minimum necessary mathematics skills to follow the course, and (2) make the students work more on solving problems.

Useful improvements in teaching conditions, discussed in more detail above, would be to include a teaching assistant or two for colloquia, as well as to embrace the use of quizzes and clicker polls for the lectures.