

# Course Analysis EK2380 Medical Sensors 2022

## Author:

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## Course design

EK2380 was given the second time time 2022. We were happy to see that the number of participating students went up to 26 students (compared to eight the first course round). The course consists of 12 lectures, four laborations and a project work. In the course the students meet eight participating teachers with specific expertise related to Medical Sensors. Also, in the laborations and the project work the assistants have specific expertise related to the content.

Prior to the course start, we sent out a form to assess the students background and give specific study material in medicine/biology or measurement technology if the students lack one of these. As course responsible, I continuously discuss with the students about course content to align to the intended learning outcomes.

## Description of the course evaluation process

Evaluation was carried out continually as discussions during the course and as an online form after the course. Unfortunately, we only got 25% of the students to answer the online form. From the few answers we can see that the female students were gave a lower rating of the course. Several Erasmus or other exchange students took the course. After the course, the teacher teams have had discussions about the evaluation and improvements.

## Description of meetings with students

In the course the students meet eight participating teachers with specific expertise, as course examiner I discussed with the student if they could grasp the content of the lectures after the course. It was clear that many students following KTH programs from bachelor level are not used to having a larger literature pool to work with depending on their background. Many students were positive to the study visits and involvement of experts.

## Students' workload

According to the course evaluation 50% of the students spend less than 50% study time for the course. From other answers it seems clear that the students did not spend the suggested time on studying the supplied literature.

## Students' results on the course

95% students passed the course, the grades were distributed from A to E.

## Students' answers to open questions

What does students say in response to the open questions?

What was the best aspect of the course?

*The labs and the study visits were a definite highlight. Personally, practical learning methods are the best way to learn. The study visits also gave a very tangible application of what this course goes through.*

*bringing professionals from each subject and the study visits really helps to understand the applications of the theory studied*

*That we got a broad overview of what the market looks like as we had different lecturers and guest lecturers from both companies and hospitals. I like that there was a lot of focus on what we can do to improve the market and that we were challenged to come up with new innovations ourselves.*

What advice would you like to give to future participants?

*Brush up on your chemistry, there is a surprising amount of chemistry involved in this course.*

*Keep track of the reading material since the beginning of the course*

*Anna is cool and well-organised, don't hesitate to ask her questions. Start to study from day*

### **Summary of students' opinions**

This year the students gave the course varying grades. Still in discussions with students during the course, I got very good feedback. Some lectures needed more depth others less, overall, the students appreciated the different lecturers and laboratory exercises. The project was less appreciated as well as mandatory attendance. Details are appended.

### **Overall impression**

Overall, both teachers and students ranked the course highly. The teacher and students commented on the challenge with different prior knowledge and the importance of reading the supplied materials. Preparation for the exam and the project will be developed to better accommodate different prior knowledge.

### **Analysis**

The strong aspect of the course is the involvement of several experts in sensors and biomedicine that creates different learning environments. The weak aspects is accommodation of very different prior knowledge which demand self-studies of supplied material. Many KTH students are not used to have large amount of reading material where they have to select depending on prior knowledge. KTH students are also not used to problem-based home exams.

Due to the low number of students making the formal evaluation no categorization of the analysis can be done with respect to gender etc.

### **Prioritized course development**

From last year we had changed. 1) More detail instructions for the laborations and 2) introduced the project earlier. We will focus on 1) introducing exam-like problems earlier in the course and 2) aligning project supervisors with the intention of the project.

We are also working on more structured self-study material will be developed to guide students lacking electronics, biology or chemistry background.

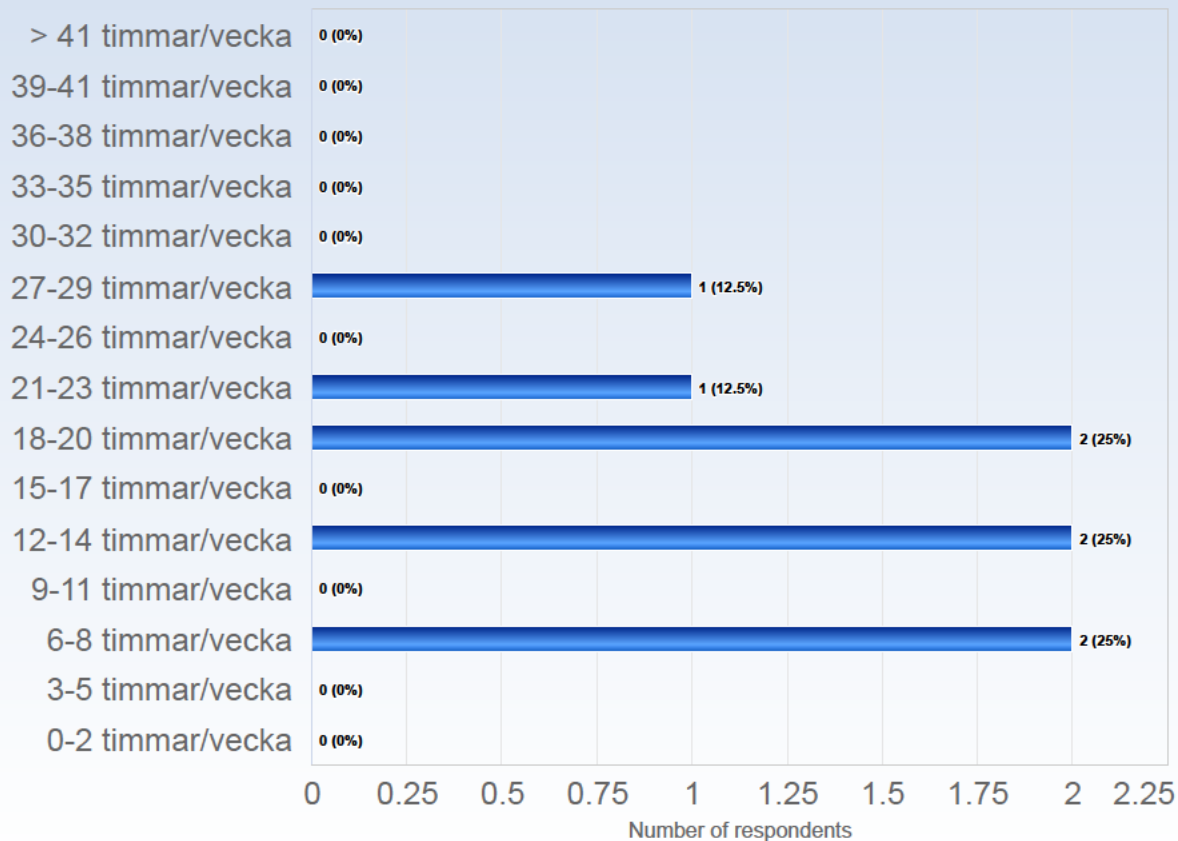
Appendix 1 - LEQ Course evaluation.

# EK2380 - 2022-10-24

Antal respondenter: 27  
Antal svar: 8  
Svarsfrekvens: 29,63 %

## ESTIMATED WORKLOAD

On average, how many hours/week did you work with the course (including scheduled hours)?



### Comments

Comments (I worked: 6-8 timmar/vecka)

Seeing as the seminars were mandatory, we had to prioritise this course over o hers. But overall, the course load was not too much.

Comments (I worked: 21-23 timmar/vecka)

It's quite a lot to be honest for 7.5 hp ...

Comments (I worked: 27-29 timmar/vecka)

The lectures was very clear and structured. The group project took a lot of time since our supervisor did not really knew about the subject so the questions we had could not be answered during our meetings and we had to find the information from other sources.

# LEARNING EXPERIENCE

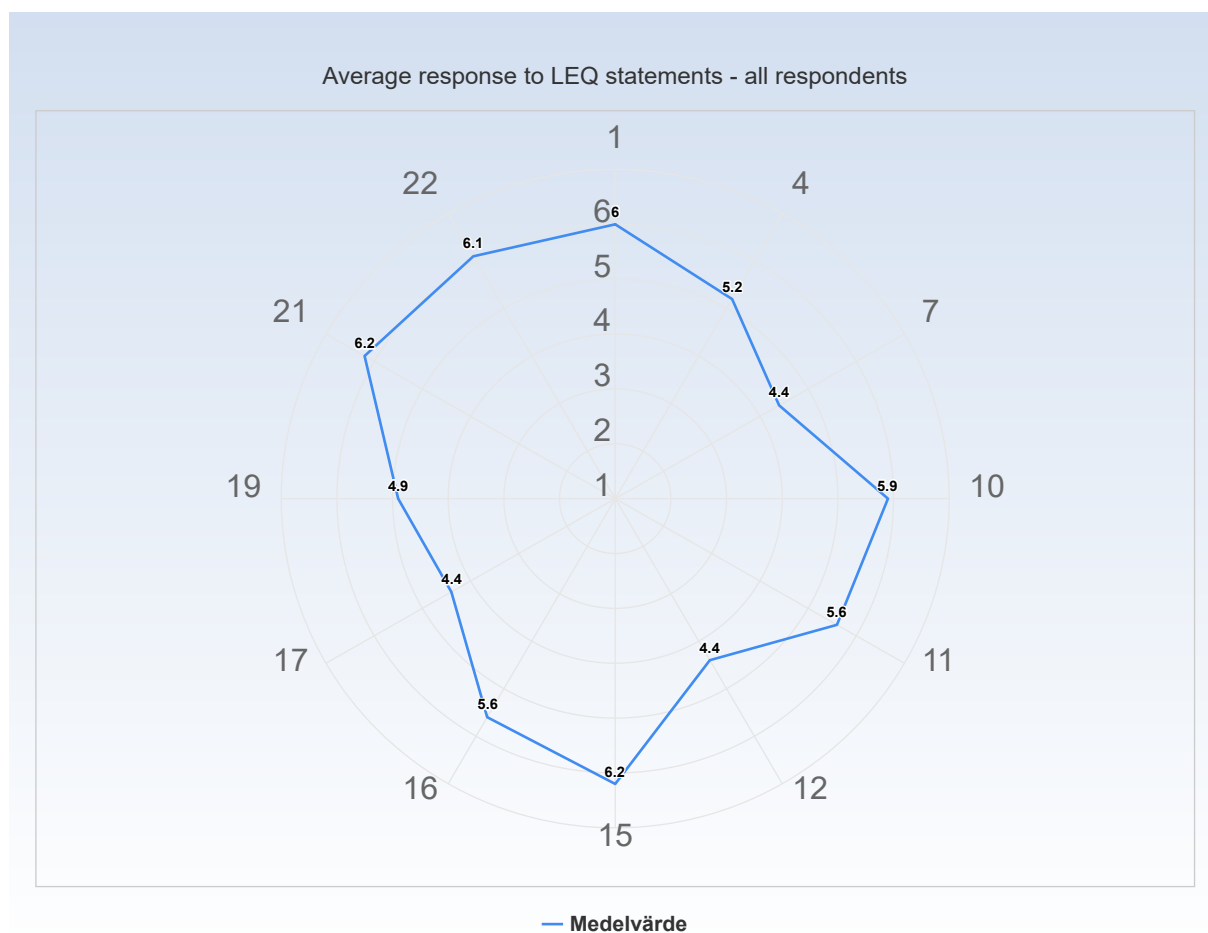
The polar diagrams below show the average response to the LEQ statements for different groups of respondents (only valid responses are included). The scale that is used in the diagrams is defined by:

1 = No, I strongly disagree with the statement

4 = I am neutral to the statement

7 = Yes, I strongly agree with the statement

**Note! A group has to include at least 3 respondents in order to appear in a diagram.**



## **KTH Learning Experience Questionnaire v3.1.4**

### **Meaningfulness - emotional level**

#### *Stimulating tasks*

1. I worked with interesting issues (a)

#### *Exploration and own experience*

2. I explored parts of the subject on my own (a)
3. I was able to learn by trying out my own ideas (b)

#### *Challenge*

4. The course was challenging in a stimulating way (c)

#### *Belonging*

5. I felt togetherness with others on the course (d)
6. The atmosphere on the course was open and inclusive (d)

### **Comprehensibility - cognitive level**

#### *Clear goals and organization*

7. The intended learning outcomes helped me to understand what I was expected to achieve (e)
8. The course was organized in a way that supported my learning (e)

*Understanding of subject matter*

- 9. I understood what the teachers were talking about (f)
- 10. I was able to learn from concrete examples that I could relate to (g)
- 11. Understanding of key concepts had high priority (h)

### *Constructive alignment*

- 12. The course activities helped me to achieve the intended learning outcomes efficiently (i)
- 13. I understood what I was expected to learn in order to obtain a certain grade (i)

### *Feedback and security*

- 14. I received regular feedback that helped me to see my progress (j)
- 15. I could practice and receive feedback without being graded (j)
- 16. The assessment on the course was fair and honest (k)

## **Manageability - instrumental level**

### *Sufficient background knowledge*

- 17. My background knowledge was sufficient to follow the course (f)

### *Time to reflect*

- 18. I regularly spent time to reflect on what I learned (l)

### *Variation and participation*

- 19. The course activities enabled me to learn in different ways (m)
- 20. I had opportunities to influence the course activities (m)

### *Collaboration*

- 21. I was able to learn by collaborating and discussing with others (n)

## *Support*

22. I was able to get support if I needed it (c)



## **Learning factors from the literature that LEQ intends to examine**

We tend to learn most effectively (in ways that make a sustained, substantial, and positive influence on the way we think, reflect, act or feel) when:

a) We are trying to answer questions, solve problems or acquire skills that we find interesting, exciting or important

b) We are able to speculate, test ideas (intellectually or practically) and learn from experience, even before we know much about the subject

c) We are able to do so in a challenging and at the same time supportive environment

d) We feel that we are part of a community and believe that other people have confidence in our ability to learn

e) We understand the meaning of the intended learning outcomes, how the environment is organized, and what is expected of us

f) We have adequate prior knowledge to deal with the current learning situation

g) We are able to learn inductively by moving from concrete examples and experiences to general principles, rather than the reverse

h) We are challenged to develop a true understanding of key concepts and gradually create a coherent whole from the content

i) We believe that the work we are expected to do will help us to achieve the intended learning outcomes

j) We are able to try, fail, and receive feedback before, and separate from, each summative assessment of our efforts

k) We believe that our work will be considered in an honest and fair way

l) We have sufficient time for learning and devote the time needed to do so

m) We believe that we have control over our own learning, and not that we are being manipulated

n) We are able to collaborate with other learners struggling with the same problems

## Literature

Bain, K. (2004). *What the Best College Teachers Do*, Chapter 5, pp. 98-134. Cambridge: Harvard University Press.

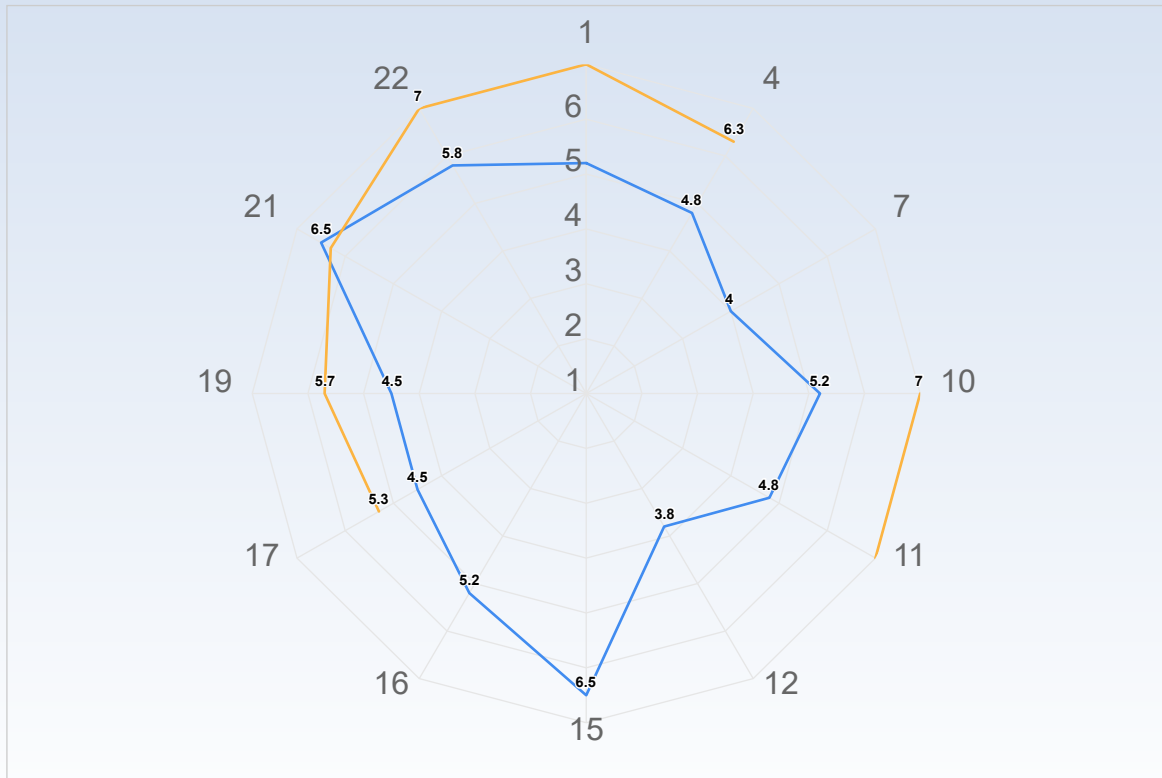
Biggs J. & Tang, C. (2011). *Teaching for Quality Learning at University*, Chapter 6, pp. 95-110. Maidenhead: McGraw Hill.

Elmgren, M. & Henriksson, A-S. (2014). *Academic Teaching*, Chapter 3, pp. 57-72. Lund: Studentlitteratur.

Kember, K. & McNaught, C. (2007). *Enhancing University Teaching: Lessons from Research into Award-Winning Teachers*, Chapter 5, pp. 31-40. Abingdon: Routledge.

Ramsden, P. (2003). *Learning to Teach in Higher Education*, Chapter 6, pp. 84-105. New York: RoutledgeFalmer.

Average response to LEQ statements - per gender



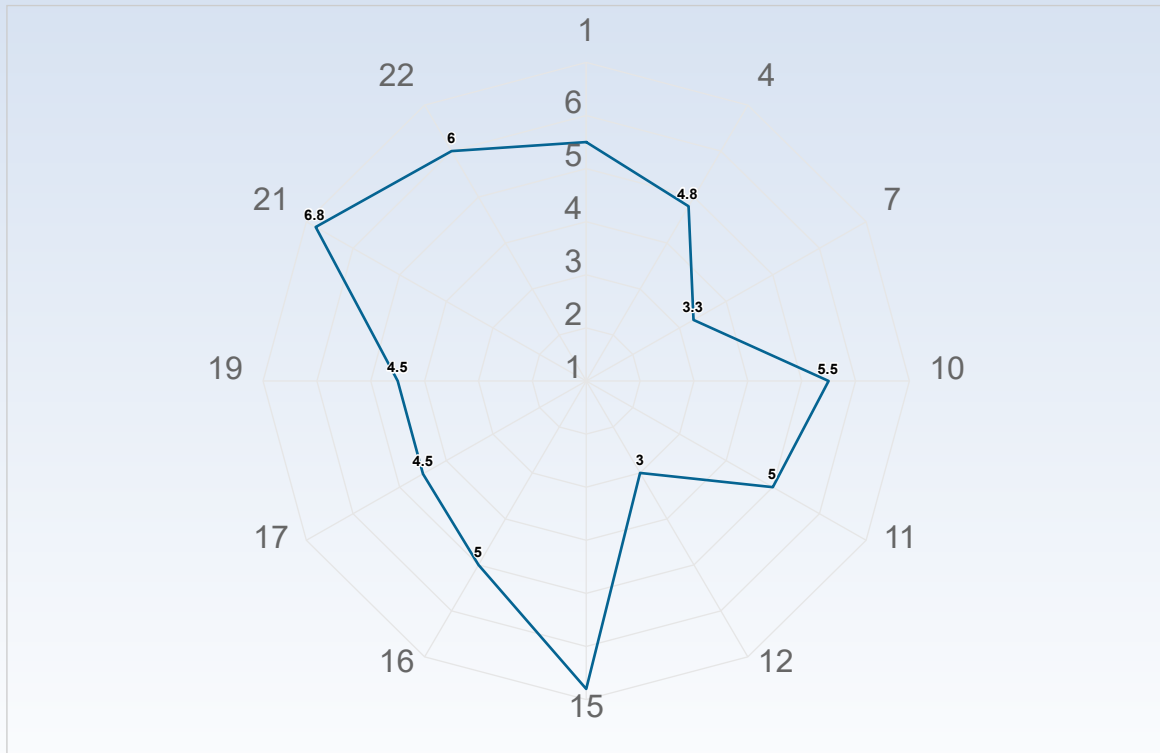
— Kvinna — Man — Annat — Vill ej uppge

Comments

Comments (I am: Kvinna)

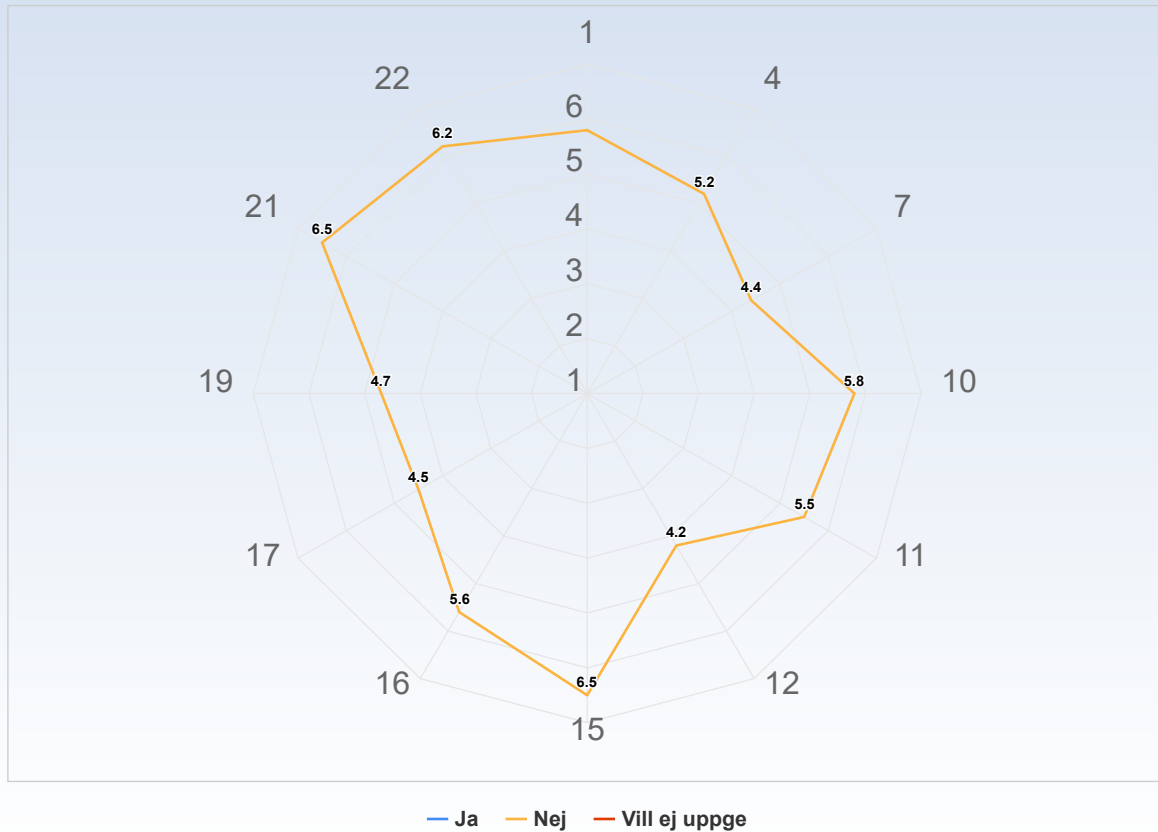
I believe that the course was equal

Average response to LEQ statements - per type of student



- Internationell masterstudent
- Svensk student i årskurs 4-5
- Internationell utbytesstudent
- Annan typ av student
- Svensk student i årskurs 1-3
- Vill ej uppge

Average response to LEQ statements - per disability



Comments

Comments (My response was: Ja)

Having ADHD following this course has been a little bit challenging. Because sometimes I couldn't keep focus on class and I really would have liked to have zoom options or recordings of the lectures.

## GENERAL QUESTIONS

What was the best aspect of the course?

What was the best aspect of the course? (I worked: 6-8 timmar/vecka)

The labs and the study visits were a definite highlight. Personally, practical learning methods are the best way to learn. The study visits also gave a very tangible application of what this course goes through.

What was the best aspect of the course? (I worked: 12-14 timmar/vecka)

bringing professionals from each subject and the study visits really helps to understand the applications of the theory studied

What was the best aspect of the course? (I worked: 18-20 timmar/vecka)

The labs was best managed. Good and knowledgeable lab assistants. However, there were a bit of confusion of how much you were supposed to know after the labs for the exam.

Home exam

What was the best aspect of the course? (I worked: 21-23 timmar/vecka)

The course was really cool, unfortunately I didn't have a super-good background in chemistry, and I think this was a big challenge.

What was the best aspect of the course? (I worked: 27-29 timmar/vecka)

That we got a broad overview of what the market looks like as we had different lecturers and guest lecturers from both companies and hospitals. I like that there was a lot of focus on what we can do to improve the market and that we were challenged to come up with new innovations ourselves.

What would you suggest to improve?

What would you suggest to improve? (I worked: 6-8 timmar/vecka)

The mandatory attendance really did not do much, especially since people showed up sick to the seminars. This might have still been a problem if there was no mandatory attendance, but it seriously added an extra element of stress that I could have gone without this study period.

What would you suggest to improve? (I worked: 18-20 timmar/vecka)

I think the structure of the course has been very poor. I do not believe in having mandatory lectures when all lecture is not giving. Some lectures felt totally irrelevant for us that had read medtech and others were so basic that they did not help increase ones understanding for the subject and certainly did not help when doing the exam. This only means that you lose a lot of time that you could have spent on studying the subjects by your own. I believe focus should be on providing better course literature so it becomes clear exactly what one is suppose to learn and how deep. It felt like either the literature was very basic or the lecturers referred to entire books. That makes it impossible to study effectively.

The biggest problem with this course was the project. It was unclear what was to be done and how deep into the subject we were suppose to dig. We got Rohollah as a supervisor, which was problem from day one. He was not willing to listen to our ideas and did not seem to have a clue of what the task was about. We then agreed to his suggestion of topic to avoid further discussion. We agreed at one meeting what we were going to do and during the next he came up with completely different directives which took a lot of unnecessary time. It also didn't feel like he really understood everything we had done or had questions about and chose to only change the topic of conversation.

Unfortunately, this is one of the worse courses I've read at KTH and I really hope you take the feedback to heart so that more people don't have to experience this.

The project was very confusing. The instructions were not clear. Our supervisor was even more confusing and couldn't help us even a bit.

What would you suggest to improve? (I worked: 21-23 timmar/vecka)

Number of credits, I had courses for 7,5 where I worked probably a quarter of the time compared to this one.

What would you suggest to improve? (I worked: 27-29 timmar/vecka)

More focus on microfluidics and not just one lecture about it since the lab consisted of a lot of new information and it would be nice to know a little more about it before the lab to increase the learning from the lab. I would also suggest to make sure that the supervisors really wants to be a part of the subject of the project so the student don't get asked to change their sensing method 1 week before the submission (this happened to us).

What advice would you like to give to future participants?

What advice would you like to give to future participants? (I worked: 6-8 timmar/vecka)

Brush up on your chemistry, there is a surprising amount of chemistry involved in his course.

What advice would you like to give to future participants? (I worked: 12-14 timmar/vecka)

keep track of the reading material since the beginning of the course

What advice would you like to give to future participants? (I worked: 18-20 timmar/vecka)

Spend a lot of time reading outside of the lectures as this will be needed before the exam.

None.

What advice would you like to give to future participants? (I worked: 21-23 timmar/vecka)

Anna is cool and well-organised, don't hesitate to ask her questions.

Start to study from day 1.

What advice would you like to give to future participants? (I worked: 27-29 timmar/vecka)

Ask questions. Take notes during the labs. Read the material that is handed out before the lecture.

Is there anything else you would like to add?

Is there anything else you would like to add? (I worked: 6-8 timmar/vecka)

Super fun course and I think it will bring a lot of use to many students!

Is there anything else you would like to add? (I worked: 12-14 timmar/vecka)

The students can tell that the professors really put all their effort to help us understand as much as possible and that they are always open to questions.

Is there anything else you would like to add? (I worked: 18-20 timmar/vecka)

Why have mandatory lectures? At least give the opportunity to attend on zoom.

Is there anything else you would like to add? (I worked: 27-29 timmar/vecka)

It was a really fun course!

## SPECIFIC QUESTIONS

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## RESPONSE DATA

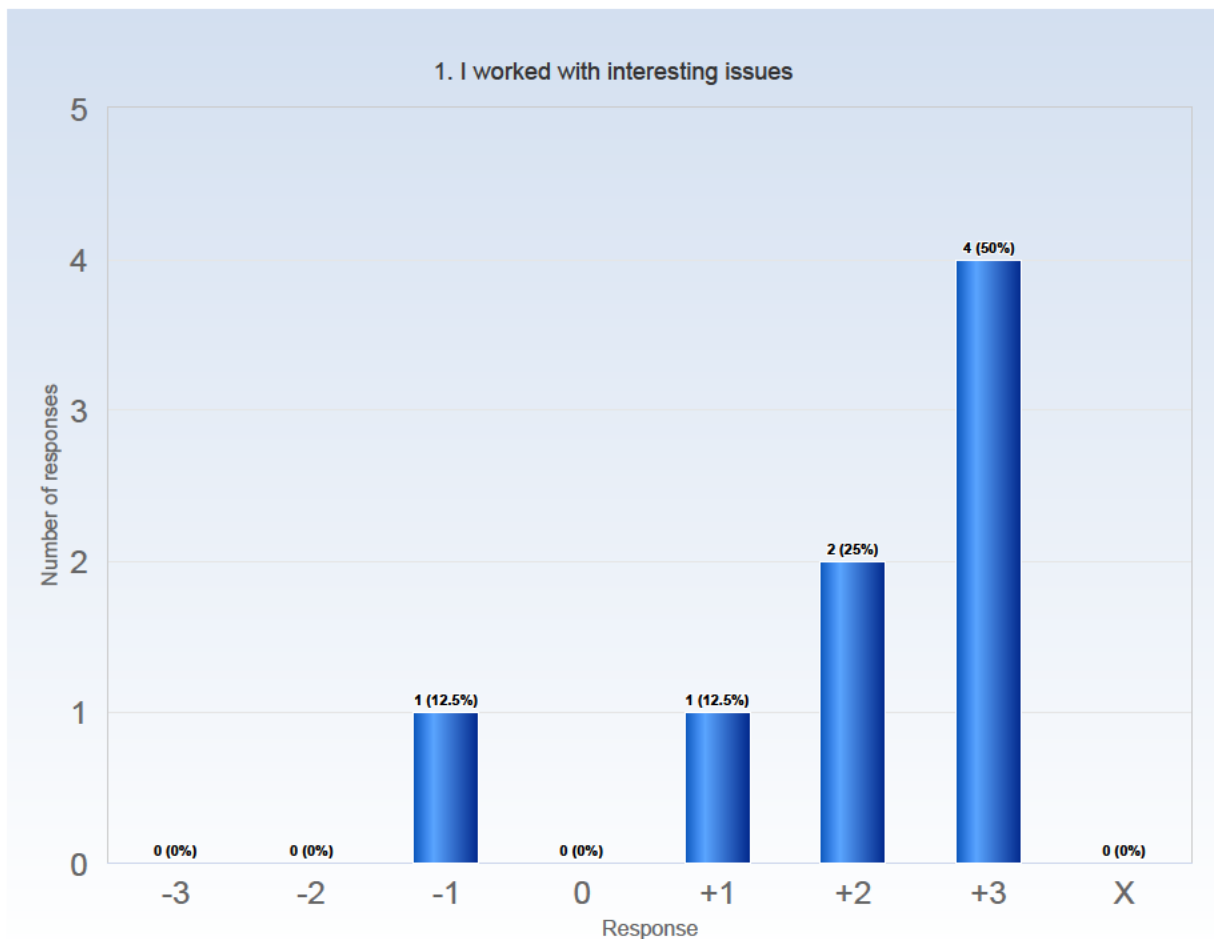
The diagrams below show the detailed response to the LEQ statements. The response scale is defined by:

-3 = No, I strongly disagree with the statement

0 = I am neutral to the statement

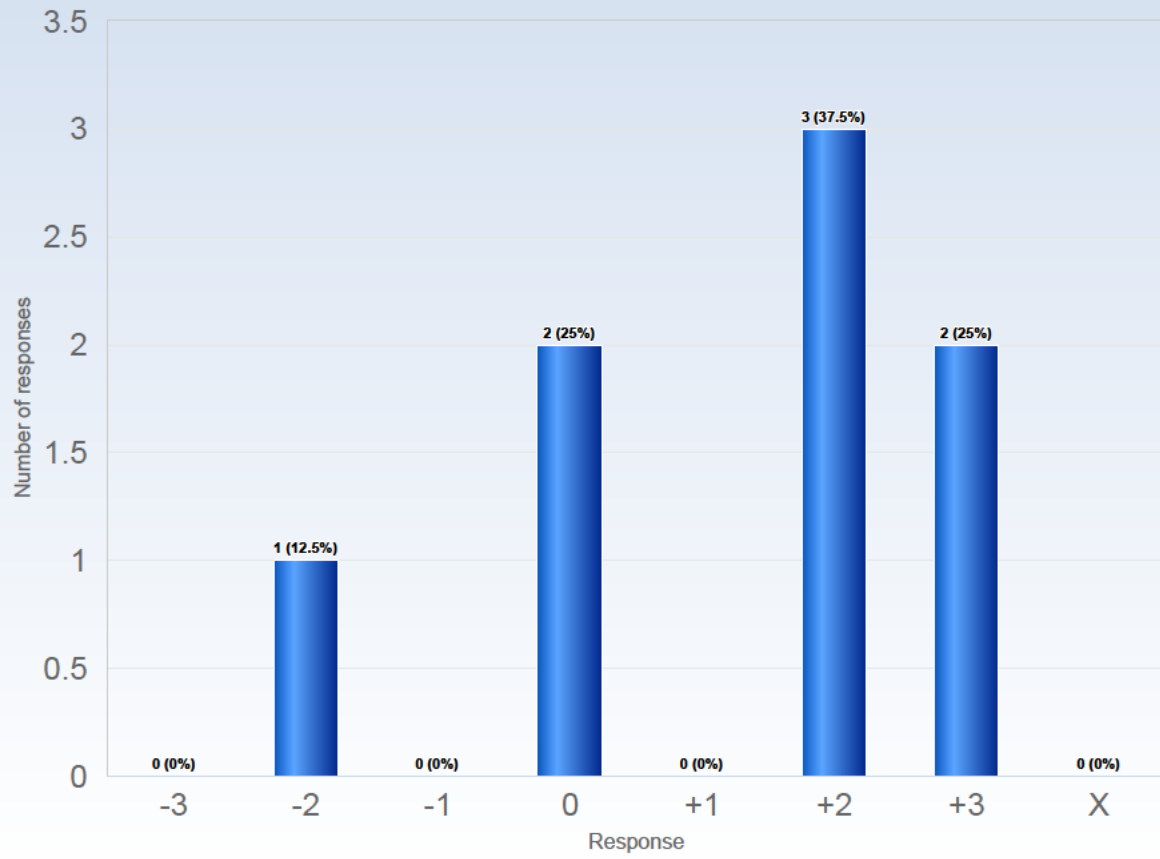
+3 = Yes, I strongly agree with the statement

X = I decline to take a position on the statement

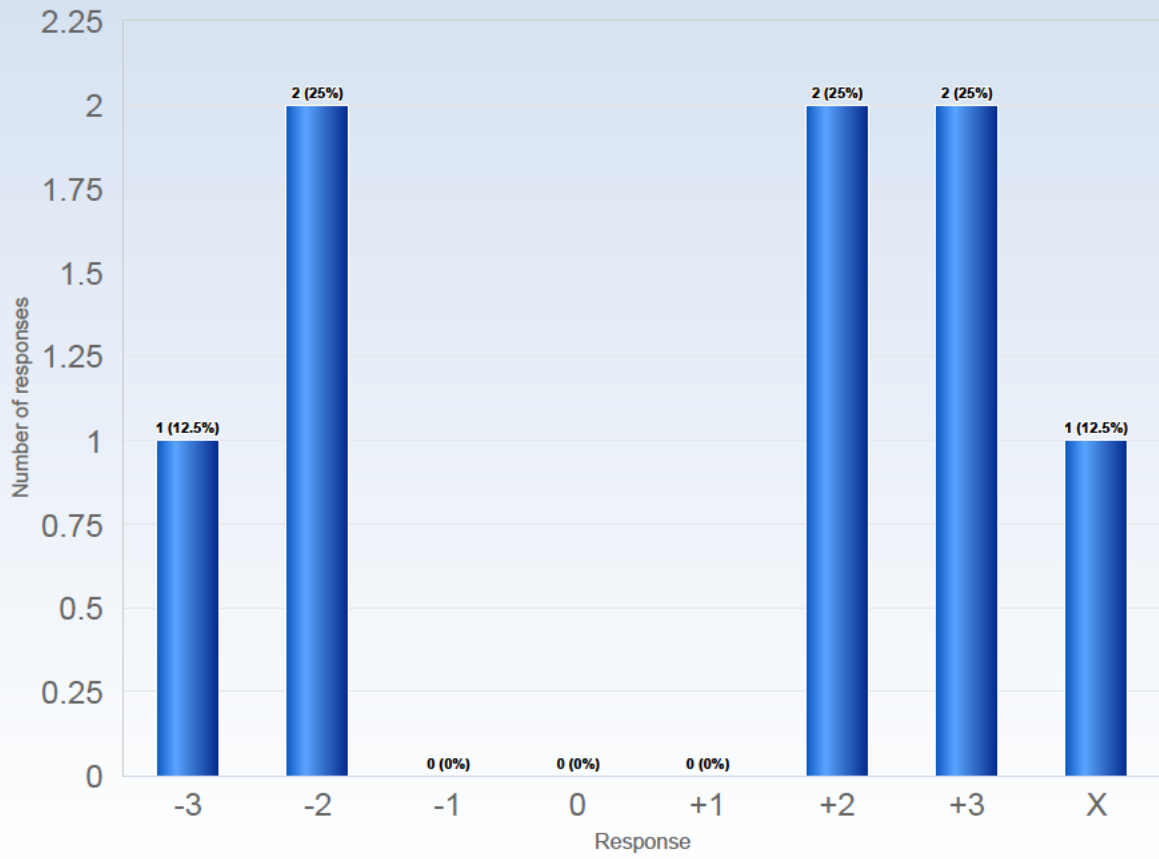




#### 4. The course was challenging in a stimulating way



7. The intended learning outcomes helped me to understand what I was expected to achieve

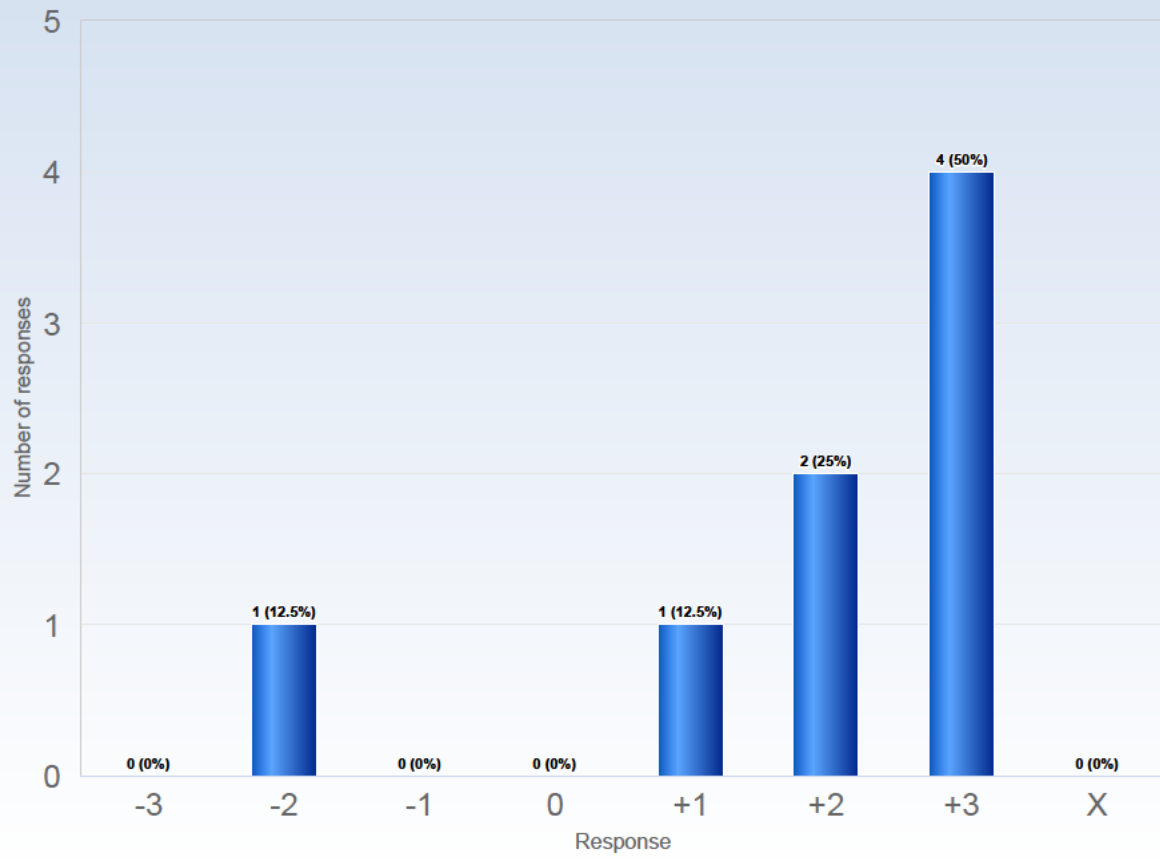


Comments

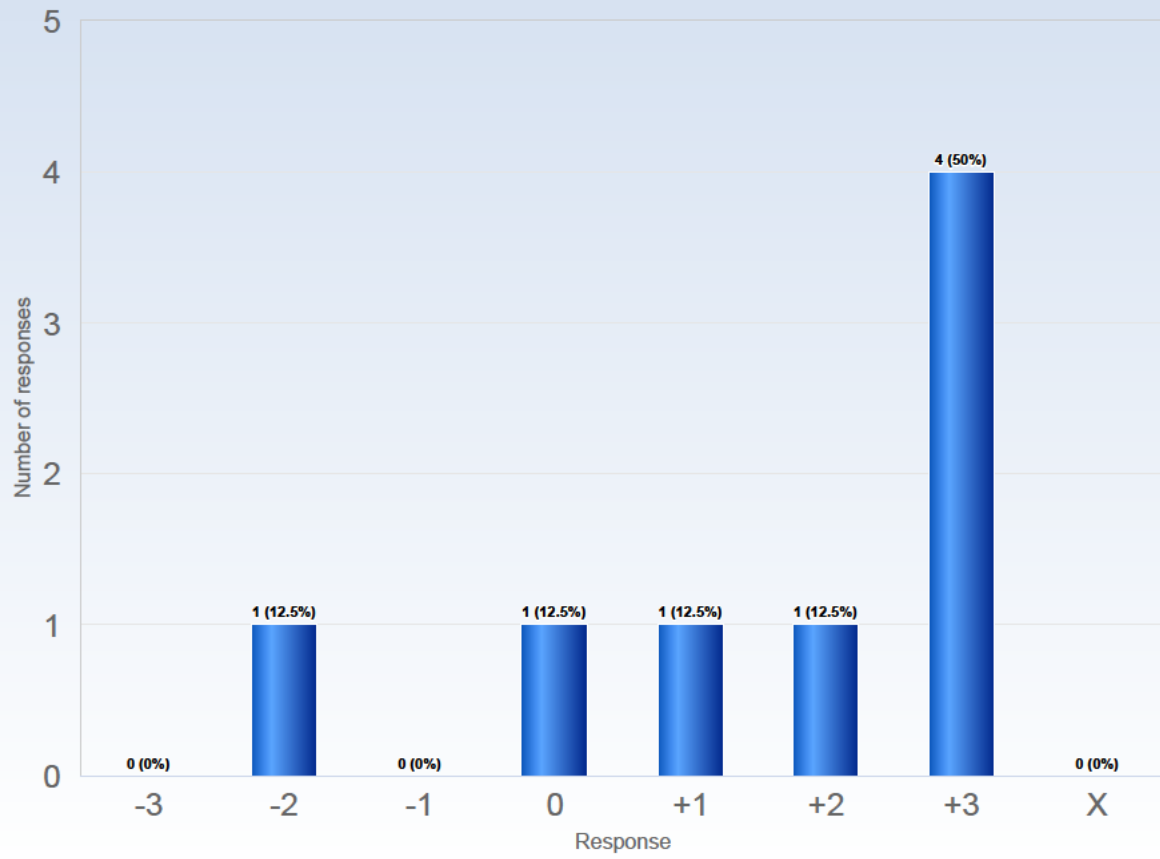
Comments (My response was: X )

I do not recall the ILOs.

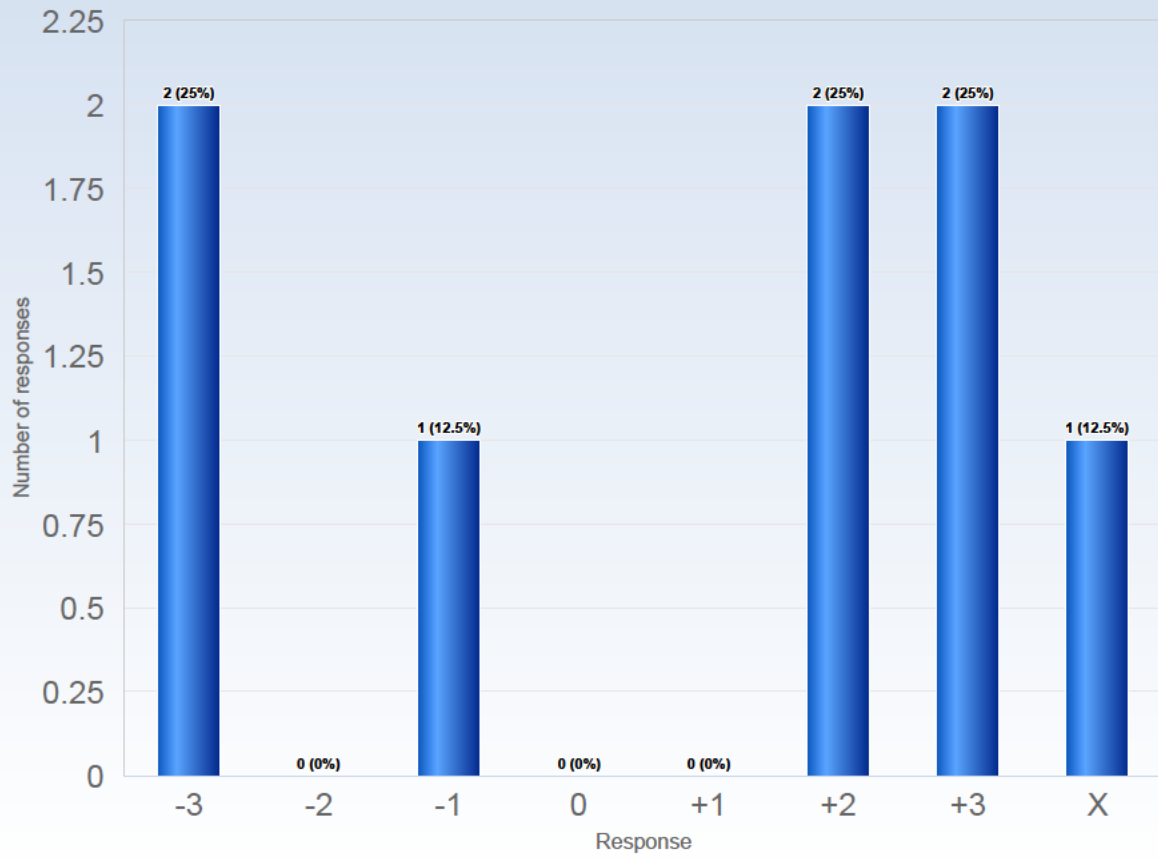
10. I was able to learn from concrete examples that I could to relate to



11. Understanding of key concepts had high priority



12. The course activities helped me to achieve the intended learning outcomes efficiently

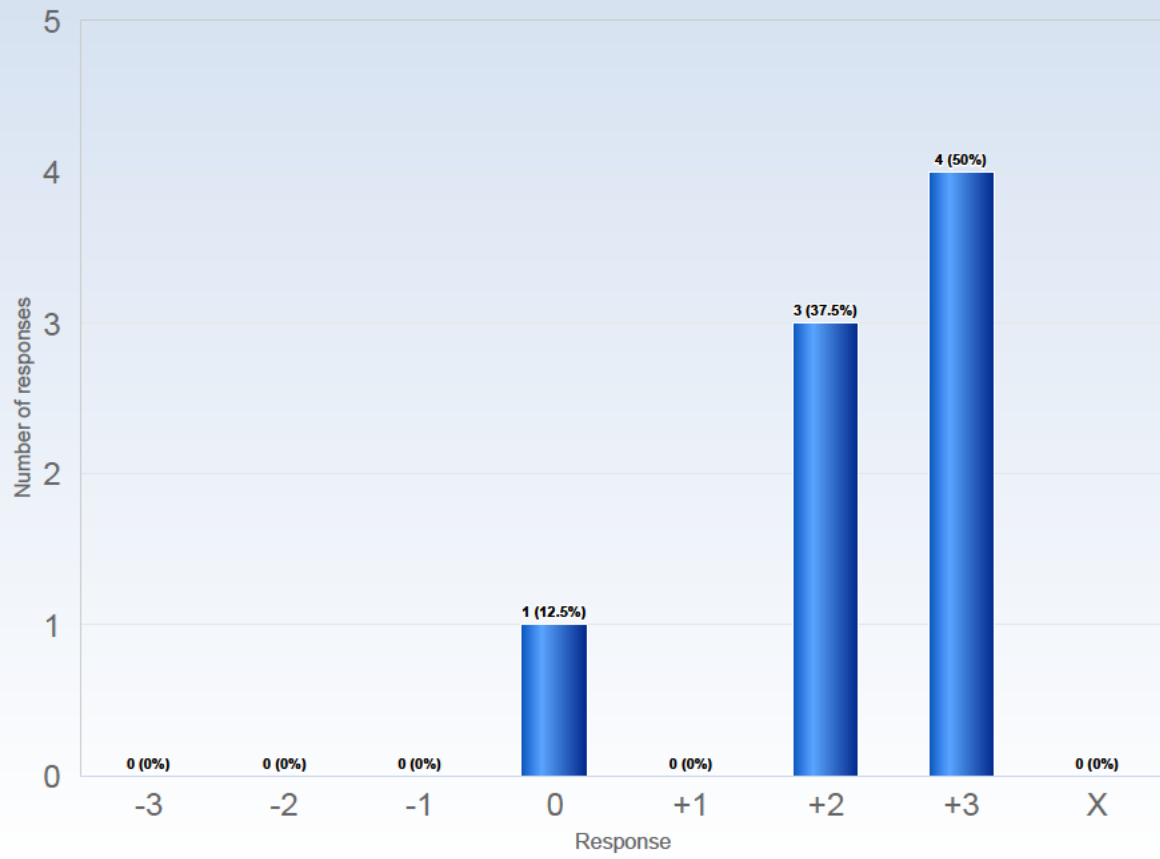


Comments

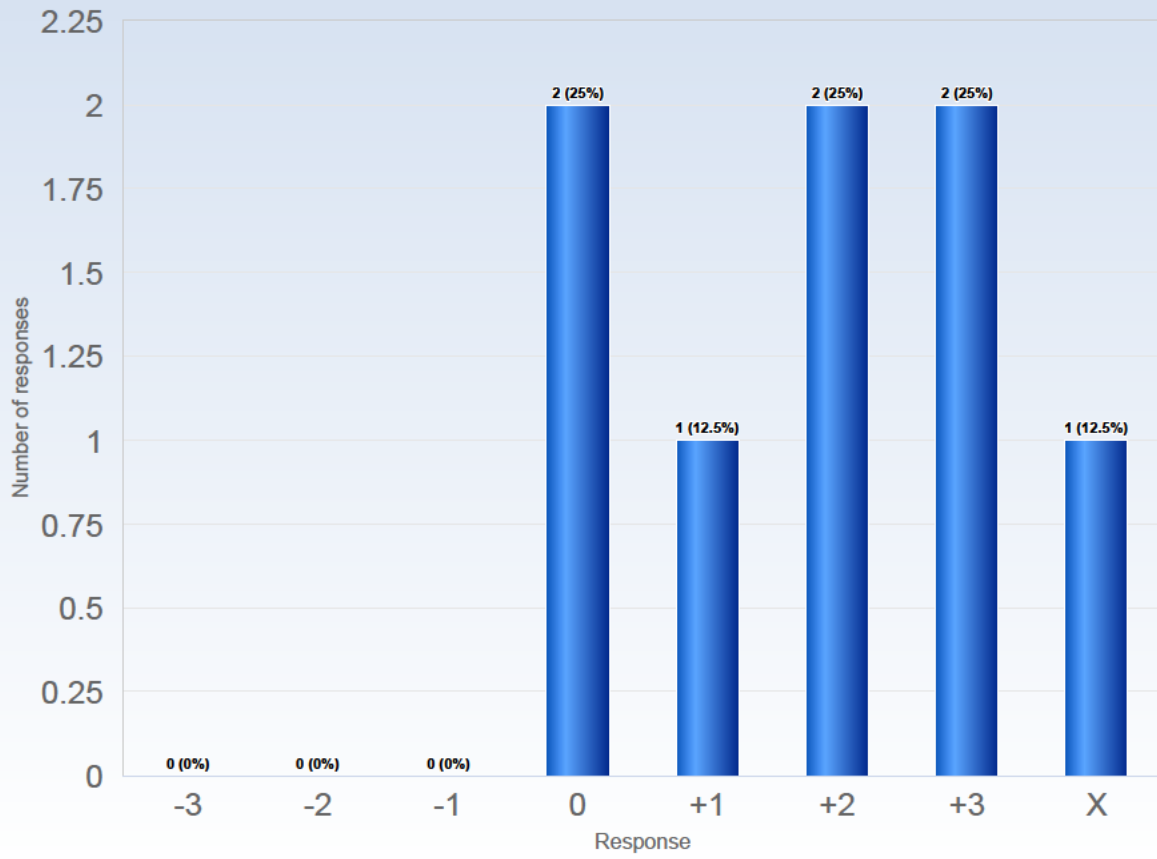
Comments (My response was: X )

Same as before, I do not recall the ILOs.

15. I was able to practice and receive feedback without being graded



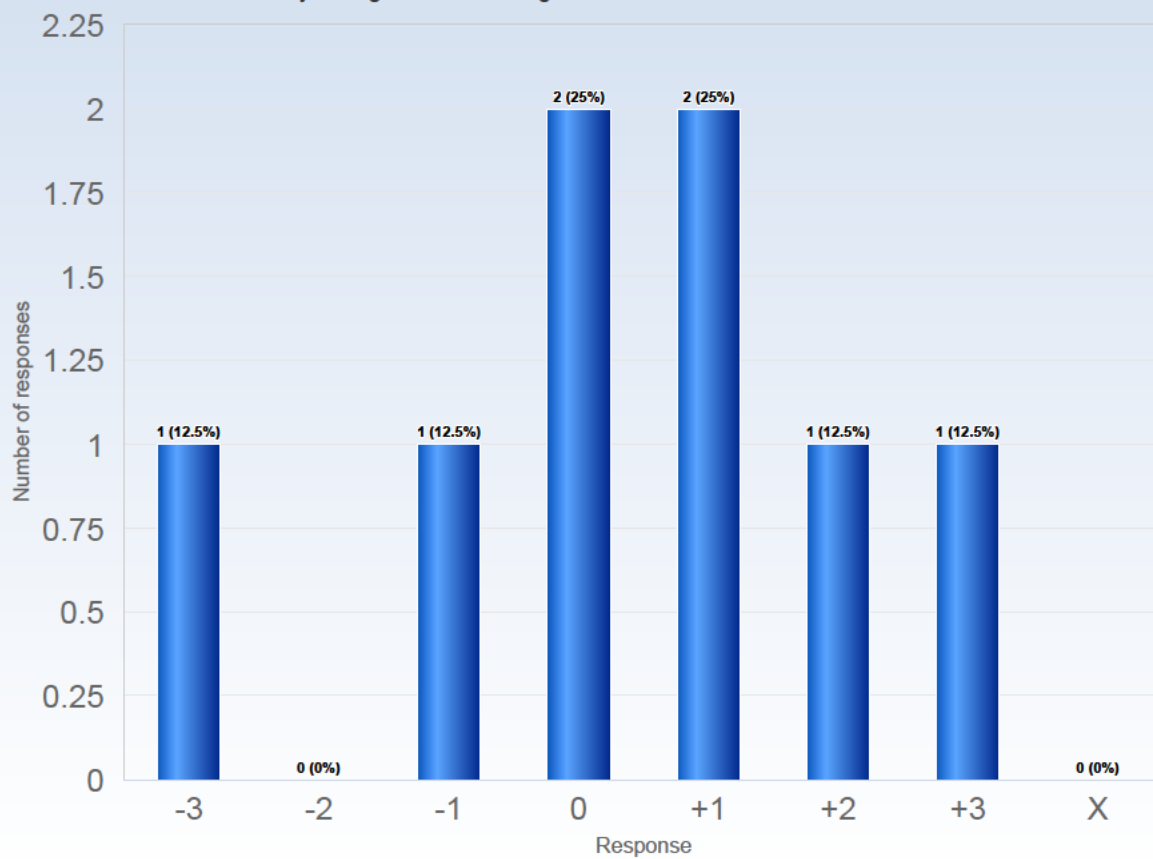
16. The assessment on the course was fair and honest



Comments

Comments (My response was: X )  
Have yet to receive any assessment.

17. My background knowledge was sufficient to follow the course



Comments

Comments (My response was: +1)

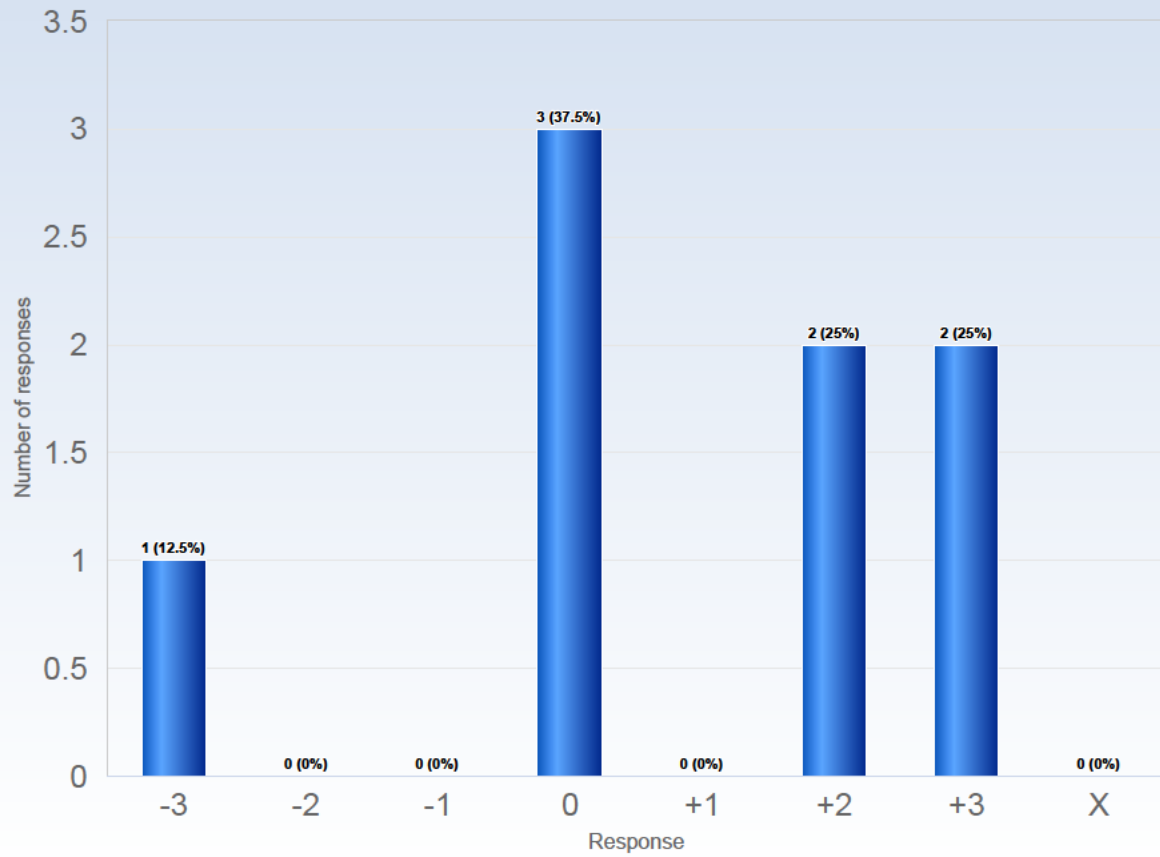
I think a lit le more chemistry might have helped with understanding some of the fundamental reactions that this course glosses over.

Comments (My response was: +2)

I felt that I lacked knowledge about the chemistry part of the course.



19. The course activities enabled me to learn in different ways

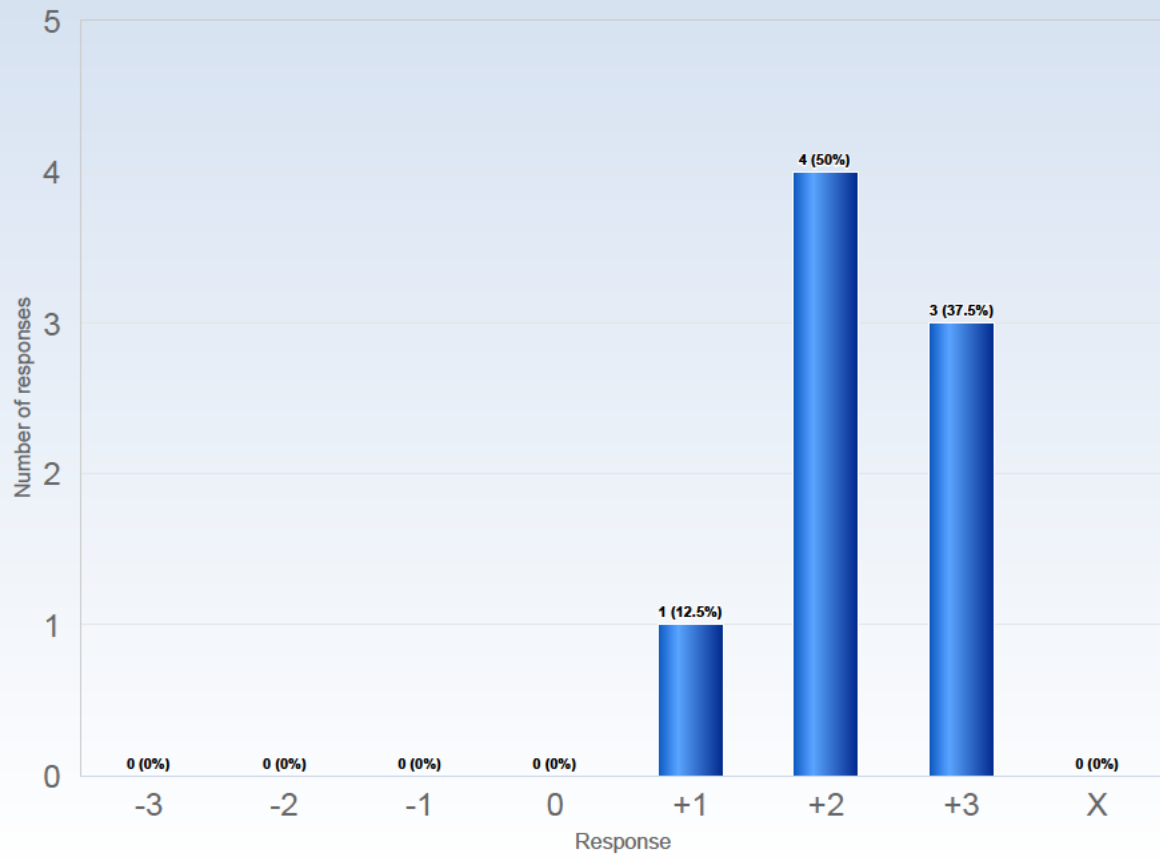


Comments

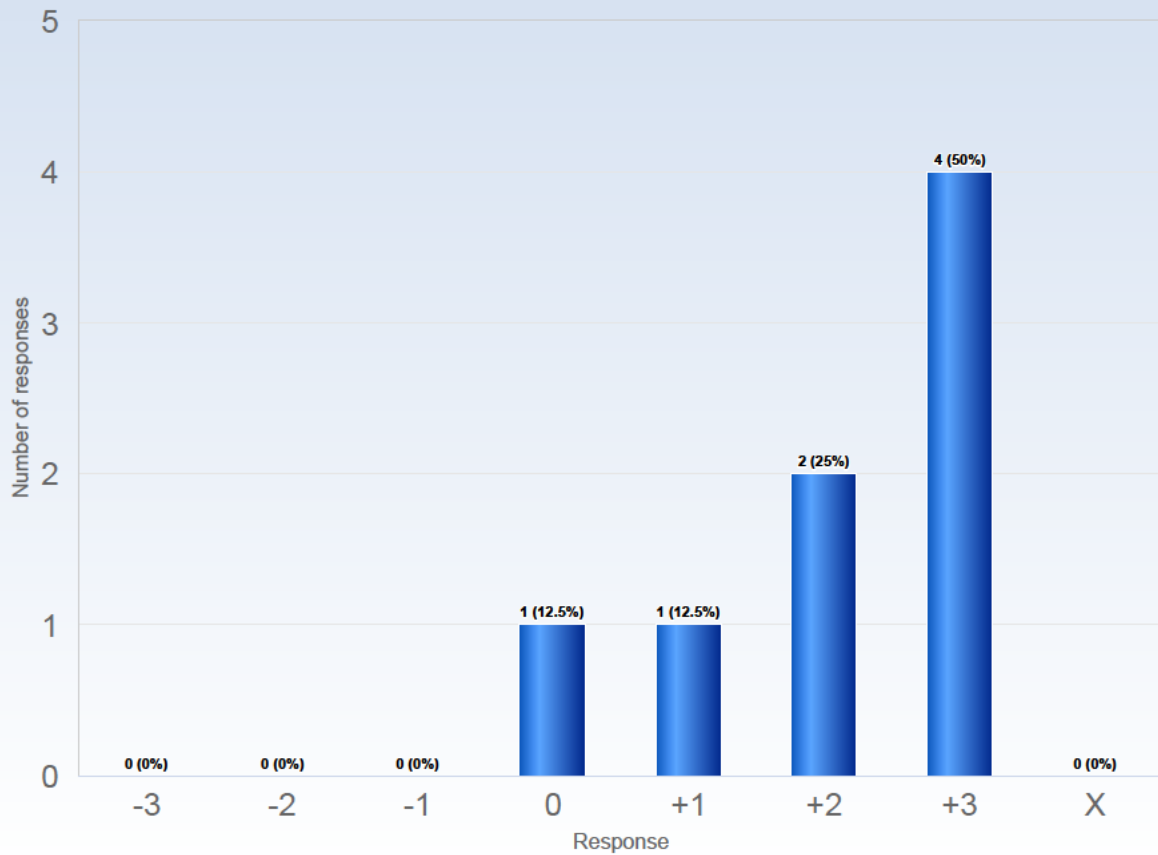
Comments (My response was: +2)

I enjoyed the labs and that there were no lab reports. The study visits were also very appreciated.

21. I was able to learn by collaborating and discussing with others



22. I was able to get support if I needed it



Comments

Comments (My response was: +2)

All lecturers and especially Anna were very helpful and happy to answer questions. On the other hand, I do not think that our supervisor was sufficiently educated about the work that we chose, even though the work was chosen from the ready list.

Comments (My response was: +3)

Course responsible and examiner was very good at answering questions and was accomodating.

**SPECIFIKA FRÅGOR**

**Kommentarer på kurs intro och info - [REDACTED]**

**SPECIFIKA FRÅGOR**

**Kommentarer på kurs intro och info - [REDACTED] nd**

Anna has been available throughout the course and communicated new information very quickly. Very happy with how she's dealt with the issues throughout the course.

The lectures did not give me the whole picture that I needed for the exam. I would have wished for more in depth information about different sensor types and what they are used for. Maybe mention what different sensors there are and a short explanation of them in the first lecture and then go into detail in every specific sensor during the following lectures. I was very confused when I started studying for the exam. I had heard all the words, but I didn't understand how it was all connected, if that makes sense.

Good overview with important point why this field of medical sensors is important

Good information and a friendly welcome to the course.

**Kommentarer på seminarie 2 - fysiologi och medicinska sensorer - [REDACTED]**

**Kommentarer på seminarie 2 - fysiologi och medicinska sensorer - [REDACTED]**

Very interesting having a medical practitioner giving a lecture, provided a very welcome perspective change.

Good practical examples. Maybe a follow up in terms of learning by doing.

Very interesting lecture! I liked that you talked about real cases from the hospital!

**Kommentarer på seminarie 3 - measurement tech - [REDACTED]**

**Kommentarer på seminarie 3 - measurement tech - [REDACTED]**

Could not attend.

Really demanding and hard to Grass for me at least. One could see that [REDACTED] knows his field.

#### Comments on seminar 4 - Transducers - [REDACTED]

##### Comments on seminar 4 - Transducers - [REDACTED]

Nothing to add.

Interesting and educational!

#### Comments on seminar 5 and 8 - Surface modifications, enzymes - [REDACTED]

##### Comments on seminar 5 and 8 - Surface modifications, enzymes - [REDACTED]

Required a little more knowledge in chemistry than I had for lecture 5, but managed to remember more for seminar 8.

I did not follow this lecture. Maybe it was because of my poor knowledge in the subject.

Interesting to see the background of some easy available tests

Very interesting and helpful to understand the whole concept!

#### Comments on seminar 6 - microfluidics - [REDACTED]

##### Comments on seminar 6 - microfluidics - [REDACTED]

Very cool guy and managed to lecture in a very relaxed way. I appreciated his way for imparting information.

One of the more difficult lectures I've been to. I did not understand much of what was discussed during the lecture. Bad when lecturers hand out questions in a passive aggressive manner to force one to answer. It doesn't get any more fun to sit there when attendance is also mandatory.

Interesting Fields with Hugo potential and good lecture in a stimulantiana way

I would have liked more specific information about the different forces that could be included in different channels

#### Comments on seminar 7 and 9 - electrochemistry and minimally invasive tech - [REDACTED]

##### Comments on seminar 7 and 9 - electrochemistry and minimally invasive tech - [REDACTED]

Overall a good lecturer and very interesting topics.

Nice and interesting to see what is possible

Some parts of the lecture felt a bit stressed and it was a lot of information on the same time with both chemistry and electronics. Maybe divide it and structure it more

#### Comments on seminar 9 - standardisation/regulation - [REDACTED]

##### Comments on seminar 9 - standardisation/regulation - [REDACTED]

Important lecture, but definitely not something that we haven't already had. Medical engineering students and students in TIHLM have had similar presentations maybe 4 times at this point.

Super interesting, maybe some case studies

Very interesting!

#### Comments on lab sessions and the project work

##### Comments on lab sessions and the project work

I really liked most of the Labs and the assistants. But Lab2 was a little bit unprofessional compared to the others. We have been left completely alone during the experiment without any kind of help. This would be ok if everyone had a background in Chemistry, Biochemistry etc.

But it's not, we were there to learn.

Labs were good and I did like the fact that there were no lab reports for each lab. However, I do think that having one of the questions on the exam be about a random lab was a little strange.

Initially, it seemed like a good idea, but having done the exam and discussed it with some of the other students, it feels like it came down to who had the best notes from the lab.

It was not about your knowledge of the given lab but moreso just how efficiently you took notes and asked questions during the lab. To me, that should not be a requirement for the course.

The project was very fun and I appreciated the fact that we had a (very knowledgeable) supervisor to guide us.

The biggest problem with this course was the project. It was unclear what was to be done and how deep into the subject we were suppose to dig. We got [REDACTED] as a supervisor, which was problem from day one. He was not willing to listen to our ideas and did not seem to have a clue of what the task was about. We then agreed to his suggestion of topic to avoid further discussion. We agreed at one meeting what we were going to do and during the next he came up with completely different directives which took a lot of unnecessary time. It also didn't feel like he really understood everything we had done or had questions about and chose to only change the topic of conversation.

Lab sessions were good. The project was not.

Som kind of report altererades in group diskussions would be great

Microfluidics: the lab assistants were very knowledgeable and kindly answered all questions both before and after the actual lab. But during the lab itself, they were not particularly helpful and sat a lot with their mobiles or talked to each other. We were told several times "you are master's students, you should know how a lab works" but I have not previously been in a lab like theirs. I would have liked them to be a little more helpful and for the material to be a little better prepared.

#### Comments on guest lectures and study visits - should they be mandatory ?

##### Comments on guest lectures and study visits - should they be mandatory ?

No!

But they should be heavily incentivised because I feel like they gave the most value out of any individual part of his course.

I do not believe in mandatory lectures or study visits. Some people learn better from lectures and others from reading books. I do not believe that it gets funnier for guest lectures when here is a high attendance when people don't want to be there. Makes it harder to plan your time when taking courses on different campus. You lose a lot of time when traveling between campuses that instead could have been spent on studying.

Lectures should not be mandatory.

Yes