

Course analysis KE2045 Chemical Reaction Engineering

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1. Description of the course evaluation process

All the students were given the opportunity to express their opinion about the course by an online course evaluation questionnaire that was sent out to them after the final examination. The gender and disability aspects were provided as optional fields to the questionnaire. Participation in the questionnaire was 50%. Summarized responses and analysis of the evaluation questionnaire is attached as an annex.

2. Description of meetings with students

The students could communicate with the teachers via online zoom meetings, via email or via Canvas any time during the course as well as after the final exam. Discussions included questions about the content and running of the course as well as about changes to the exam format etc.

3. Course Design

Course description

The course introduces students to chemical reaction engineering and reactor design. The aim is to give an enhanced understanding of the theory of chemical reactors and skill in formulation and analysis of mathematical models in chemical reaction engineering. The classroom problems and the computer laboratory exercises aim to establishing problem solving skills with and without computer aid.

Learning Objectives

After completing the course, the students should be able to:

- Identify and describe ideal reactors and their characteristics.
- Develop mathematical expressions (models) to describe the behavior of chemical reactors and analyze how kinetics, mass transfer and heat transfer affect the performance of the reactors
- Apply analytical and numerical methods to determine reactors' behavior and analyze the results.
- Size and design chemical reactors and optimize operating conditions
- Apply RTD (Residence Time Distribution) methods to diagnose non-ideal flows in reactors and calculate conversions

Course Design

The course is based on three different modules that try to address the above-mentioned learning objectives. Namely, theory and problem solving, classroom and home problems and computer lab.

The theory and problem-solving part of the course consists of three sections, namely: ideal reactor models, heterogeneous systems and nonideal reactors. This provides the fundamental concepts of

reactors theory and describe the important mathematical relationships needed to size and analyze them. This year, the theory was provided in form of video recorded lectures before the arranged lecture day so the students could study at their own pace. During the lecture day, discussion of the concepts presented in the videos and further explanation were provided. The students could evaluate their understanding of by taking non graded online quizzes on Canvas platform.

Home and classroom problems are exercises that are solved by students working in small groups. Classroom problems are solved by the students with the help of the teachers, if needed. The help is provided in form of problem discussion. The home problems are solved by the students at home usually with the help of computers for solving the equations using numerical techniques. Some of the home problems are linked to the computer laboratory exercises.

Computer laboratory exercises are also carried out in groups. By this, the students exercise the whole chain from a problem in chemical reaction engineering, formulating a mathematical problem, choosing numerical algorithms, calculation methods and computer software, and doing the computer calculations in the computer classroom.

The class problems and the computer laboratory exercises aim to enhance problem solving skills both with and without computer usage. For passing the course is it essential to participate in classroom solving the problems. The classroom problems allow the direct interaction of students with the teacher during problem solving and get peer feedback from the other participants.

4. Students' workload

Given the course structure and duration a relatively high load is expected. The students' responses were distributed evenly in a large workload span. 33.3% of the responses indicated a workload of 30-35 hr/week. While a 33.3 % 18-20 hr/week workload and 33.3% 9-11 hr/week workload. Given that the response rate to the questionnaire was 50% it is risky to conclude whether the workload deviates from the expected. However, based on the students comments the workload was relatively high which they like and stimulated their understanding (see 7. Summary of students' opinions).

5. Students' results on the course

The results from the course are summarized in the table below. They are similar to previous years despite the change from a 5-hour written exam to a combined online written exam and an oral exam.

Grade	A	B	C	D	E	F	Did not take exam
No. of students	0	1	3	4	1	2	1

6. Students' answers to open questions

Most of the students appreciated the classroom problems and the continuous active participation evaluation and preparation for the exam through the different activities.

The distribution of the assignments over the teaching period might be of a concern even though that was improved from previous year. Some of students felt that the assignments were increased towards

the end of the period which was closer to the exams. Things to improve is also the addition of extra solved exercises either during lectures or as additional material.

7. Summary of students' opinions

The students indicated that it is a demanding course with many assignments/deliverables during the course which, however, stimulated their understanding and prepared them for the exam. Online quizzes were also appreciated as a way for them to evaluate their own understanding. The recorded lectures were appreciated by students because allowed them to go through many times to clarify questions. They indicated though that they would like to have more solved examples as a resource to help them understand some concepts more easily. The course content was very adapted to previous knowledge but also enriched with industry and real-life related issues. The students indicated that the online examination time was too short, and they felt very much stressed given the uncertainty of the circumstances (covid-19 pandemic).

8. Overall Impression

The students seemed to respond quite well to the changes implemented due to the pandemic and appreciated the extra effort. Their result indicate a satisfactory pass rate (81%) with a satisfactory grade (89% of the passed students had a grade of equal to or greater than D) .

9. Analysis

Based on the responses:

The meaningfulness of the course was well perceived by the students and most of the students felt that the topics discussed were very interesting and all the respondents a had a neutral to positive response. Also, most of the respondents explored things on their own to some extent. However, the distribution of the answers indicates that some of the students did not test ideas some of their own ideas or learn from experience. The course allowed for freedom in learning attitude and things to be tried by the students in a supportive environment. The students felt included in the community and worked together.

Most of the students felt that it was clear what the learning objectives of the course as well as the course structure would be.

All the respondents felt that the course was challenging but at the same time stimulating. This is also indicated in their general comments section for the course. Even though the course it was demanding the students had enough time to reflect on their understanding. Based on the scores of the answers even though relatively high, it seems that the students felt that the course was lacking opportunities to influence the course activity. That may have to do with the many predefined tasks that the students have to deal with and in this particular occasion the online teaching.

Limited information on gender perspectives can be concluded since the responses of men are very close, yet slightly lower, to the scores of the overall group of respondents. Here it must be noted that to get information based on gender at least three responses are needed.

Unfortunately, no conclusions can be reached for the responses based on national/international students and disability.

It has to be noted that, it may be risky to rely solely on students' responses on learning experience due to rather low response rate and the correlation of response to grade expectations¹. Distributions and their comments might be more valuable.

10. **Prioritized course development**

Given the current situation, the responses and interactions with the students, the teachers feel that enhancement of distance learning activities and structures should be emphasized. Additional examples of solved problems (preferably recorded videos) will help the students as they have also indicated in their responses. Distribution of the assignments and their deadlines over the teaching period will be reviewed.

11. **Other information you want to share**

References

- (1) Stark, P.; Freishtat, R. An Evaluation of Course Evaluations. *Sci. Res.* **2014**. <https://doi.org/10.14293/s2199-1006.1.sor-edu.aofrqa.v1>.

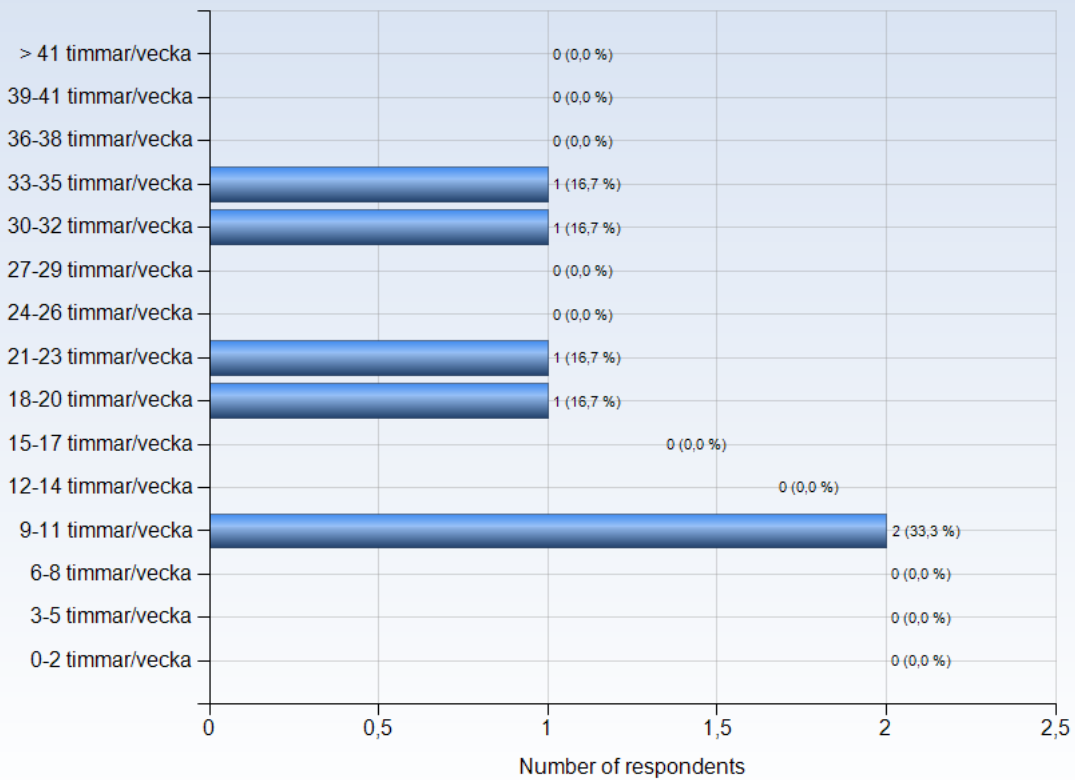


KE2045 - 2020-05-26

Antal respondenter: 12
Antal svar: 6
Svarsfrekvens: 50,00 %

ESTIMATED WORKLOAD

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



Comments

Comments (I worked: 9-11 timmar/vecka)

Given the amount of assignments, this was the time needed to complete all of them. It was, however, a good way of preparing for the exam. Sometimes it felt like the classroom problems were a bit too hard to perform, making them quite time-consuming. Perhaps it could have helped to have some more uploaded calculated examples from you, so that we could easier see how certain given parameters influence the final answer, if there are certain assumptions that we can do in a given case etc.

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

It was a very demanding course with many problems to hand in such as classroom problems, home problems, and labs. I think this is good since it forces the students to actively study during the whole course. This is something I am satisfied with!



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:

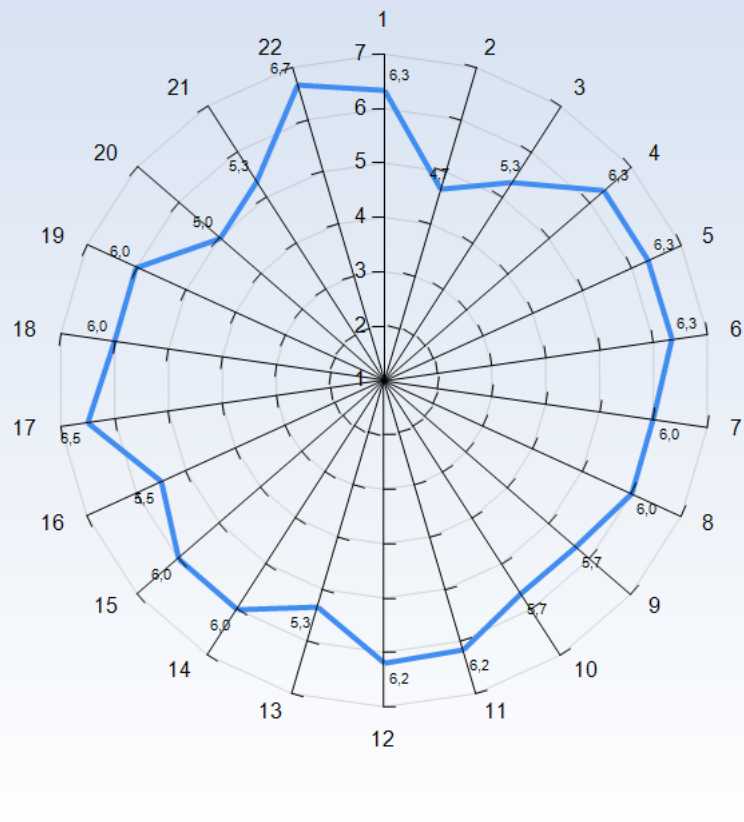
1 = No, I strongly disagree with the statement

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.

Average response to LEQ statements - all respondents





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.

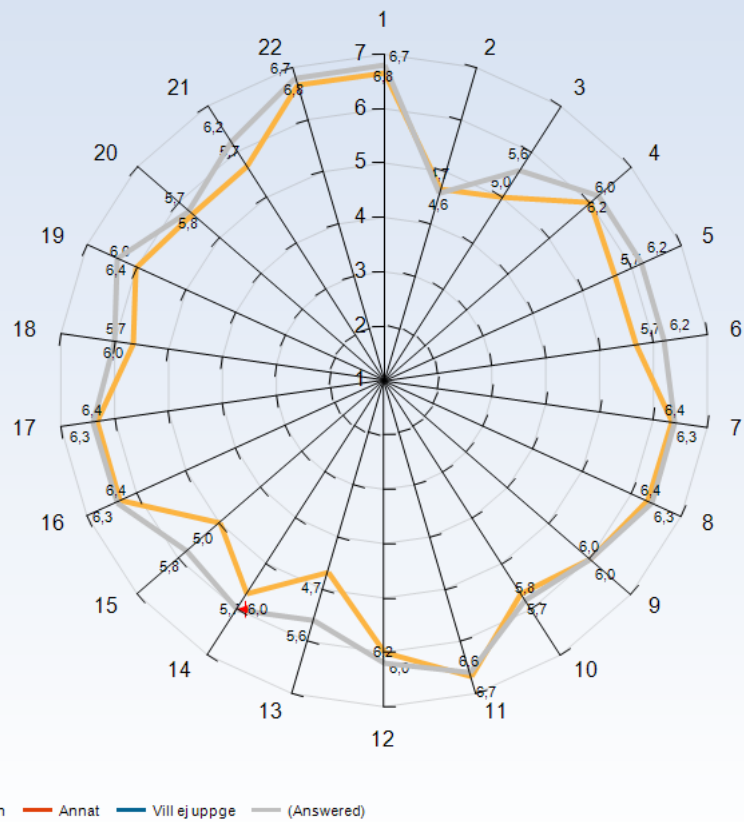
Biggs J. & Tang, C. (2011). *Teaching for Quality Learning at University*, Chapter 6, pp. 95-110. Maidenhead: McGraw Hill.

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



Comments

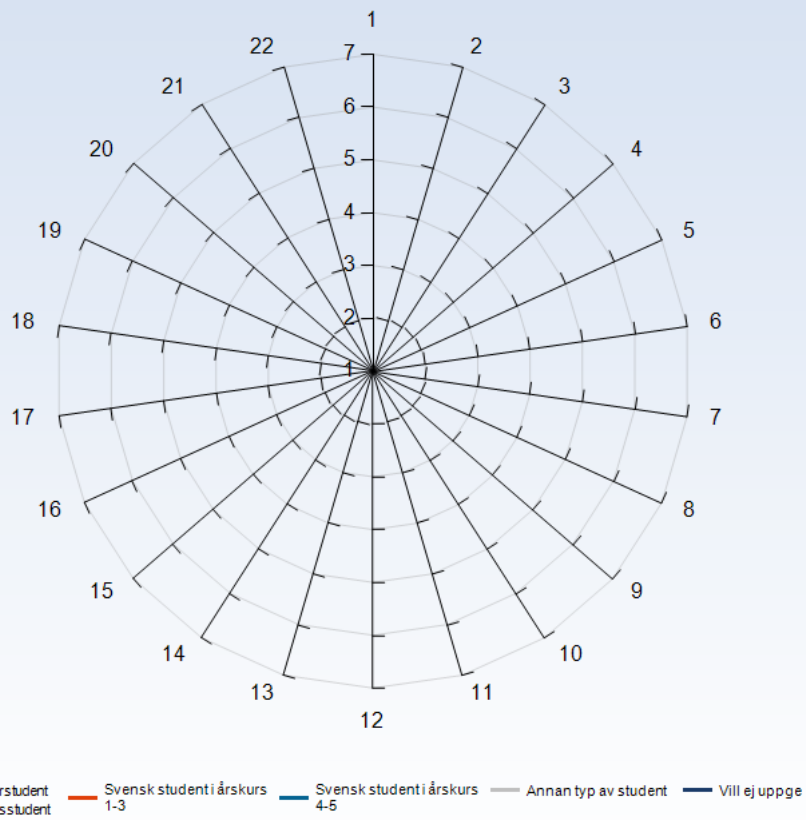
Comments (I am: Kvinna)

I have a bachelor degree in Chemical Engineering and currently at my first year of master degree.

Comments (I am: Man)

nothing to add

Average response to LEQ statements - per type of student

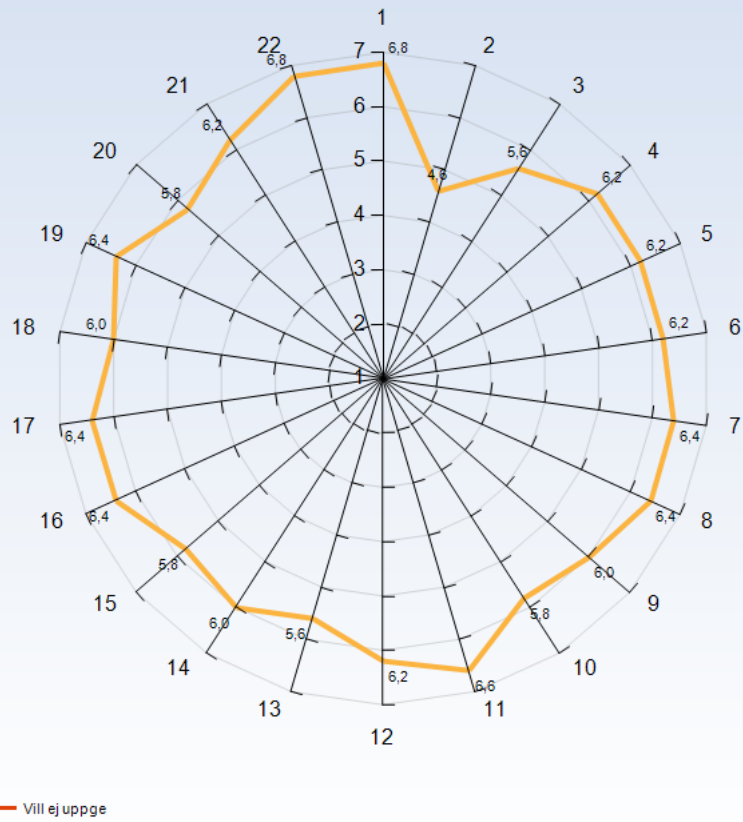


Comments

Comments (I am: Internationell masterstudent)

Very adapted to my previous knowledge but with a more practical focus and touching what's actually happening in the industry

Average response to LEQ statements - per disability



Comments



GENERAL QUESTIONS

What was the best aspect of the course?

What was the best aspect of the course? (I worked: 9-11 timmar/vecka)

The continuous preparation for the exam by the many assignments proposed

I liked having the lectures recorded so that you could look through them multiple times if you wanted to. I liked having online questions that you could go over to see if you understood the related part of the course sufficiently well or not.

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

The content of the course was really good, the exercises dealt with real problems and were interesting to work with.

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

All classroom problems and home problems were a very nice way to learn during the course. Very nice!

What was the best aspect of the course? (I worked: 30-32 timmar/vecka)

The assignments were very interesting and challenging and I felt that I learned a lot from them.

What was the best aspect of the course? (I worked: 33-35 timmar/vecka)

It was an hard course, with a lot of assignment and deadlines and it took a lot of time in term of hours spent on it. Nonetheless, it was incredibly stimulating and challenging, sometimes I felt stressed and under pressure because all of the assignments, but I feel I improved different skills and collaboration with other students and exchange of opinions. In two words: difficult and stimulating.

What would you suggest to improve?

What would you suggest to improve? (I worked: 9-11 timmar/vecka)

To reevaluate the time span of the exam, since it was too short

Some of the published old exams on the course-site were perhaps a bit too old in my opinion, the course responsible and the course itself might have changed from 2010, for example. So I would suggest some more "newer" exams, with answers being published as well. As already mentioned, some more examples I think would have been good. Maybe you could have had a time each week when you went through a calculation example or two, preferably recorded it too (as you had done with the lectures). I would also have liked to have more online questions available, perhaps one after each lecture to get a understanding of how well you understood the subject, to get as feel if you should go over the lecture again or not.

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

No comments

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

I think this course was very good under the given circumstances.

What would you suggest to improve? (I worked: 30-32 timmar/vecka)

I would like to see more solved exercises during lectures.

Also, I felt that in the last weeks of the period we had a lot more assignments gathered than the rest of the period.

What would you suggest to improve? (I worked: 33-35 timmar/vecka)

I had the feeling that the theory explanations sometimes were not deep enough and we had to do a lot of the study by ourselves, so the lectures did not add information that could be found also in the book.

What advice would you like to give to future participants?

What advice would you like to give to future participants? (I worked: 9-11 timmar/vecka)

Do all of the assignments and try to understand them, it would be helpful for the exam

Not all in my group had the course literature, but it is quite good to have so I recommend buying it.

Also try to read some of the course literature in advance, so that you have read a bit about the subject that the lecture is going to be about. It makes it easier to understand the content of the lectures.

Don't be afraid to ask the lecturers/professors if there is something you don't understand (they will not grade you lower because you ask questions).

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

Continuous learning is important to keep up with the course

What advice would you like to give to future participants? (I worked: 30-32 timmar/vecka)

I would say that it is very important to study the course from the beginning of the period and pay a lot of attention to the assignments.

What advice would you like to give to future participants? (I worked: 33-35 timmar/vecka)

Study well the theory from the beginning and ask any doubt to the professors since they are really keen on helping and that improved my knowledge way better.



Is there anything else you would like to add?

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

I understand that under the circumstances the exam modality was changed and that we are the experiment group in this new modality. In my opinion, three hours were not enough to think and analyze most of the problems.

Is there anything else you would like to add? (I worked: 21-23 timmar/vecka)

I was quite surprised when doing the exam. My view is that I have learnt very much during the course and could handle the course content on at least an E-level. But the exam was very short with many questions so that made the exam unnecessary hard in relation to the problems with distance courses.

I am very glad that you now are thinking about eventually change the grading limits for the exam after this problem was brought up to you. This makes it feel that the teachers on the course actually listens and cares about us and our progression in the field.

I sincerely hope that everyone that tried to do the exam and got F is given a new chance for an FX complimentary exam even though they might not reach the FX level.

Is there anything else you would like to add? (I worked: 33-35 timmar/vecka)

I found the written exam harder than I thought because of the time, and unfortunately I think that in order to try to write stuff I have written very wrong things that can give the impression that I was less prepared than I actually felt.

SPECIFIC QUESTIONS

RESPONSE DATA

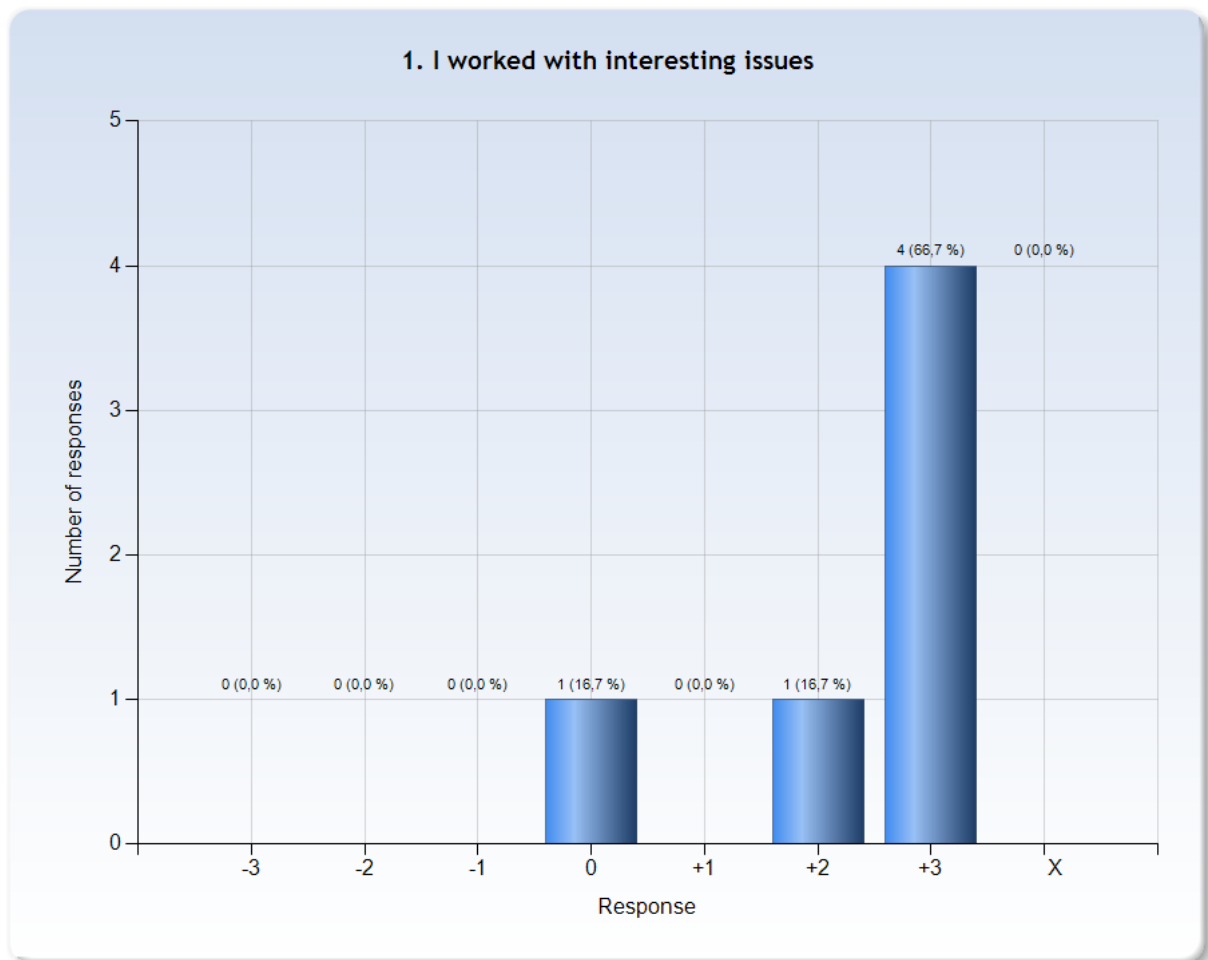
The diagrams below show the detailed response to the LEQ statements. The response scale is defined by:

-3 = No, I strongly disagree with the statement

0 = I am neutral to the statement

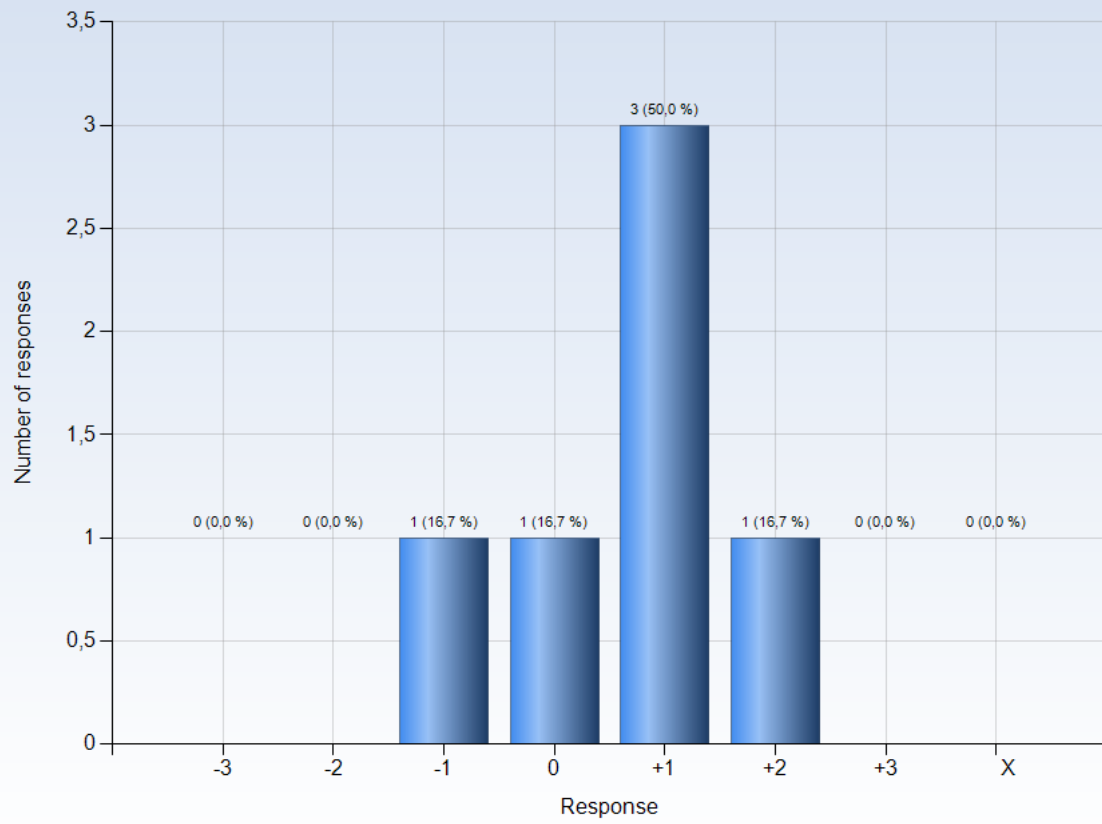
+3 = Yes, I strongly agree with the statement

X = I decline to take a position on the statement



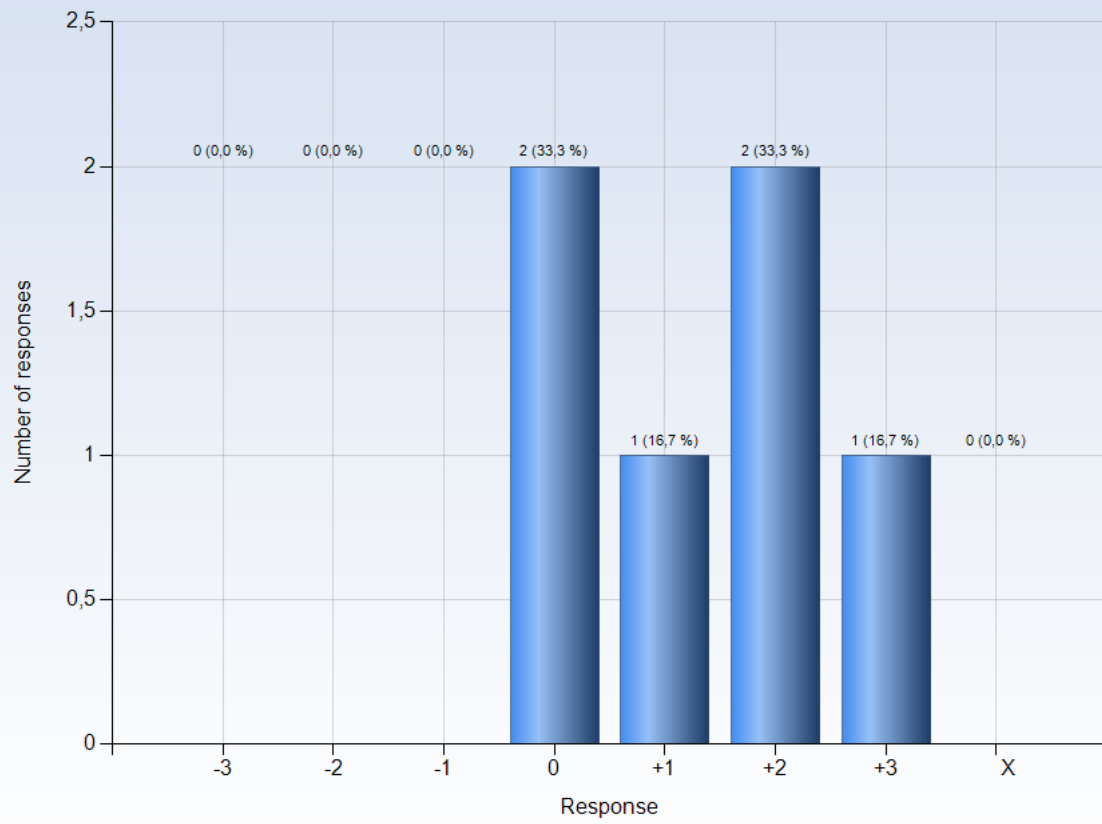
Comments

2. I explored parts of the subject on my own



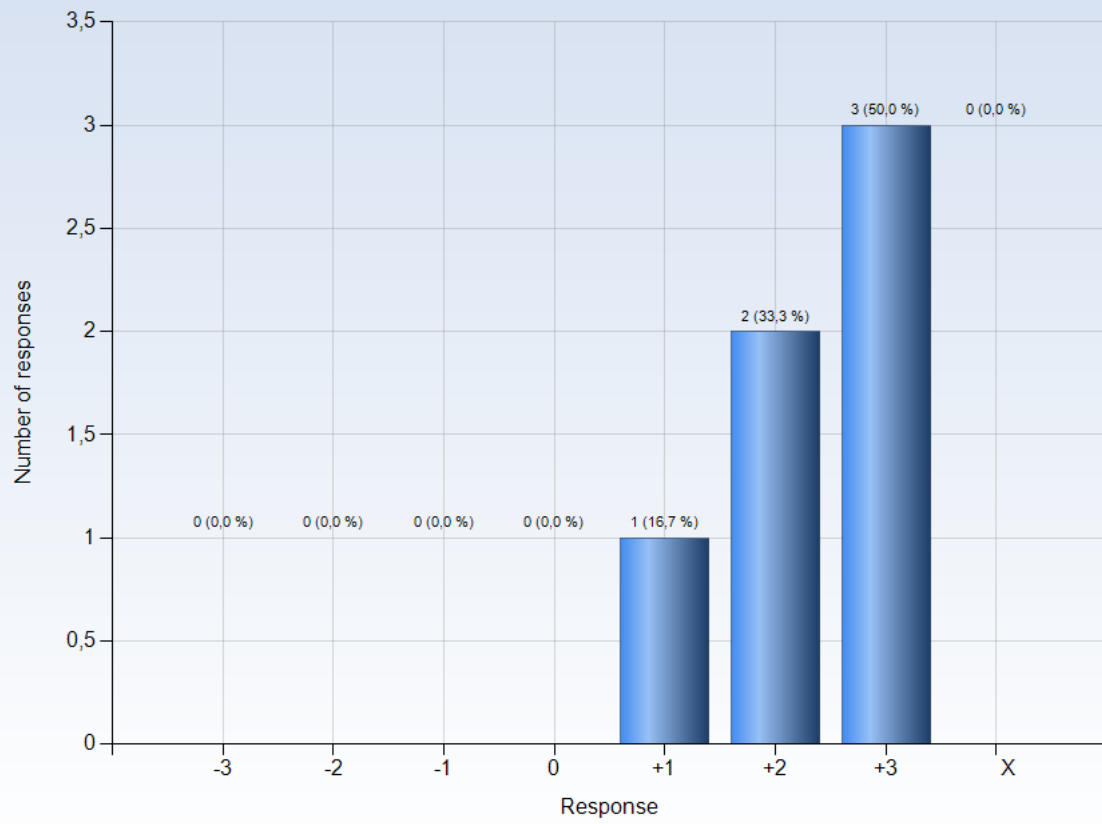
Comments

3. I was able to learn by trying out my own ideas



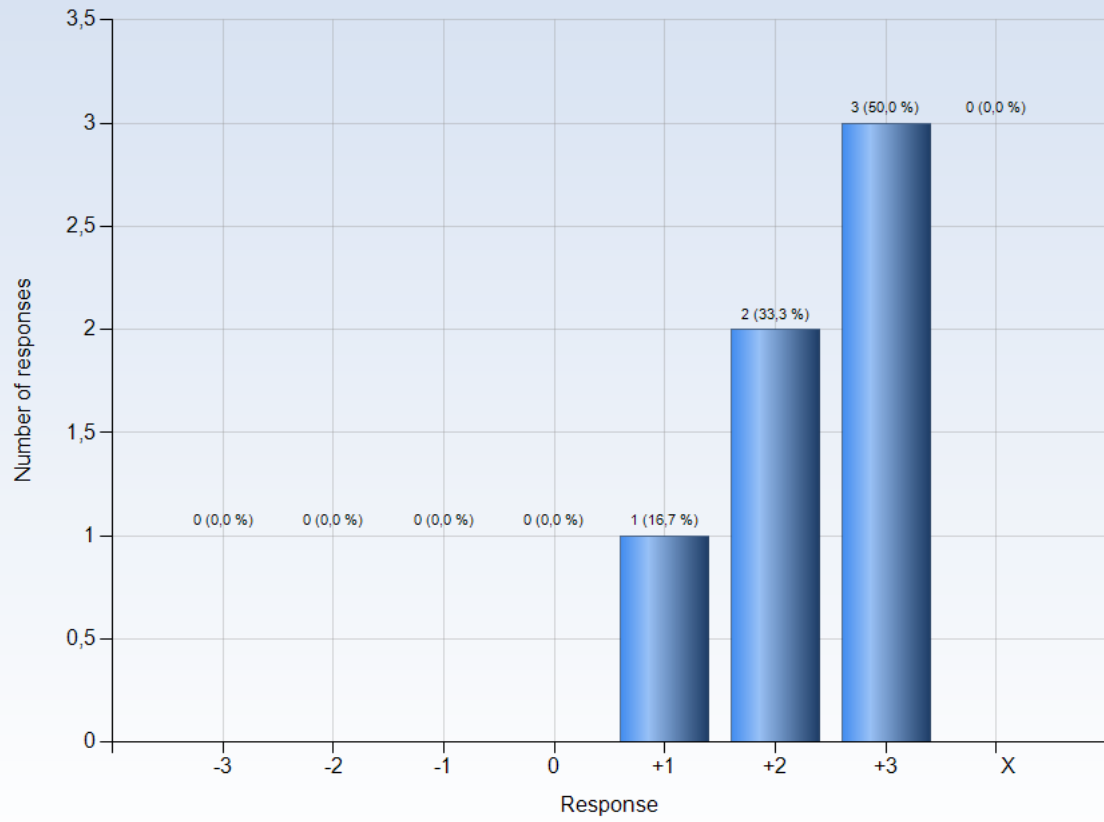
Comments

4. The course was challenging in a stimulating way



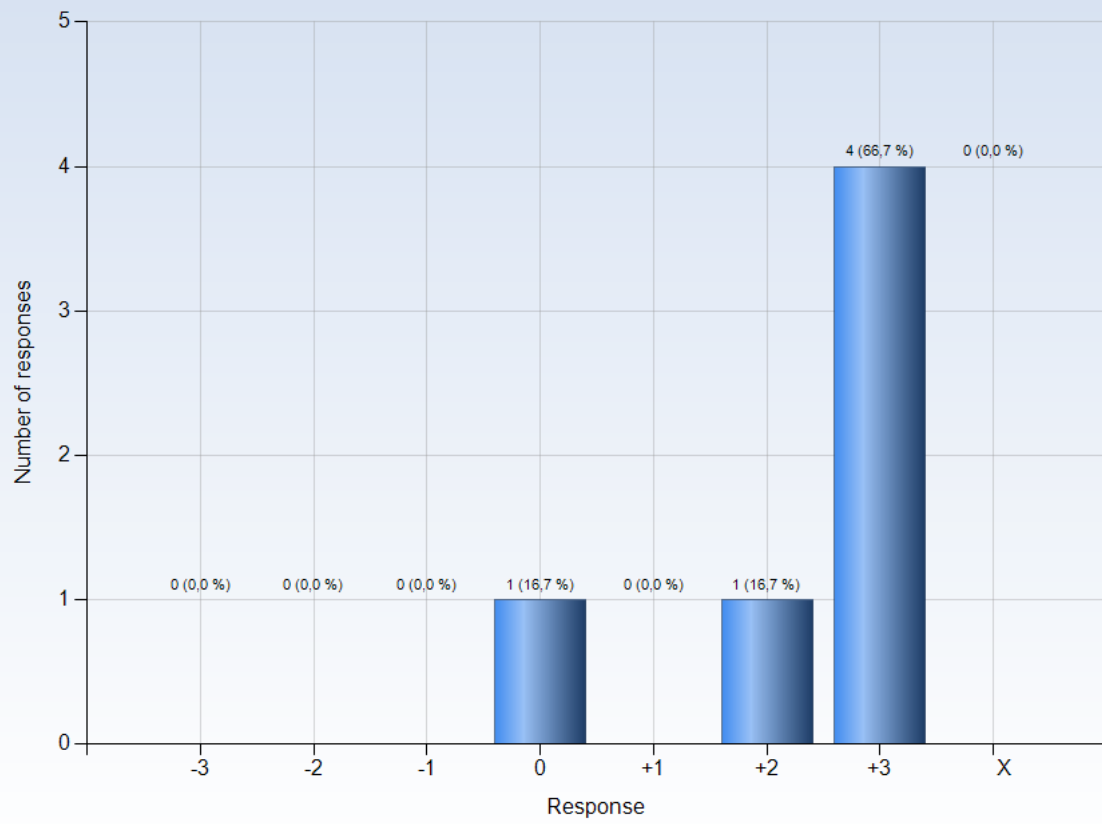
Comments

5. I felt togetherness with others on the course



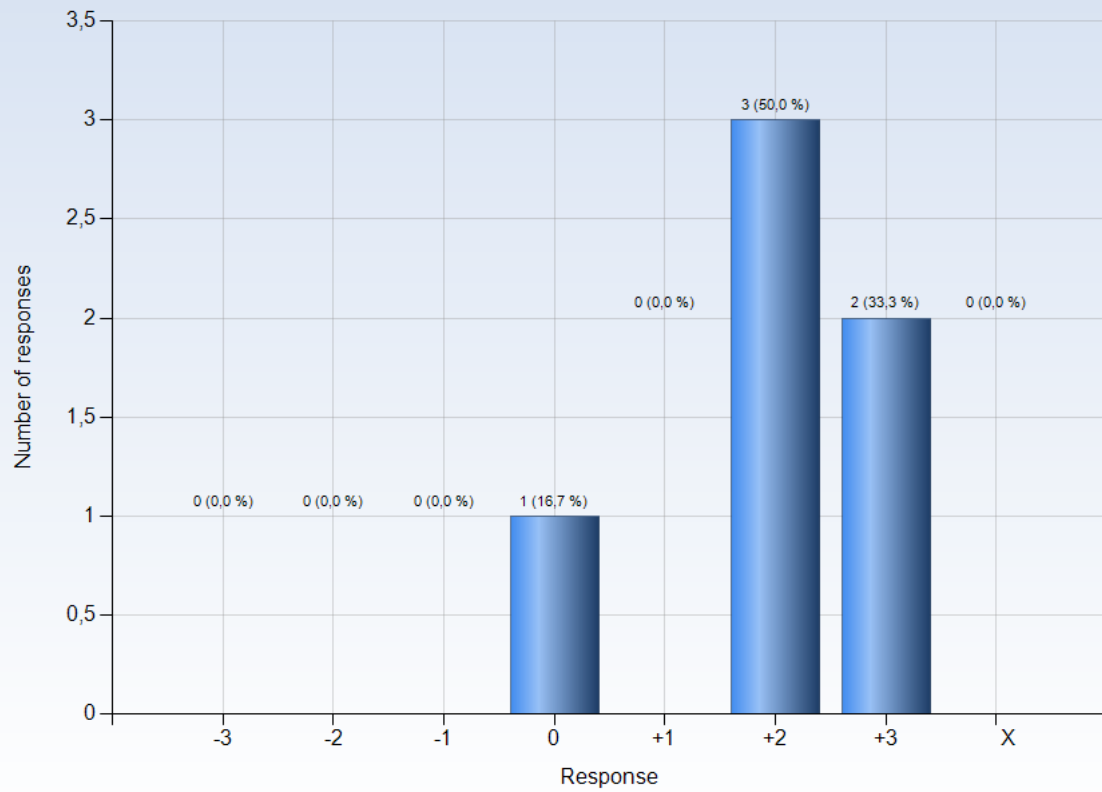
Comments

6. The atmosphere on the course was open and inclusive



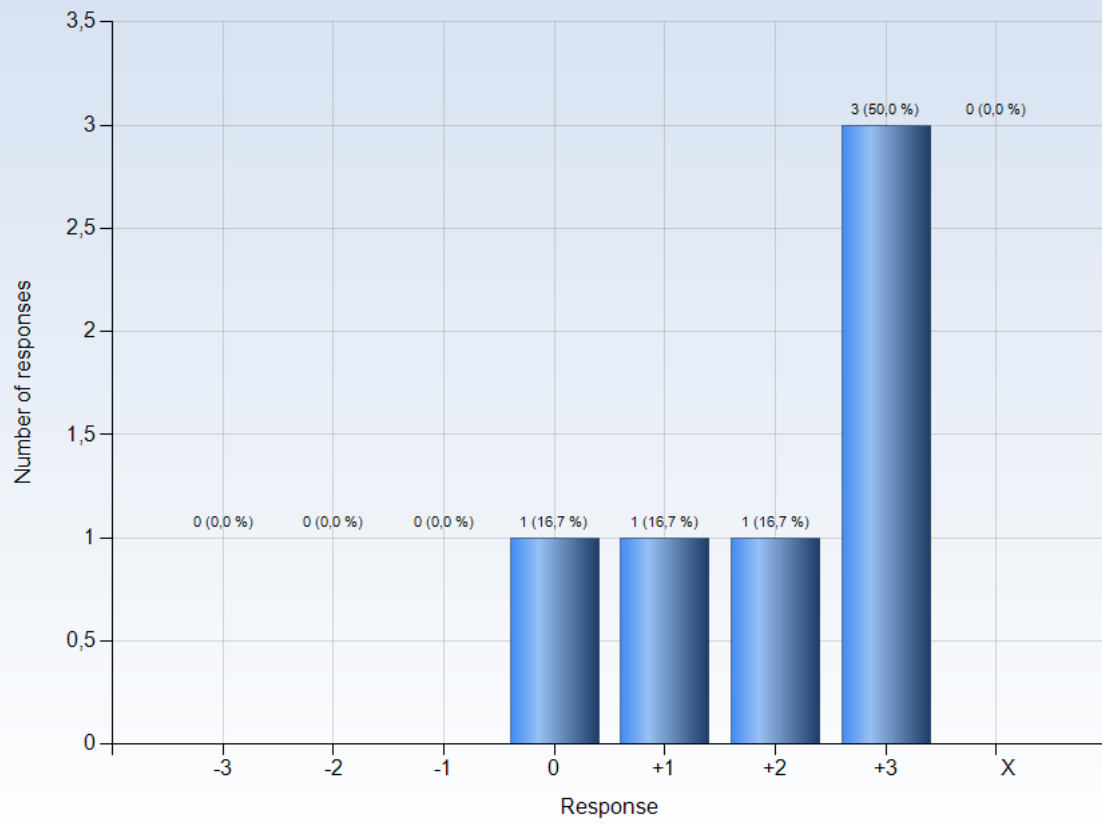
Comments

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



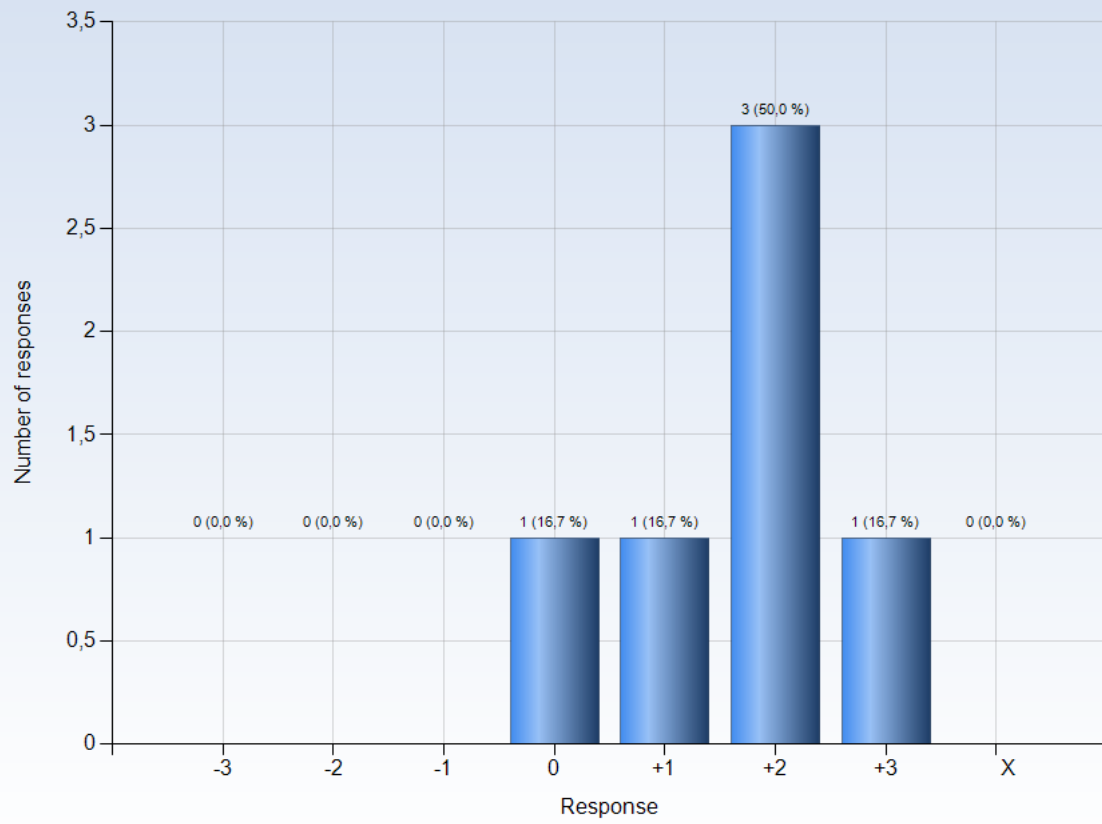
Comments

8. The course was organized in a way that supported my learning



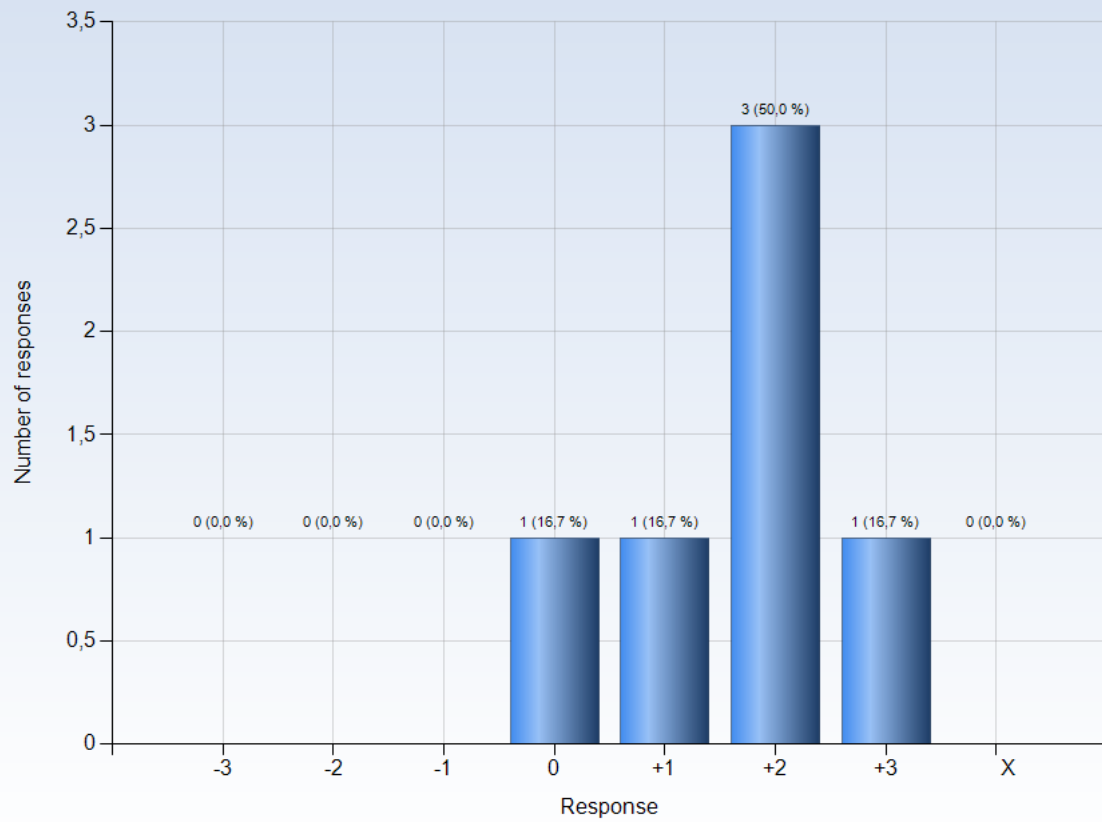
Comments

9. I understood what the teachers were talking about



Comments

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

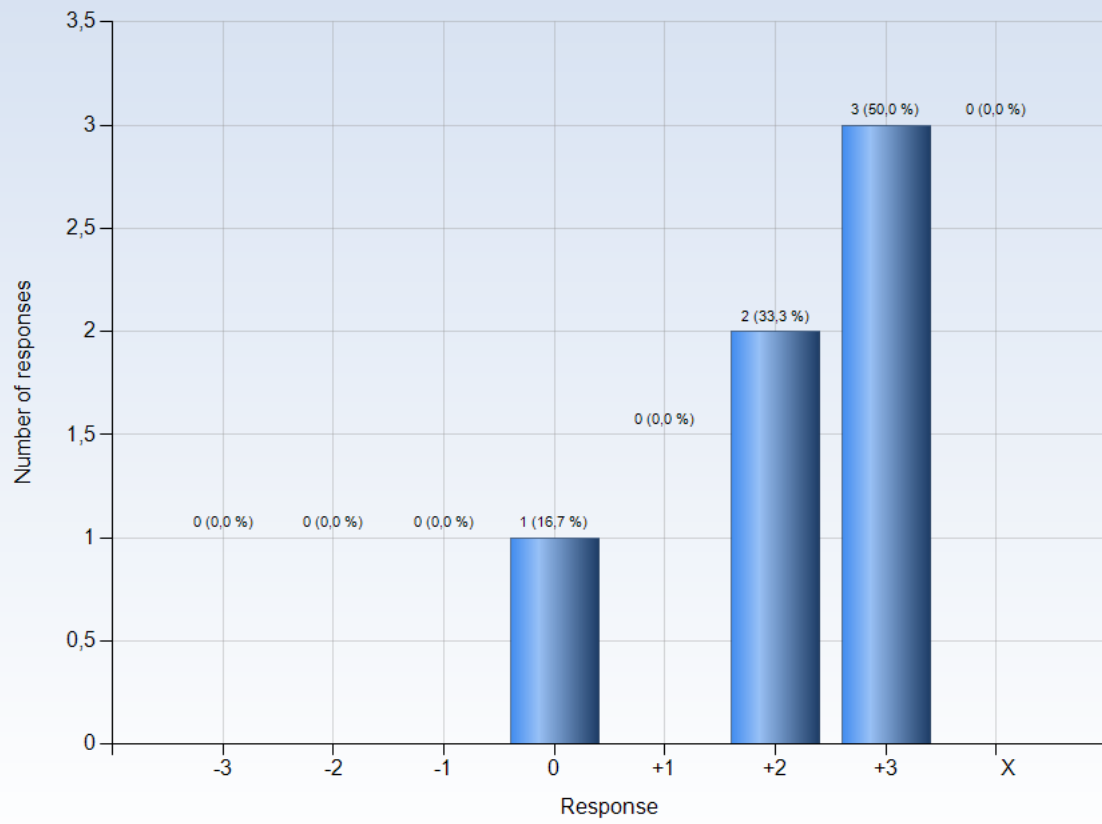


Comments

Comments (My response was: 0)

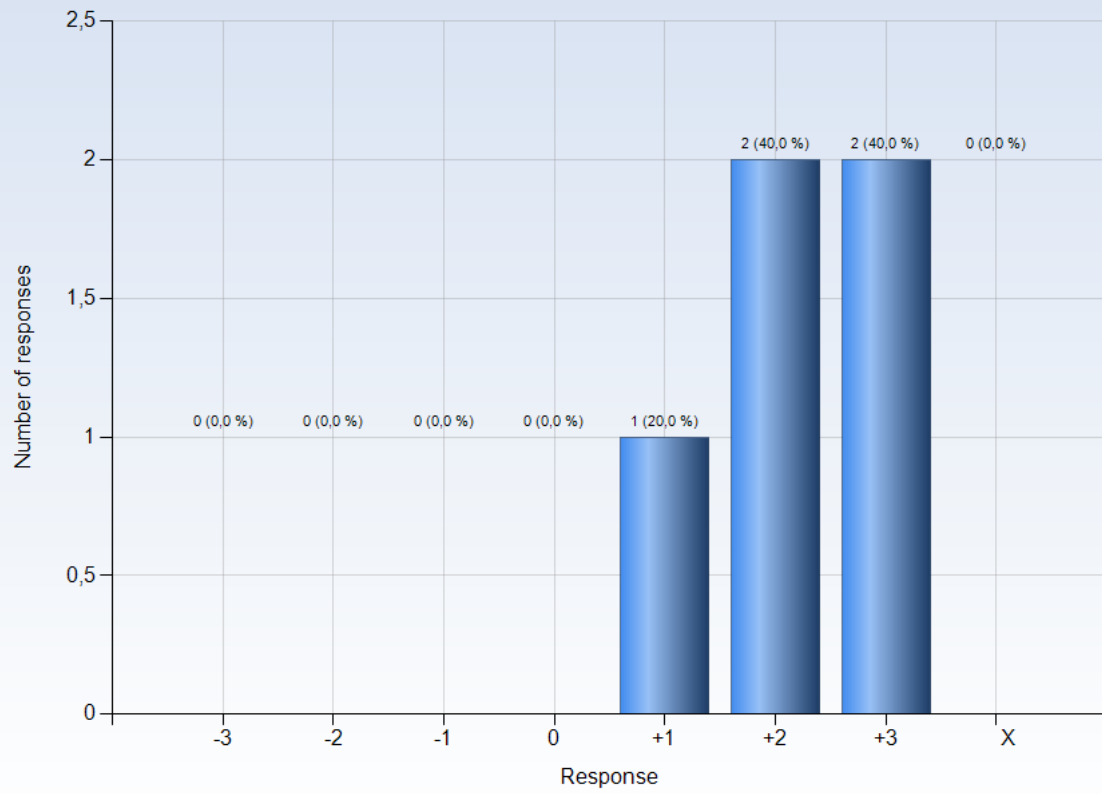
More examples I think would have been good. Maybe you could have had a time each week when you went through a calculation example or two, preferably recorded as you had done with the lectures.

11. Understanding of key concepts had high priority



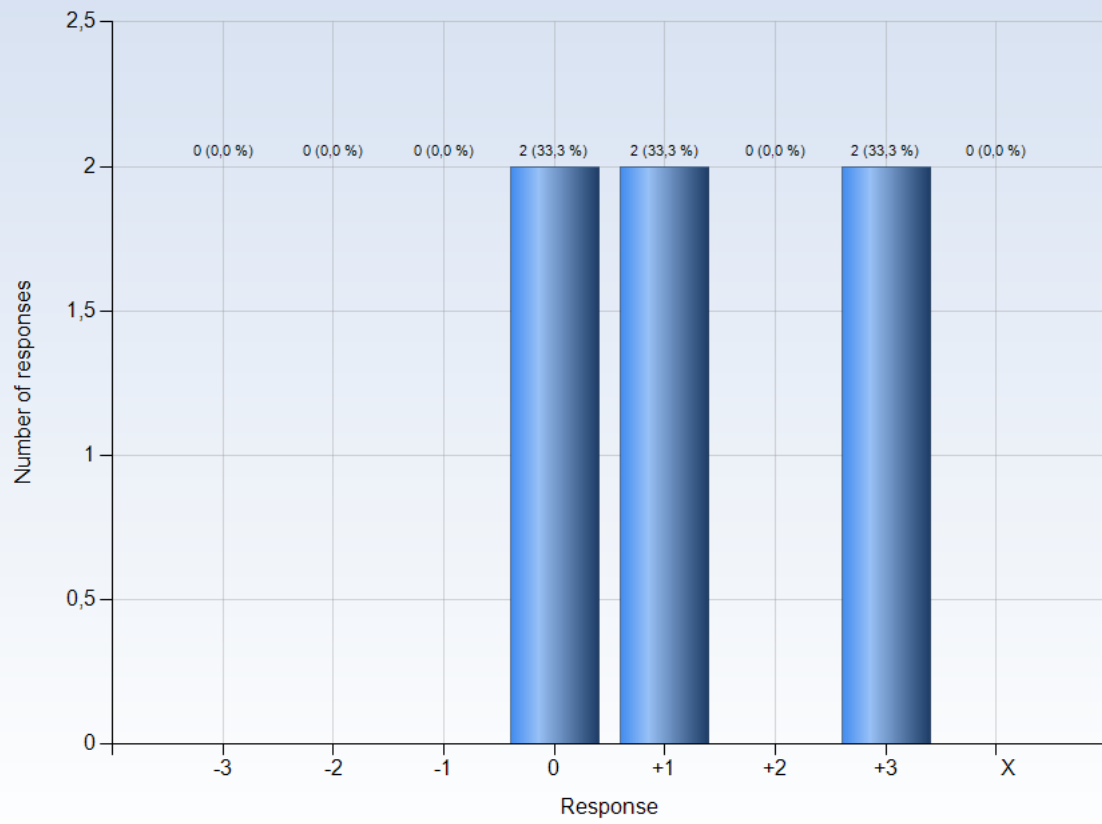
Comments

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



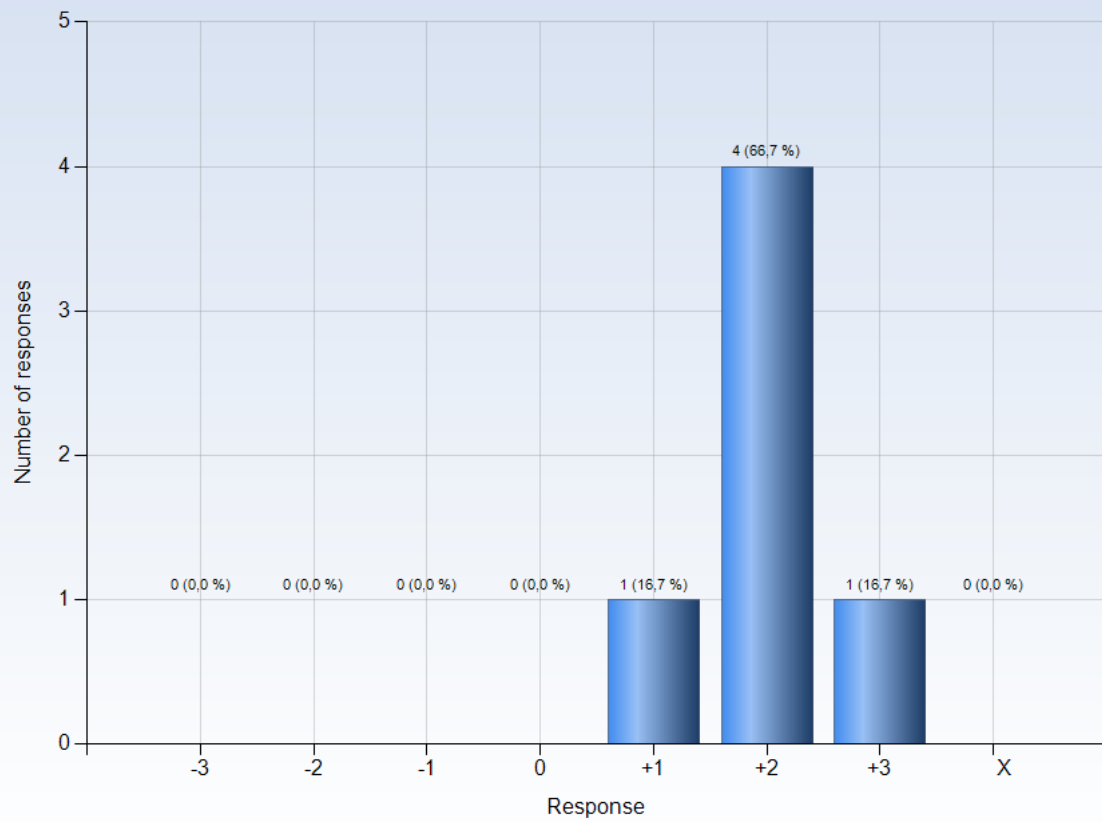
Comments

13. I understood what I was expected to learn in order to obtain a certain grade



Comments

14. I received regular feedback that helped me to see my progress

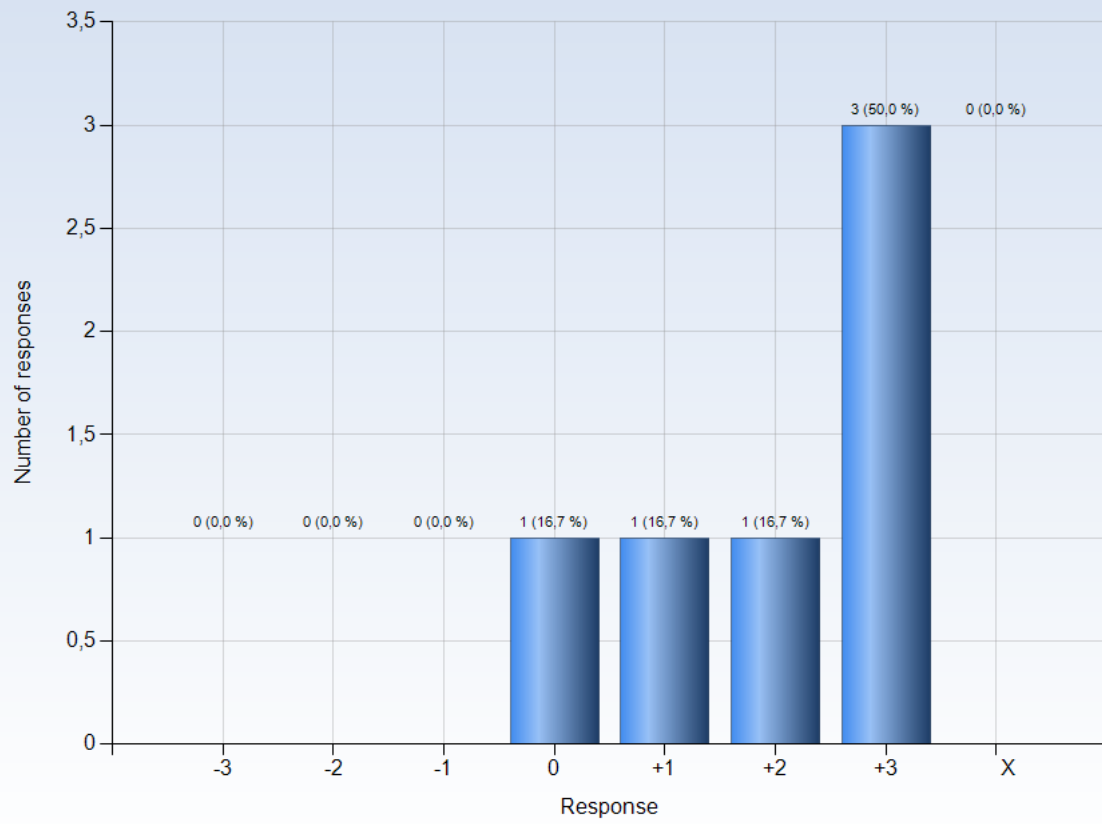


Comments

Comments (My response was: +1)

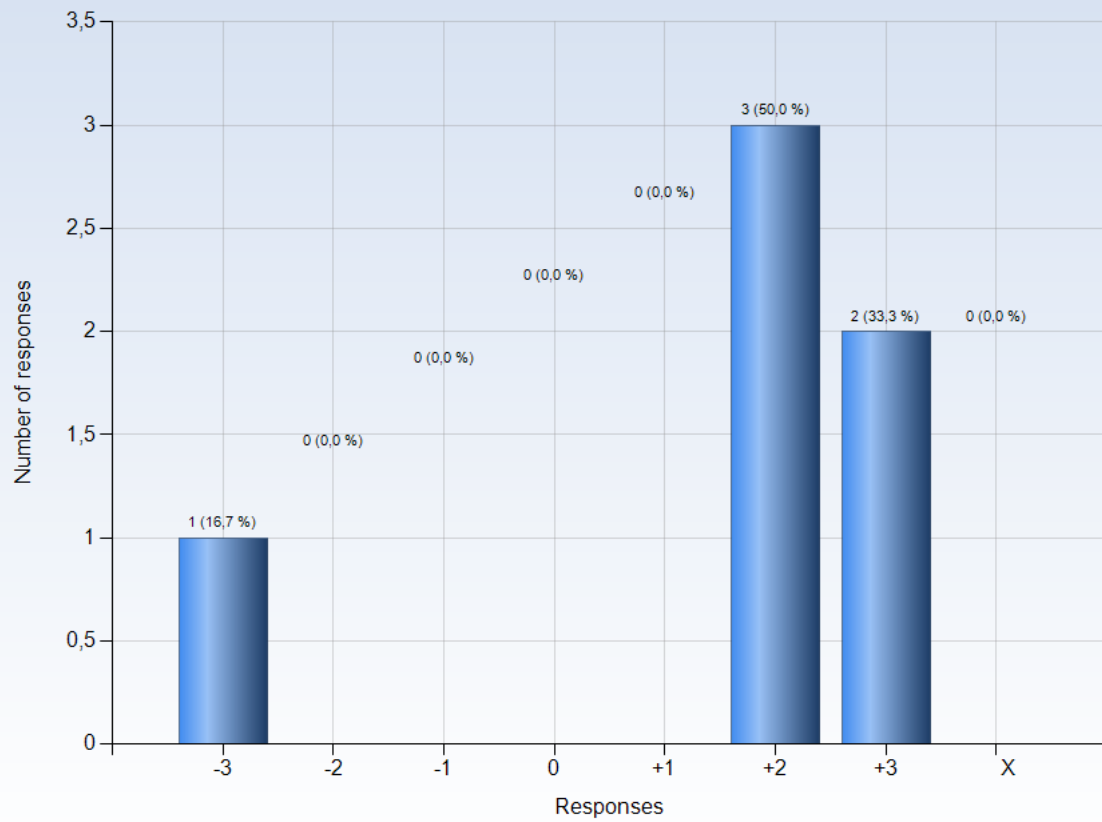
I would have liked to see how you would have tackled the questions (classroom problems, computer labs and the home problems). That way it is easier to see where we did "a bad turn".

15. I could practice and receive feedback without being graded



Comments

16. The assessment on the course was fair and honest

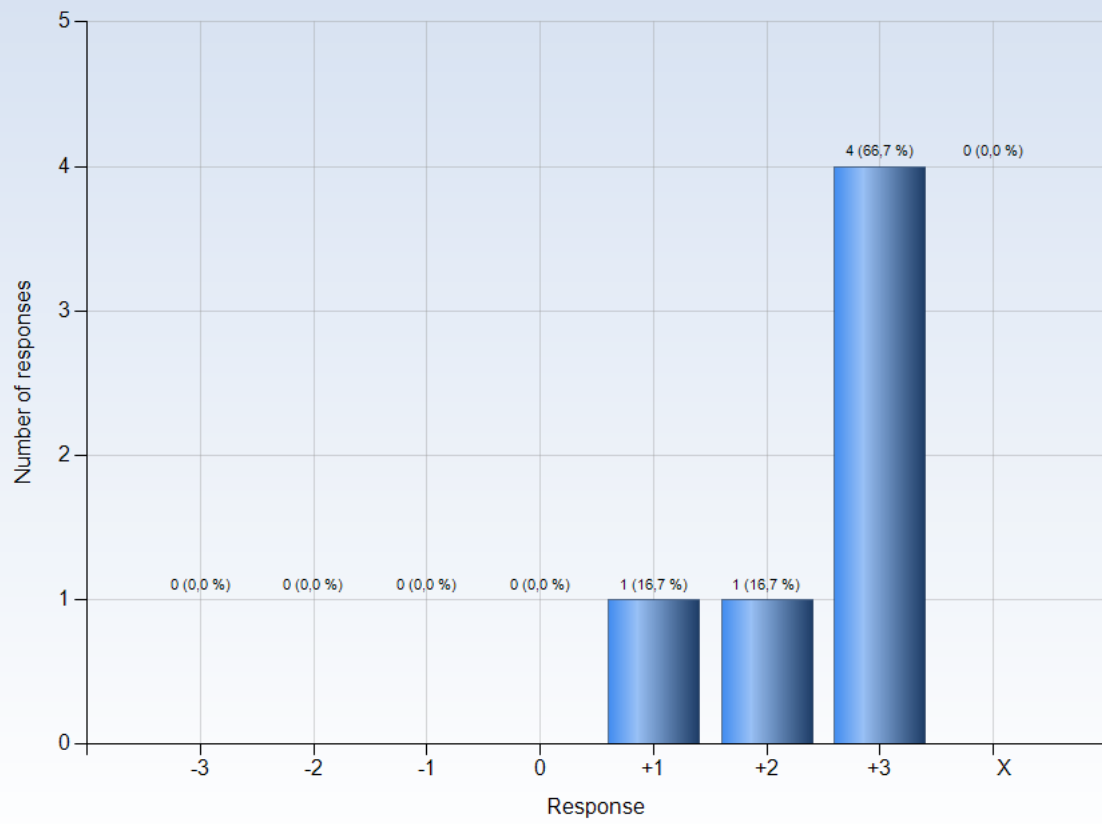


Comments

Comments (My response was: -3)

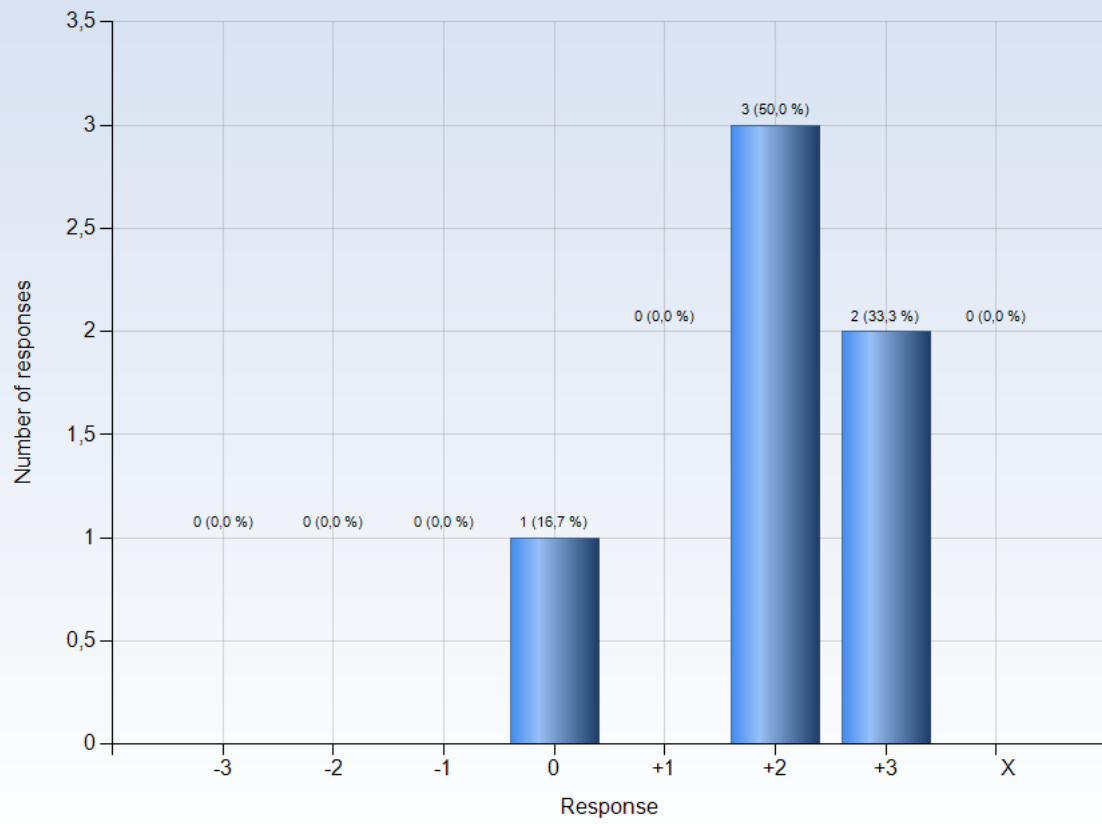
The course was very good! But the exam was very very hard

17. My background knowledge was sufficient to follow the course



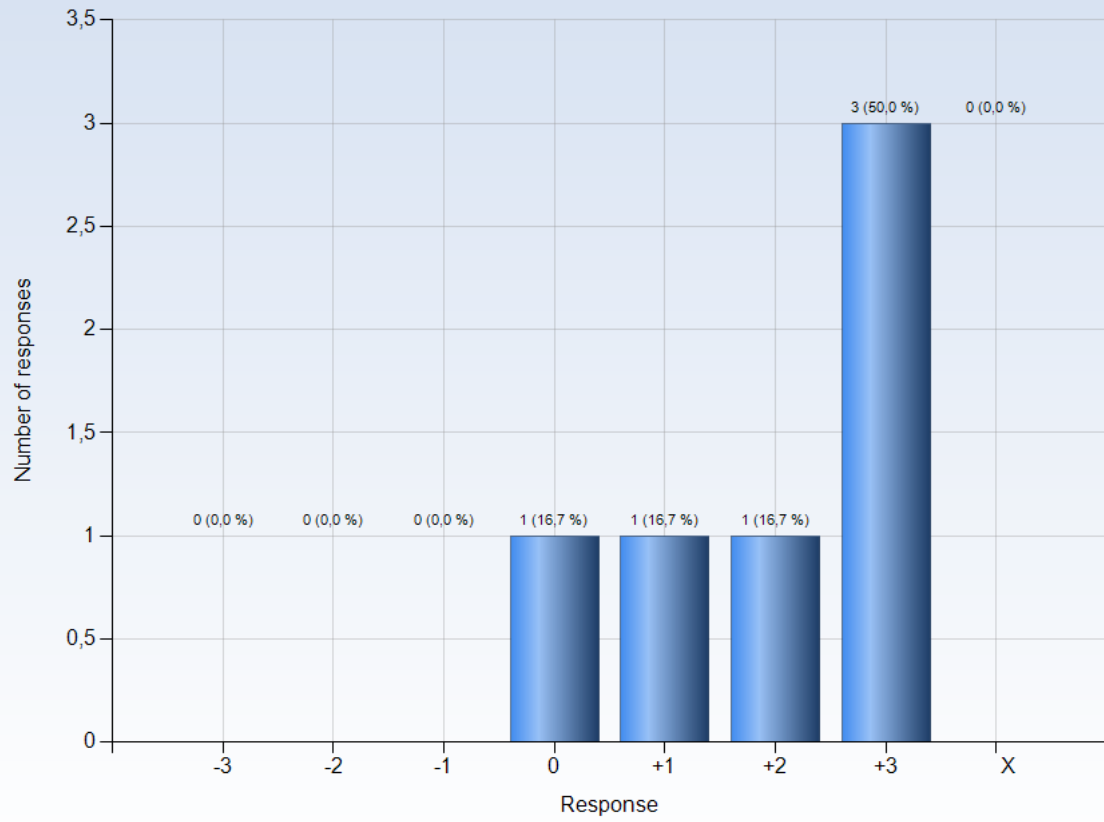
Comments

18. I regularly spent time to reflect on what I learned



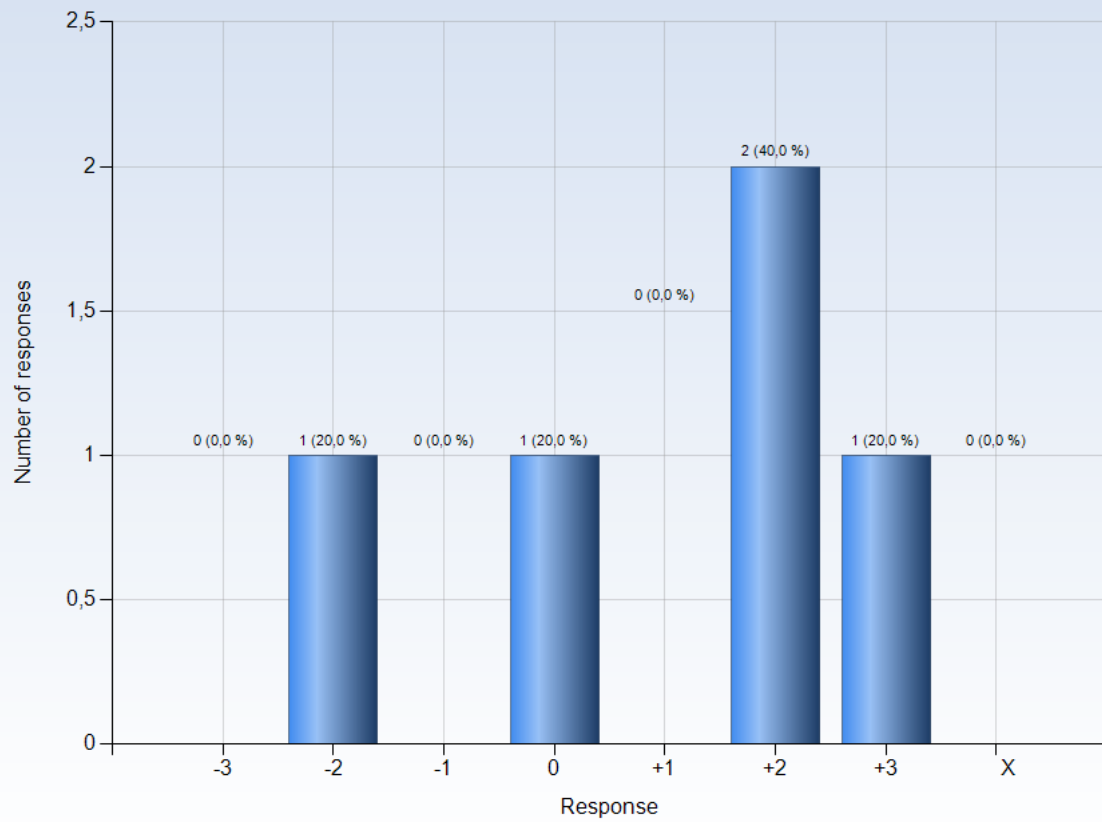
Comments

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



Comments

20. I had opportunities to influence the course activities

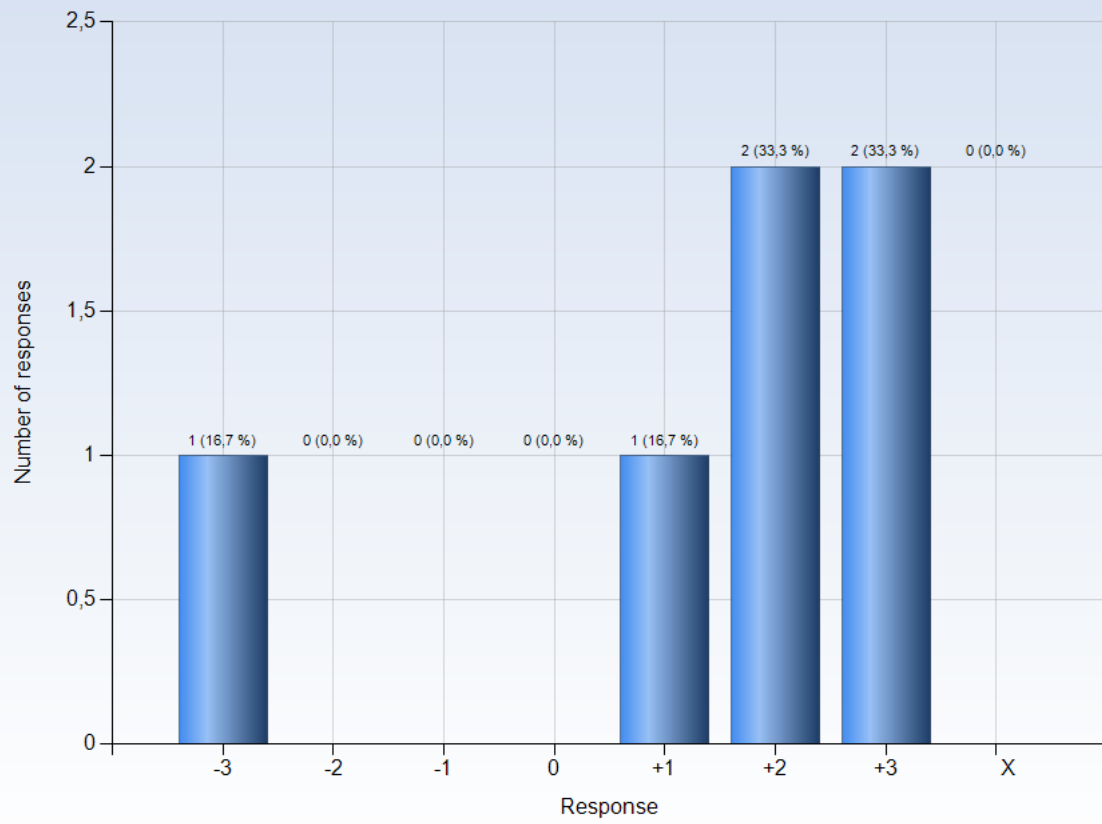


Comments

Comments (My response was: +3)

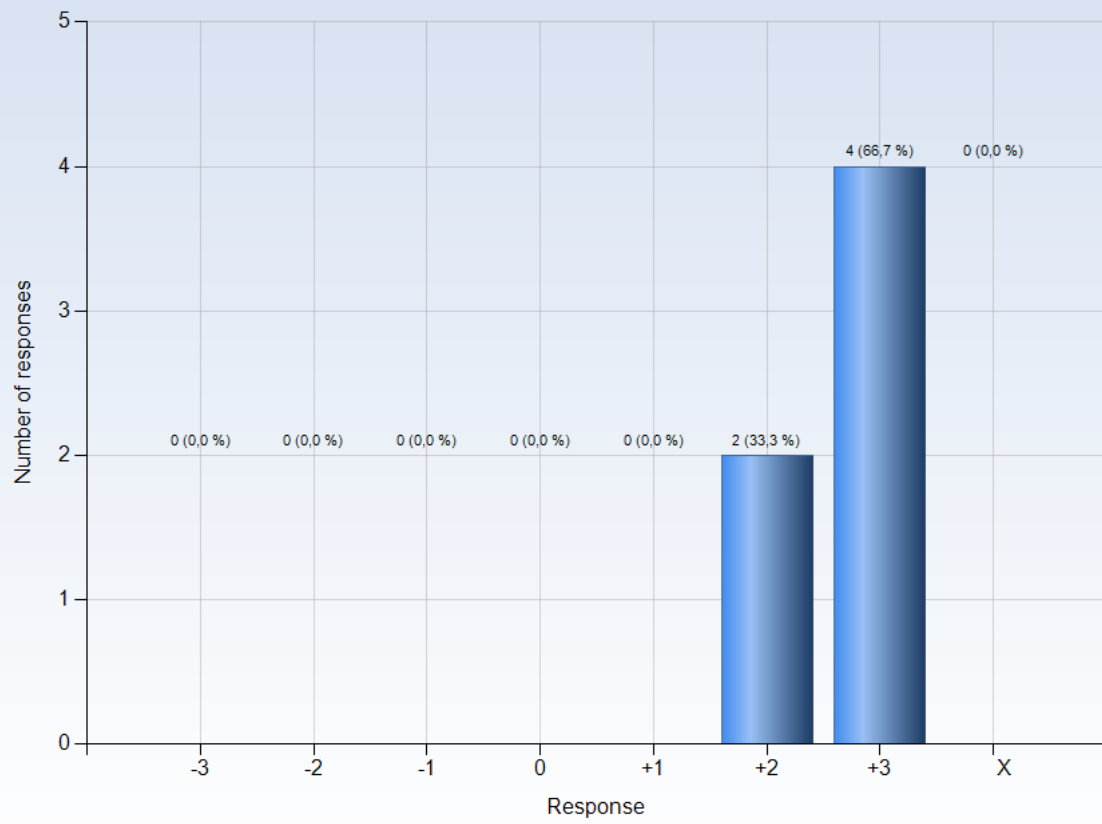
It really felt like you listened to what we had to say, which I think is very important.

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



Comments

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



Comments