Course Analysis
EQ2411 Advanced Digital Communications

Ragnar Thobaben, ISE, EECS, KTH

Course Data

Course name	**Advanced Digital Communications**
Course code	EQ2411
Credits	7.5 cu
Prerequisites	EQ2310 Digital Communications
Term	**VT 2018, period 3**
Participation	7 registered students (4 women) Targeted groups of students: TINNM1, TINNM1-COE, TIVNM2-DMTE
Teachers	**Ragnar Thobaben** (course responsibility and lectures) Email: `ragnart@kth.se` Phone: +46 8 790 8452 **Sahar Imtiaz** (TA at the tutorials) Email: `sahari@kth.se`
Lectures	12 lectures, 2h per lecture
Tutorials	12 tutorials, 2h per tutorial
Examination	Written exam, 5h
Examination rate	6 of 7 students (4 of 4 women) passed the course

General Information

Background The course Advanced Digital Communications has been given once per year since 2001 by teachers from the Signal Processing Lab and the Communication Theory Lab at the School of Electrical Engineering at KTH. Between VT-2008 and VT-2014, R. Thobaben has been the responsible teacher for the course. Between VT-2015 and VT-2017 Ming Xiao has given the course. Since VT-2018, R. Thobaben is again course responsible. The course has been redesigned in VT-2018 and is now given as a flipped class room course.

Students The course targets students from the Information and Network Engineering Master's Programme (mandatory for students with specialization in communication engineering; otherwise optional but recommended) and the ICT Innovation Master's Programme (optional).

Goals This course aims at introducing advanced topics in digital communications and provides students with up-to-date knowledge of the techniques used in modern communication systems and the principles underlying their design. The teaching an learning outcomes are defined as follows:
In order to pass the course, the students should be able to

- Describe the limiting effects in digital communication systems.
- Explain the basic principles of the transmission techniques.

- Apply the learned transmission techniques to standard problems in digital communications and to evaluate their performance in an analytical/mathematical way.

In order to acquire a higher grade, the students should also be able to

- Apply the learned transmission techniques to new and advanced problems, to adapt them appropriately, and to evaluate their performance under these new conditions analytically.
- Combine different techniques and perform an analysis in an analytical/mathematical fashion.

Lecture and Tutorial Format In this course round, the course has been redesigned, and it is now offered as a flipped classroom course (see the section on course development below for further details). Eight of the 12 lectures are available online as video lectures, and the corresponding meetings in class are used to deepen the understanding and work more interactively with the students. The remaining four lectures are currently taught in a classical format with power point lecture material. During the tutorials, the TA demonstrates the solutions of relevant problems. We ask the students for every other tutorial to prepare the solutions in advance.

Homework Projects Three voluntary homework projects are offered that allow the students to obtain bonus points on the exam. The projects are hands-on and combine simple matlab implementation tasks with analytical methods. The projects are partly solved in group work.

Main Textbook Fundamentals of Digital Communications, Upamanyu Madhow, 2008.

Examination Written exam (5h) consisting of five problems, each of which can give a maximum of 5 points. Up to 4 bonus points can be obtained from the voluntary homework projects. In order to pass the exam with grade E or better, both of the following two criteria have to be fulfilled:

- More than 11 (eleven) credits have to be obtained (including the bonus from the homework projects).
- 4 (four) out of 5 (five) exam problems have to be passed with 2 (two) or more credits.

This year, 6 of 7 students passed the course.

Course Development

As mentioned above, the course design has been changed to flipped classroom. For eight out of twelve lectures, video lectures are now available online, which are watched by the students before coming to class. The videos are currently offered as unlisted playlists on YouTube since YouTube allows students to adjust the speed and size of the videos to their preferences. These functionalities have not been available in the KTH system at the point in time, when the course was offered. After watching the videos, the students also do a small quiz to get initial feedback on their understanding. The quiz questions are then discussed in class at the following meeting. The class room meetings are also used to provide students with further details and to deepen their understanding.
Besides the new course design, the course content has been restructured into three main blocks (time-dispersive channels, advanced coding, and wireless transmission) in order to give a clear outline of the course and some content has been updated/replaced in order to keep the course up-to-date w.r.t. the development in the field.

Course Evaluation

The course was evaluated using the online system provided by KTH social. The course evaluation was anonymous and based on the standard learning experience questionnaire used at KTH. The answers were submitted after the final exam. **3 of 7 students participated in the course evaluation**.

Summary The polar diagram of the average responses for all questions shows that the course was received rather well. Except for two questions, all averages are above 4[1], which means that the students are positive with respect to the course. For example, the students felt that they could explore parts of the subjects on their own, the course was challenging in a stimulating way, the students felt togetherness with others, the atmosphere was open and inclusive, the organization and expectations were clear, students understood what the teacher was talking about, students could learn from examples and learn by collaborating with others, students felt supported, and understanding of key concepts was given high priority.
In the case of question 19, which received an average of 3.7, the comment of one student reveals that there was one individual student in the course who prefers a more conventional course design over flipped class room. Accordingly, the student's answers were rather on the negative side.

Criticism The students also point out ways to improve the course: For the projects, the students request more support during the execution of the projects and better feedback ofter grading the projects. For the exam, the students felt that one exam problem was unfair since they were told in the lecture that the respective topic will not be adressed in the given format in the exam. The students also suggest to revise the quiz questions, and to provide the video material as early as possible.

Workload The course credits of 7.5 hp translate into an expected full-time workload of 5 weeks and an average workload of roughly 22 hours per week. The responses by the students show that the students stay slightly below the expected workload, and in one case only half of the expected time is spent. From the comments it becomes also clear that the large variety of topics covered in the course is challenging for the students.

Personal Reflection

We completely agree that the students should get more support for and feedback on the projects. However, since the redesign of the course was done in real-time as the course was given, there was no time left to provide the students with additional help. We also think that it is unfortunate that the students got an exam problem that in its format was excluded in the lecture. The reason for this was a lack of communication between the TA and the course responsible. The video material was provided just in time when it was required. However, since the material is now ready, it will be available earlier in the next course round. We noticed though that the course schedule sometimes limits how much time the students have available for working with the video material. Finally, the workload looks reasonable, and considering that the indicated average workloads are slightly below the expectation, one could expect from the students to better deal with large scope of the course.

[1] 1 = "No, I strongly disagree with the statement;" 4 = "I am neutral to the statement;" and "7 = Yes, I strongly agree with the statement."

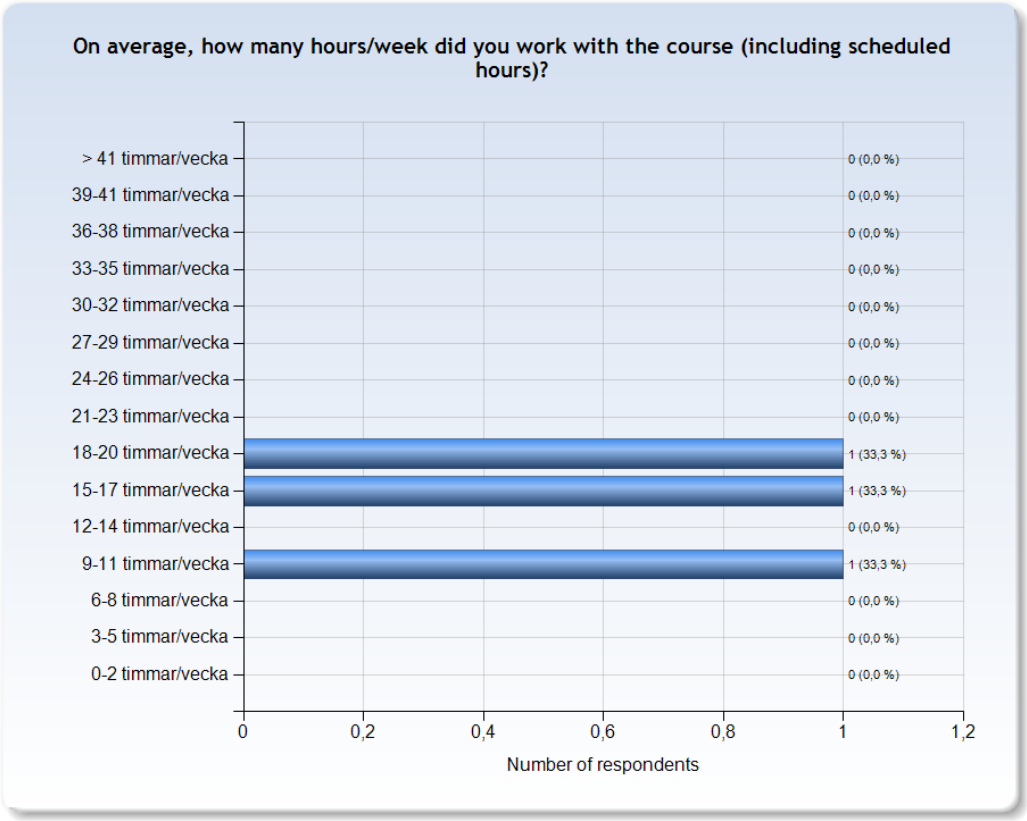
Conclusions and Next Steps

In the next course round, the content of two more lectures will be provided as video lectures, and new class-room material and quizzes will be developed for these lectures. Although the projects are identical to the projects that have been used since 2010, we will slightly revise the projects in order to make sure that students' time is spent well in this course. If time allows the existing video material may undergo a slight revision in order to add pointers etc. to increase understandability.

EQ2411 - 2018-03-27

Antal respondenter: 7
Antal svar: 3
Svarsfrekvens: 42,86 %

ESTIMATED WORKLOAD



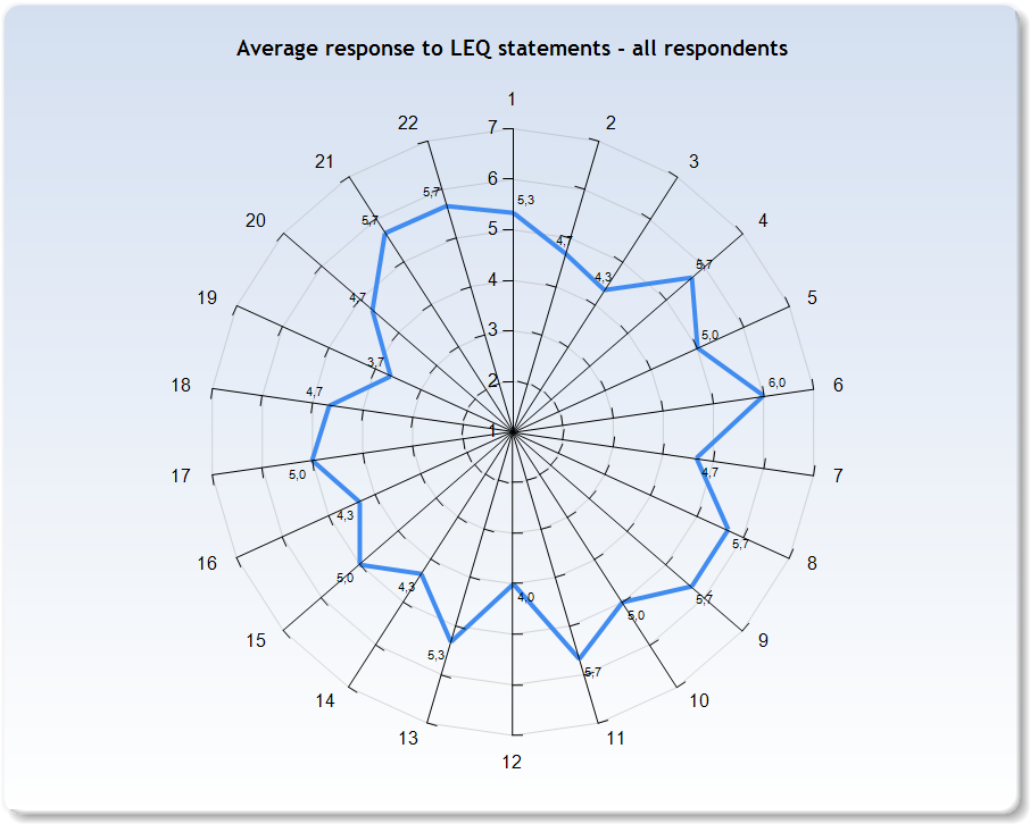
Comments

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
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5,3
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4,7
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4,7
3,7
4,7
5,7

KTH Learning Experience Questionnaire v3.1.3

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. I understood how the course was organized and what I was expected to do (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 choices

19. I was able to learn in a way that suited me (m)
20. I had opportunities to choose what to do (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, intriguing or important

b) We can speculate, try out 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 yet supportive environment

d) We feel that we are part of a community and believe that other people have faith 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 sufficient background knowledge to manage the present learning situation

g) We can learn inductively by moving from specific examples and experiences to general principles, rather than the other way around

h) We are challenged to develop a proper understanding of key concepts and successively create a coherent whole of the content

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

j) We can try, fail, and receive feedback in advance of and separate from any summative judgment of our efforts

k) We believe that our work will be considered fairly and honestly

l) We have sufficient time to learn and devote the time necessary to do so

m) We believe that we are in control of our own learning, not manipulated

n) We can work collaboratively with other learners struggling with the same problems

Literature

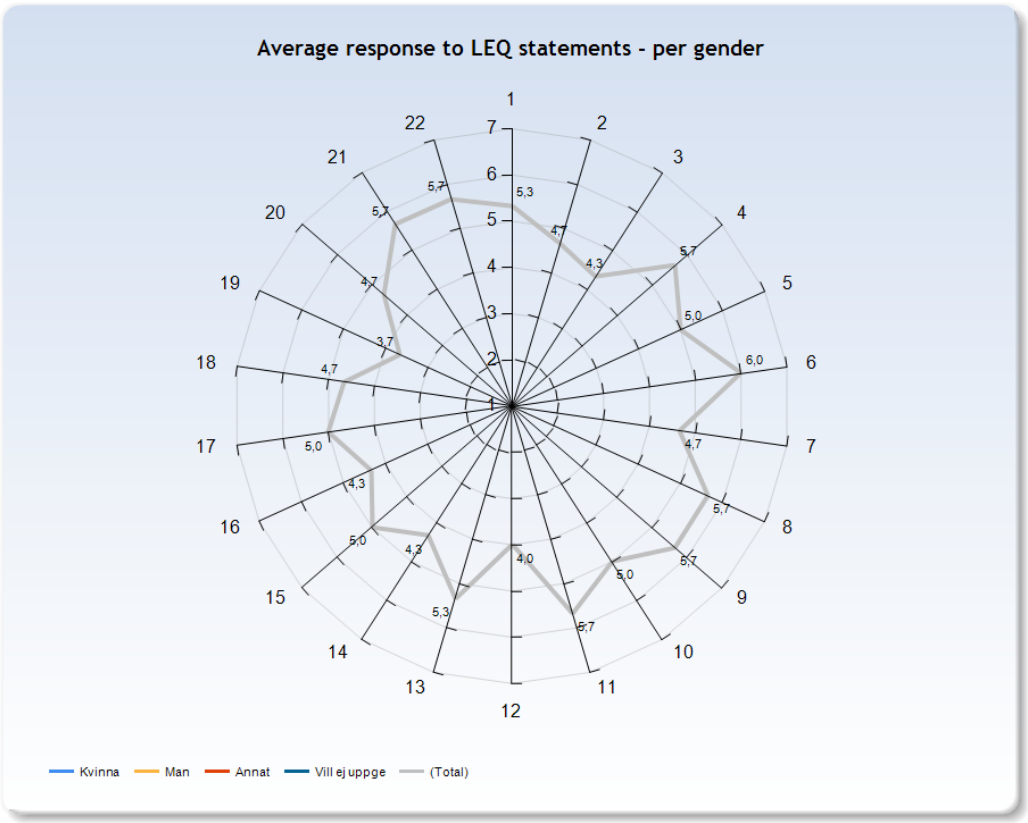
Bain, K. (2004). *What the Best College Teachers Do*, Chapter 5, pp. 98-134. Cambridge: Harvard University Press.

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
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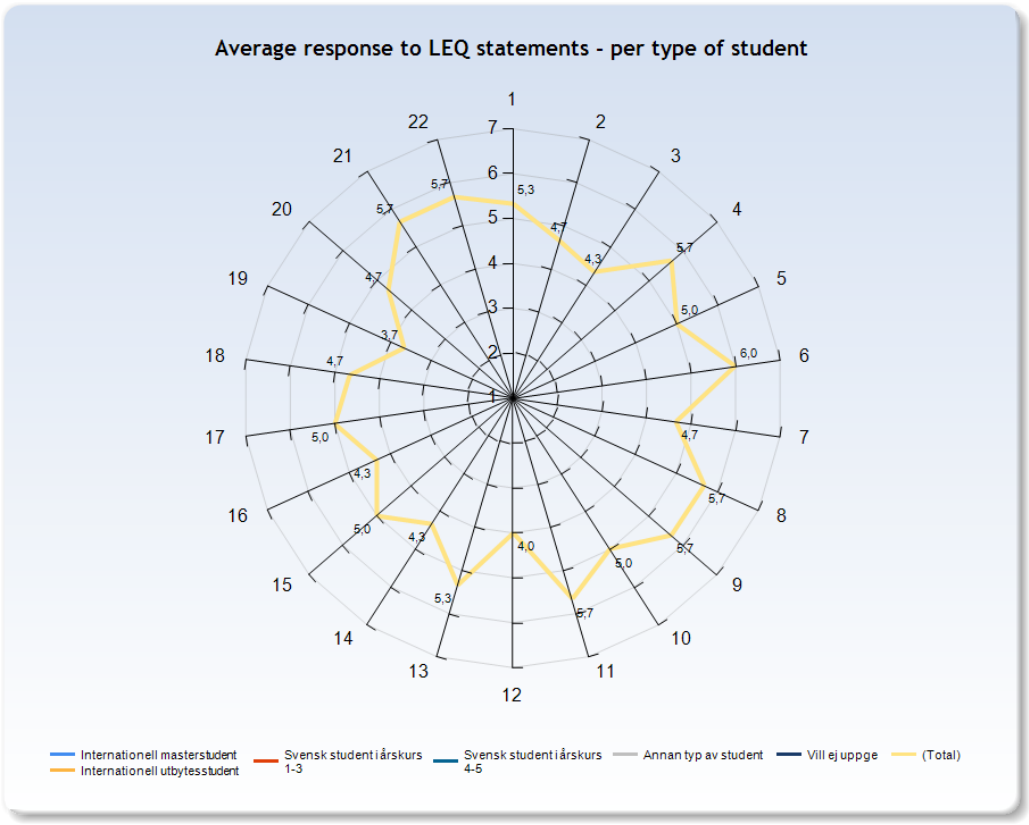
Comments


Average response to LEQ statements - per type of student
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22
Internationell masterstudent
Internationell utbytesstudent
Svensk student i årskurs 1-3
Svensk student i årskurs 4-5
Annan typ av student
Vill ej uppge
(Total)

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 flipped classroom. Being able to watch the lectures at any time is helpful.

What was the best aspect of the course? (I worked: 15-17 timmar/vecka)
I liked the relatively open environment and small class size. Sahar was really nice as a TA and good with solving the questions in tutorial.

What was the best aspect of the course? (I worked: 18-20 timmar/vecka)
The structure of the course in 3 parts helped to see clearly the learning expectations. Reverse classroom is a good concept, helps to see the subject before come to class

What would you suggest to improve?

What would you suggest to improve? (I worked: 9-11 timmar/vecka)
It might have been helpful to be able to watch some of the video lectures earlier than it was possible now, having maybe a week to watch the lectures before the flipped classroom?

What would you suggest to improve? (I worked: 15-17 timmar/vecka)
The projects felt really poorly executed in that a lot of the time we had questions but could not get a clear answer as neither the lecturer or TA knew the projects too well. Additionally, we received grades for the projects but no comments as to what was done wrong.

What would you suggest to improve? (I worked: 18-20 timmar/vecka)
Maybe prepare new quizz questions for the lectures to make it more interactive

What advice would you like to give to future participants?

What advice would you like to give to future participants? (I worked: 15-17 timmar/vecka)
Start everything early and try to work ahead. Also, solve many old exams and the offered collection of problems.

Is there anything else you would like to add?

Is there anything else you would like to add? (I worked: 15-17 timmar/vecka)
I felt the exam was a bit unfair in that we were asked about BCJR algorithm after being told that it was unlikely to show up and having such a tedious process be worth only 1 mark... It seemed almost set up to just penalize you and distract from the other problems.

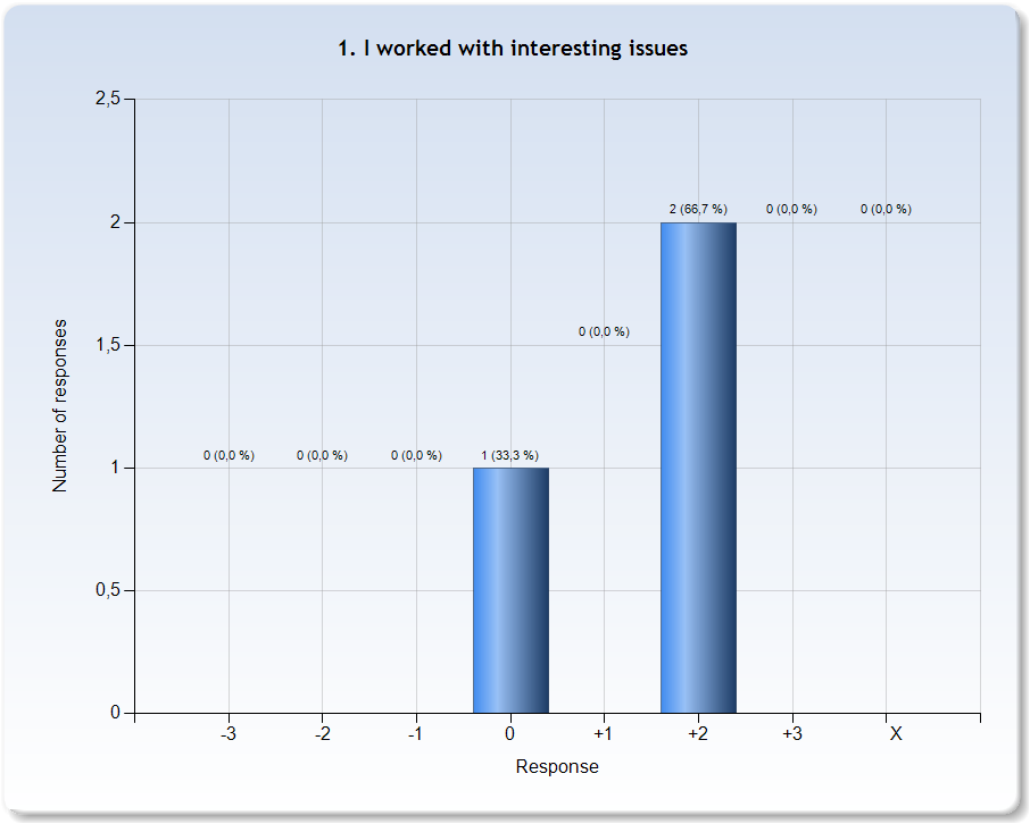
SPECIFIC QUESTIONS

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


1. I worked with interesting issues
Number of responses
2,5
2
1,5
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0,5
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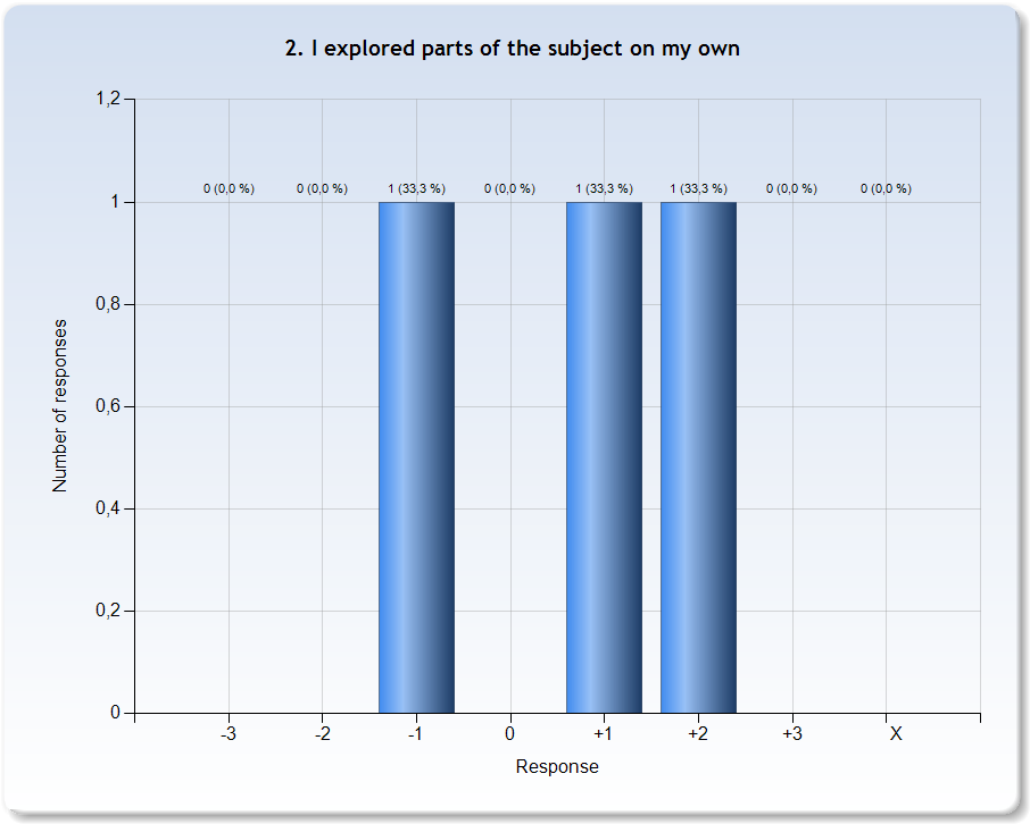
0 (0,0 %)
0 (0,0 %)
0 (0,0 %)
1 (33,3 %)
0 (0,0 %)
2 (66,7 %)
0 (0,0 %)
0 (0,0 %)
-3
-2
-1
0
+1
+2
+3
X
Response

Comments


2. I explored parts of the subject on my own
1,2
1
0,8
0,6
0,4
0,2
0
Number of responses
0 (0,0 %)
0 (0,0 %)
1 (33,3 %)
0 (0,0 %)
1 (33,3 %)
1 (33,3 %)
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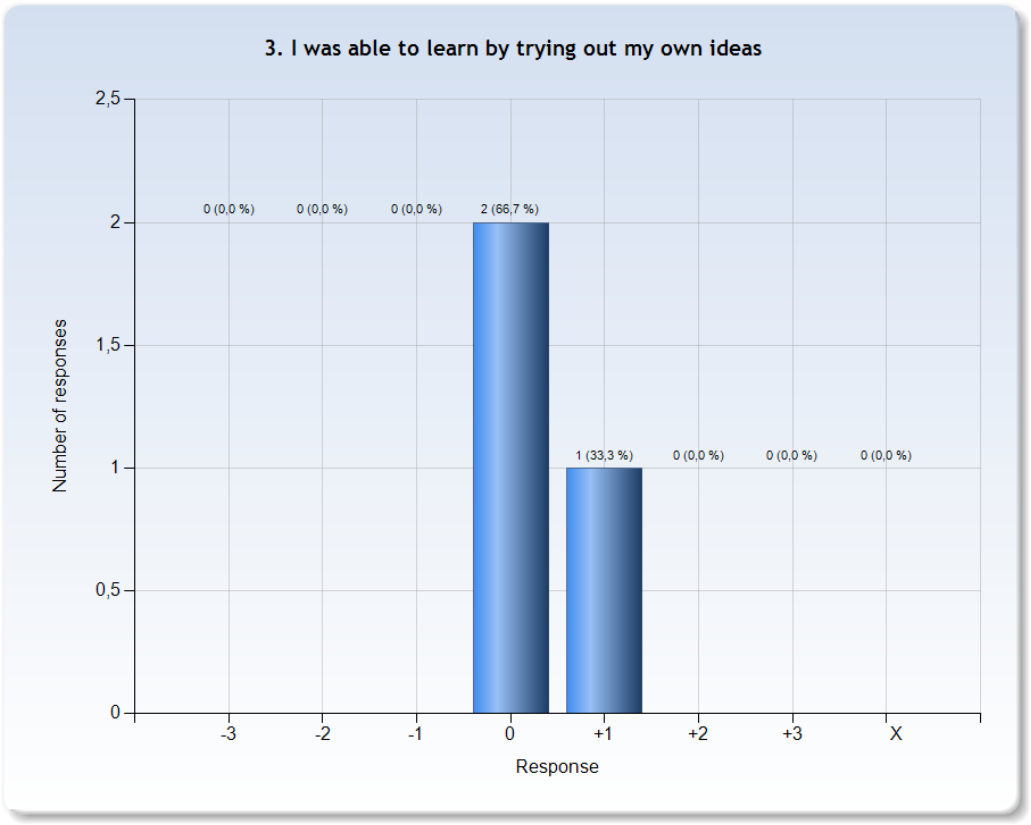
-3
-2
-1
0
+1
+2
+3
X
Response

Comments


3. I was able to learn by trying out my own ideas
Number of responses
2,5
2
1,5
1
0,5
0
0 (0,0 %)
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0 (0,0 %)
2 (66,7 %)
1 (33,3 %)
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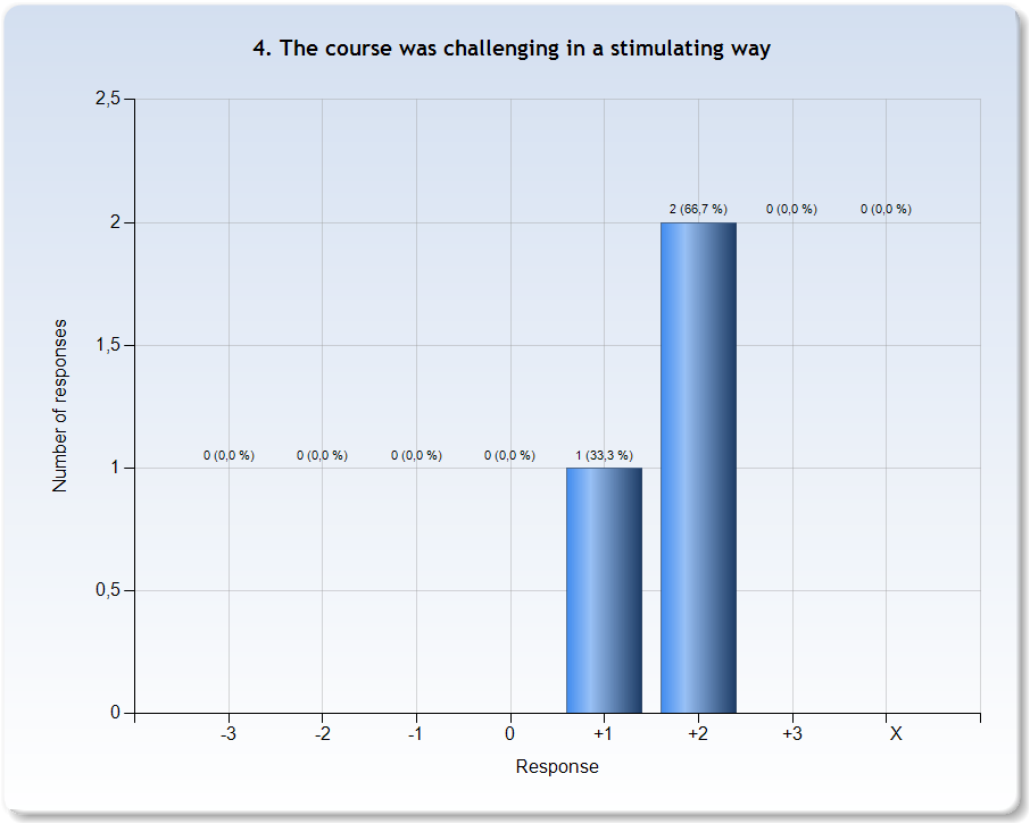
X
Response

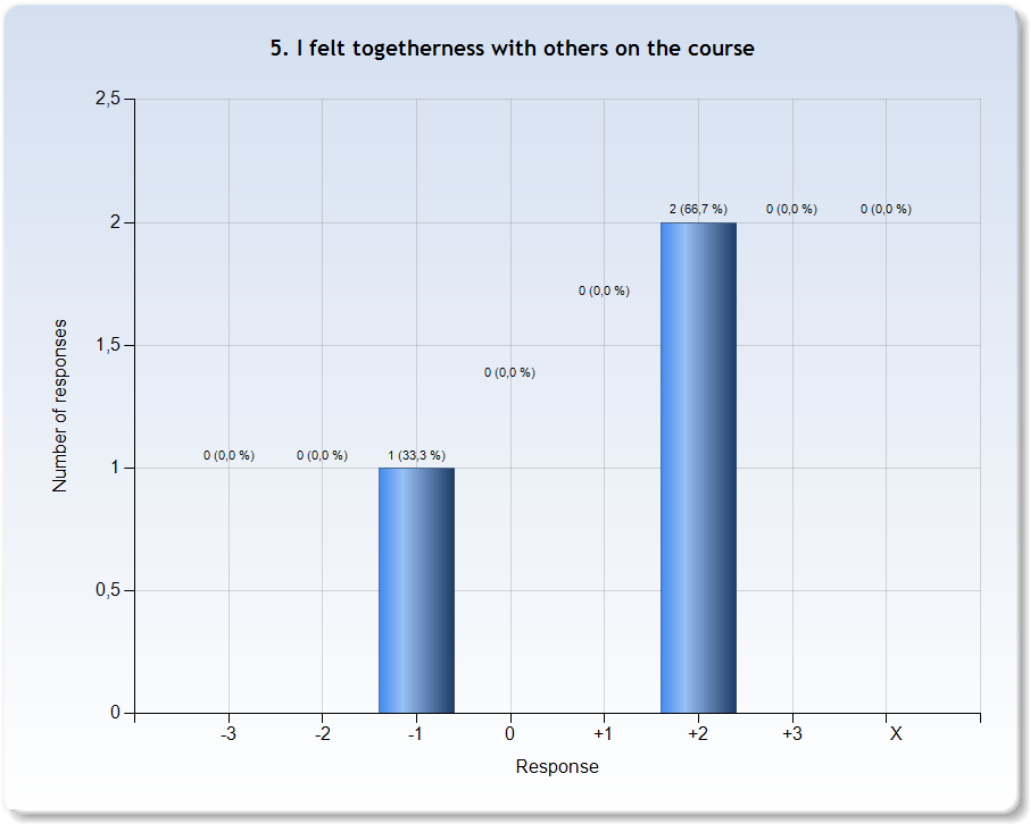
Comments



Comments

Comments (My response was: +2)

I think the course material is super interesting but felt very limited by how rushed the period felt and with the workload I had in my other course.


5. I felt togetherness with others on the course
Number of responses
2,5
2
1,5
1
0,5
0
0 (0,0 %)
0 (0,0 %)
1 (33,3 %)
0 (0,0 %)
0 (0,0 %)
2 (66,7 %)
0 (0,0 %)
0 (0,0 %)
-3
-2
-1
0
+1
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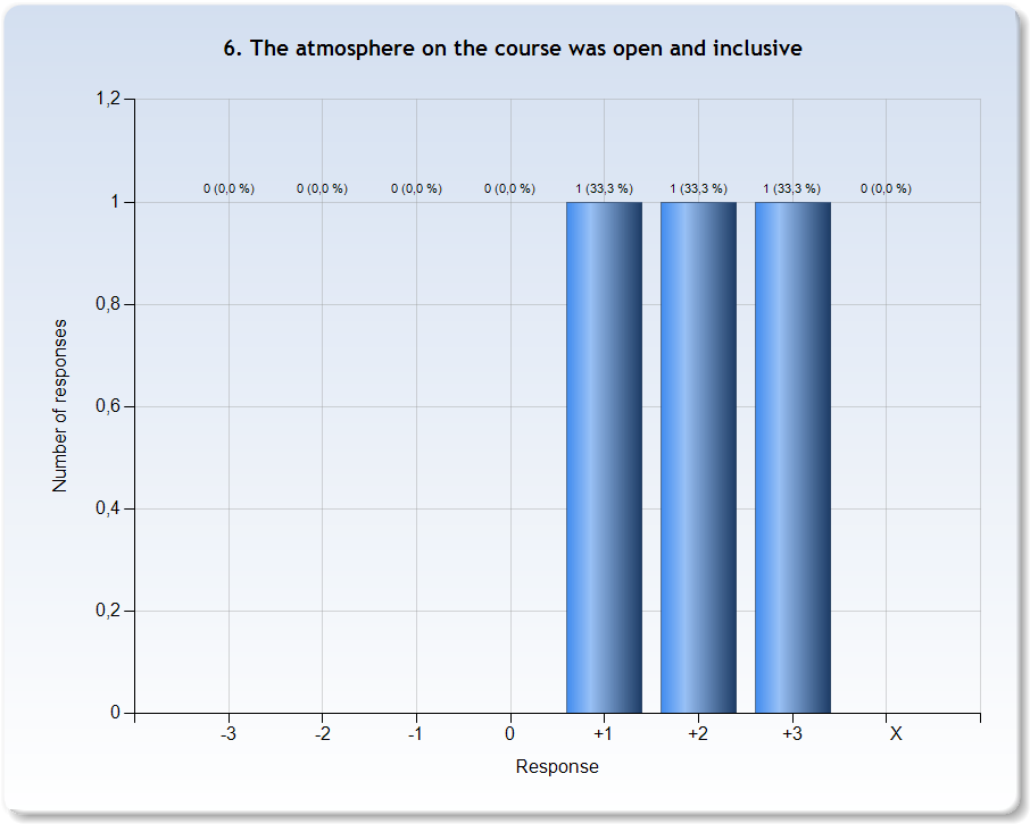
+3
X
Response

Comments


6. The atmosphere on the course was open and inclusive
1,2
1
0,8
0,6
0,4
0,2
0
Number of responses
0 (0,0 %)
0 (0,0 %)
0 (0,0 %)
0 (0,0 %)
1 (33,3 %)
1 (33,3 %)
1 (33,3 %)
0 (0,0 %)
-3
-2
-1
0
+1
+2
+3
X
Response

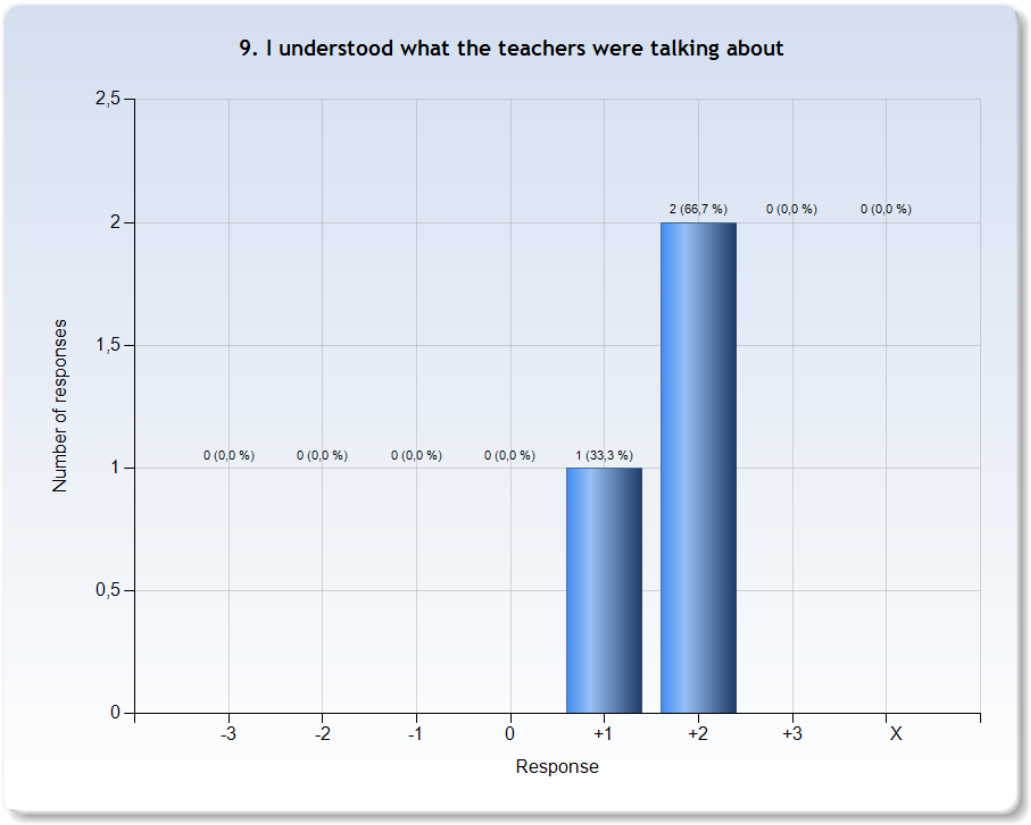
Comments


7. The intended learning outcomes helped me to understand what I was expected to achieve
Number of responses
1,2
1
0,8
0,6
0,4
0,2
0
0 (0,0 %)
0 (0,0 %)
1 (33,3 %)
0 (0,0 %)
1 (33,3 %)
1 (33,3 %)
0 (0,0 %)
0 (0,0 %)
-3
-2
-1
0
+1
+2
+3
X
Response

Comments


8. I understood how the course was organized and what I was expected to do
1,2
1
0,8
0,6
0,4
0,2
0
Number of responses
0 (0,0 %)
0 (0,0 %)
0 (0,0 %)
1 (33,3 %)
0 (0,0 %)
1 (33,3 %)
1 (33,3 %)
0 (0,0 %)
-3
-2
-1
0
+1
+2
+3
X
Response

Comments


9. I understood what the teachers were talking about
Number of responses
2,5
2
1,5
1
0,5
0
0 (0,0 %)
0 (0,0 %)
0 (0,0 %)
0 (0,0 %)
1 (33,3 %)
2 (66,7 %)
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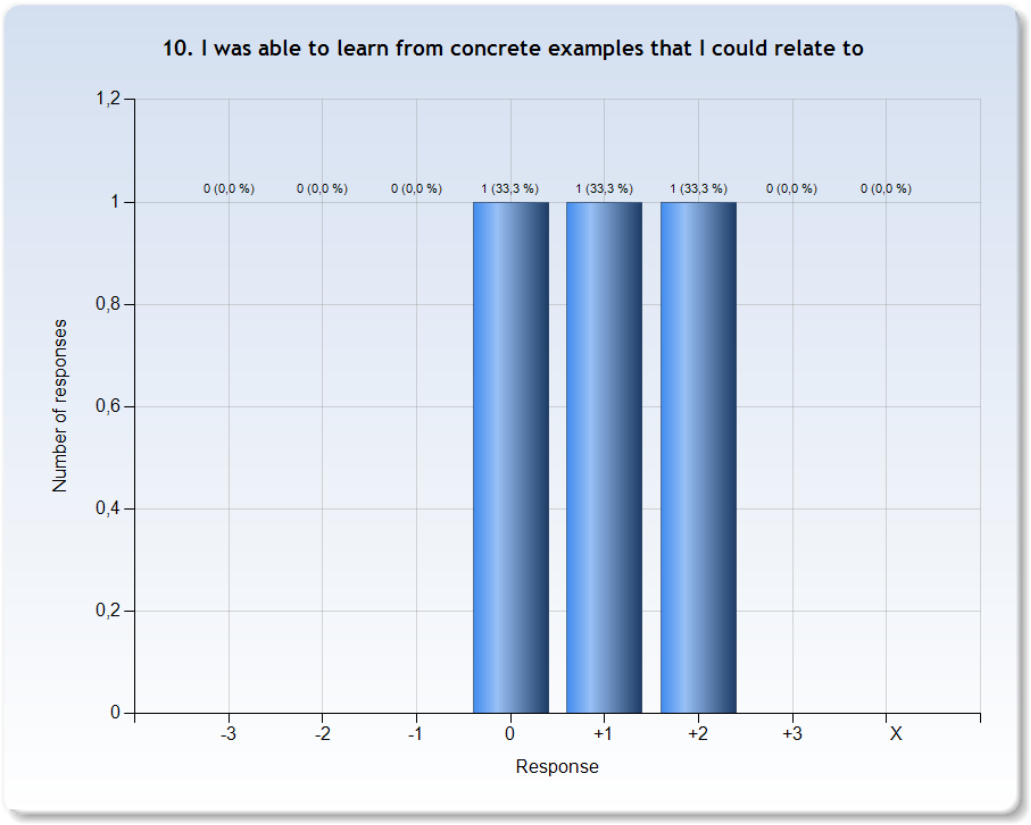
+3
X
Response

Comments


10. I was able to learn from concrete examples that I could relate to
1,2
1
0,8
0,6
0,4
0,2
0
Number of responses
0 (0,0 %)
0 (0,0 %)
0 (0,0 %)
1 (33,3 %)
1 (33,3 %)
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+2
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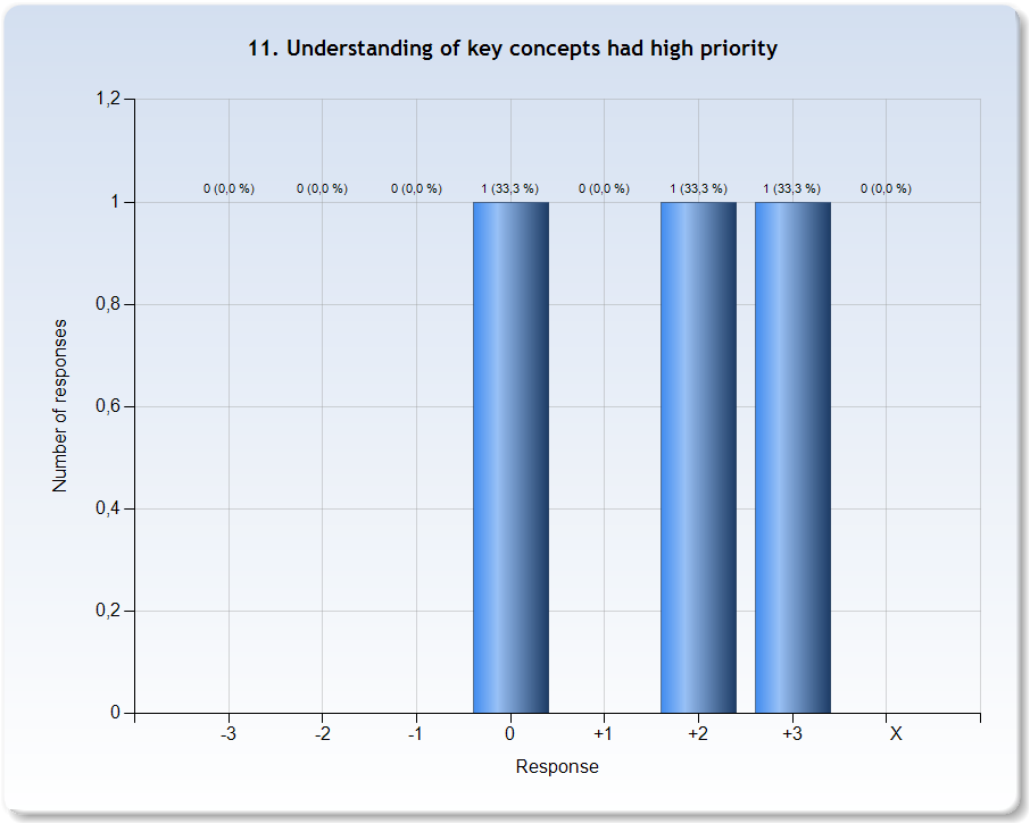
X
Response

Comments


11. Understanding of key concepts had high priority
Number of responses
1,2
1
0,8
0,6
0,4
0,2
0
0 (0,0 %)
0 (0,0 %)
0 (0,0 %)
1 (33,3 %)
0 (0,0 %)
1 (33,3 %)
1 (33,3 %)
0 (0,0 %)
-3
-2
-1
0
+1
+2
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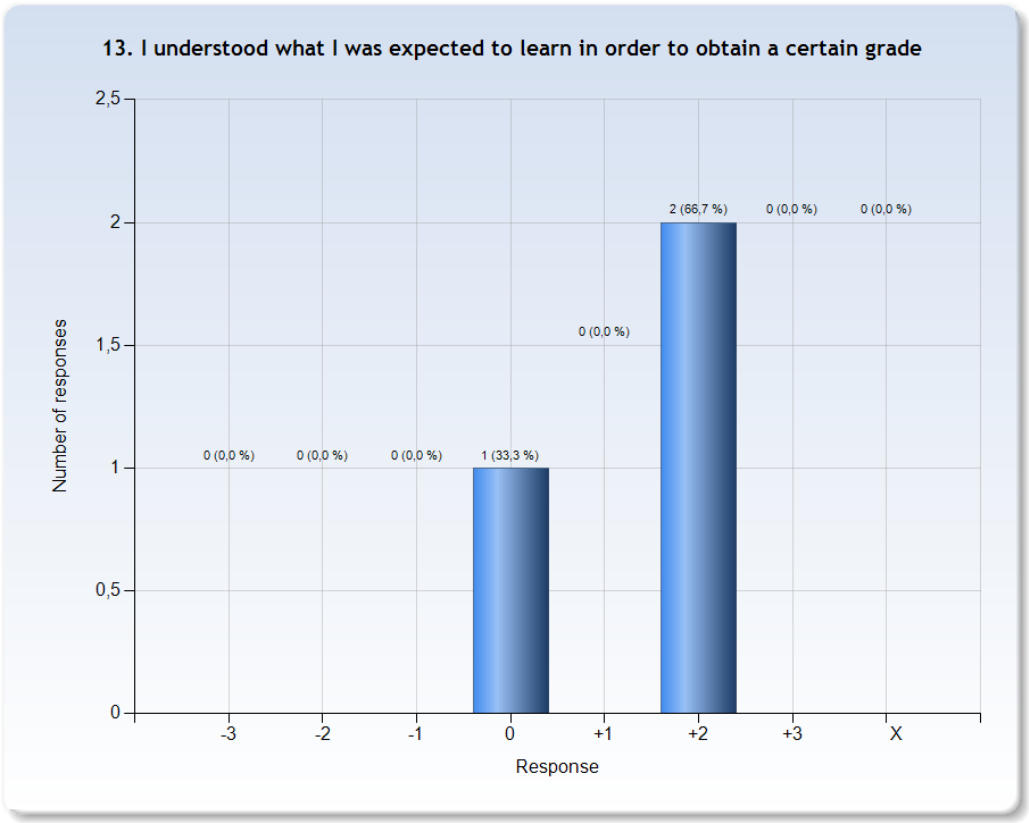
X
Response

Comments

Comments

(My response was: -2)
I honestly feel like swapping the projects out in favour of homework assignments would be way more beneficial

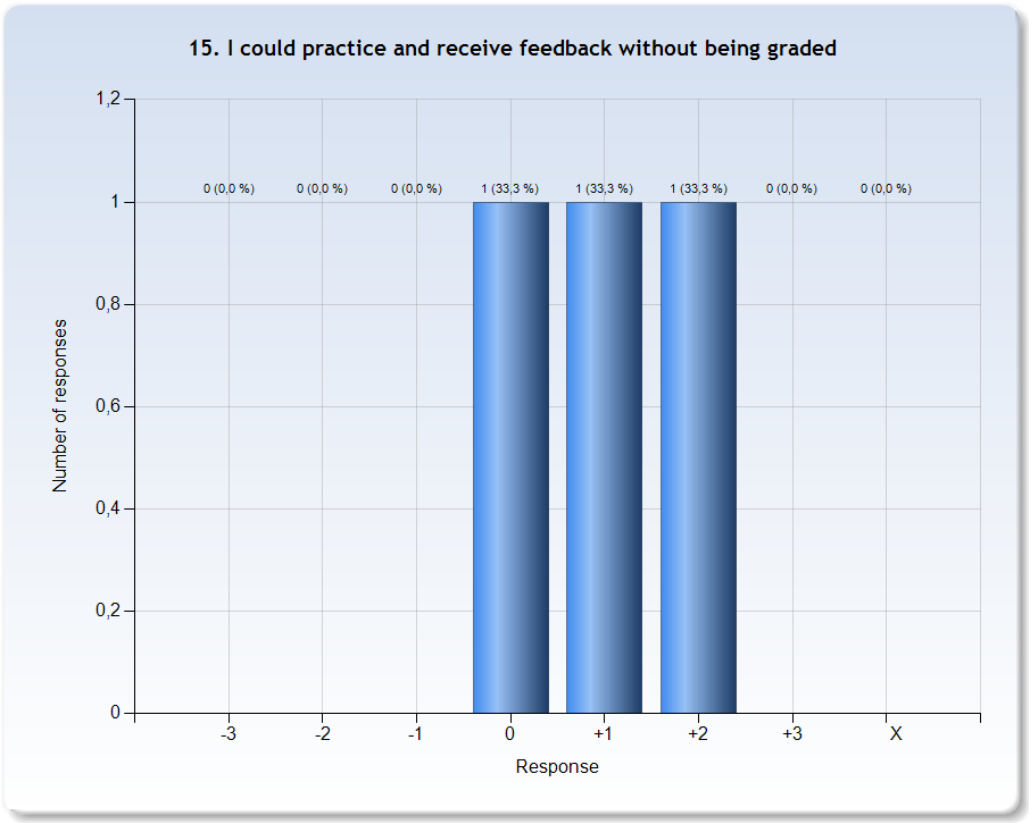

13. I understood what I was expected to learn in order to obtain a certain grade
Number of responses
2,5
2
1,5
1
0,5
0
0 (0,0 %)
0 (0,0 %)
0 (0,0 %)
1 (33,3 %)
0 (0,0 %)
2 (66,7 %)
0 (0,0 %)
0 (0,0 %)
-3
-2
-1
0
+1
+2
+3
X
Response

Comments

Comments

Comments (My response was: -1)

Only feedback we received was grades on the project which came with no explanation. I would add that the individual lecture quizzes were also a method of feedback but not enough.


15. I could practice and receive feedback without being graded
Number of responses
1,2
1
0,8
0,6
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0 (0,0 %)
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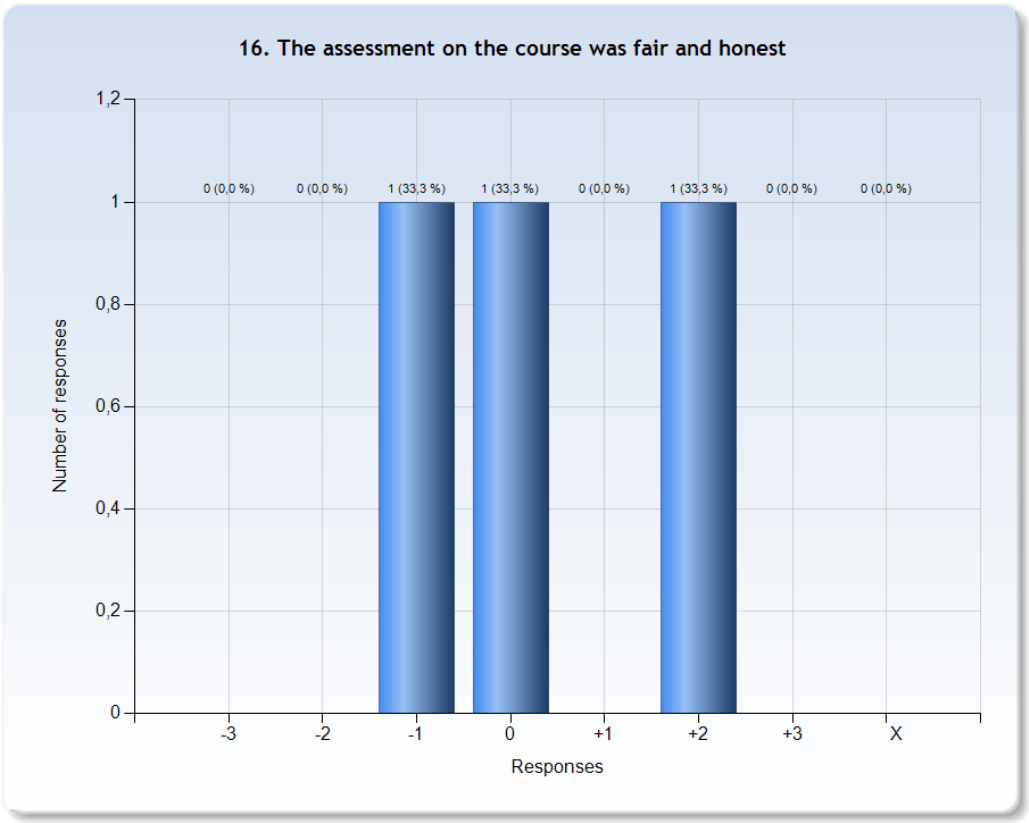
Response

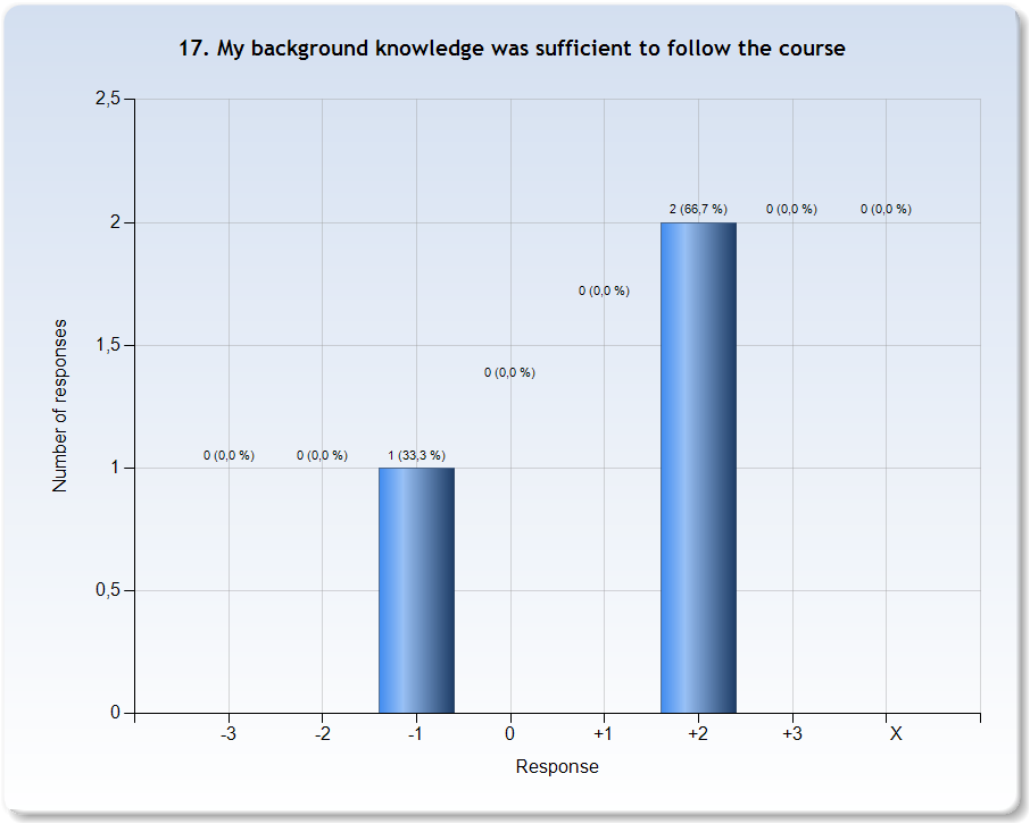
Comments



Comments

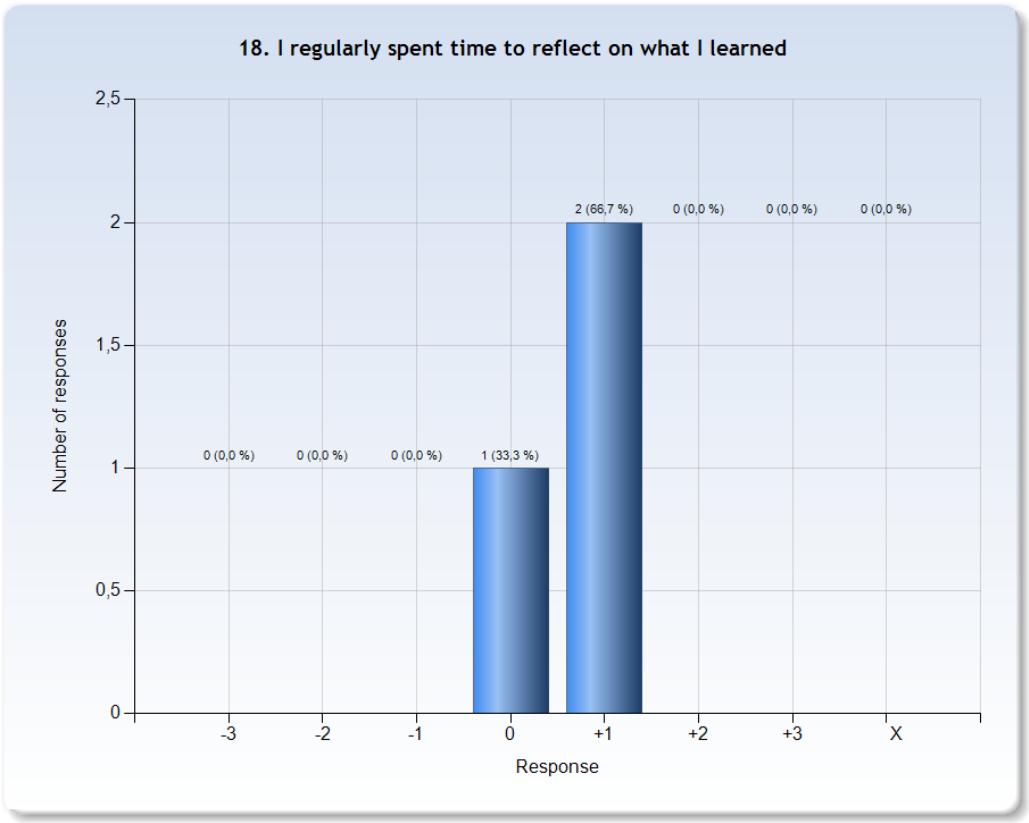
Comments (My response was: -1)

Deductions seemed a bit harsh at times - especially when no reasoning was given as to what exactly was incorrect



Comments

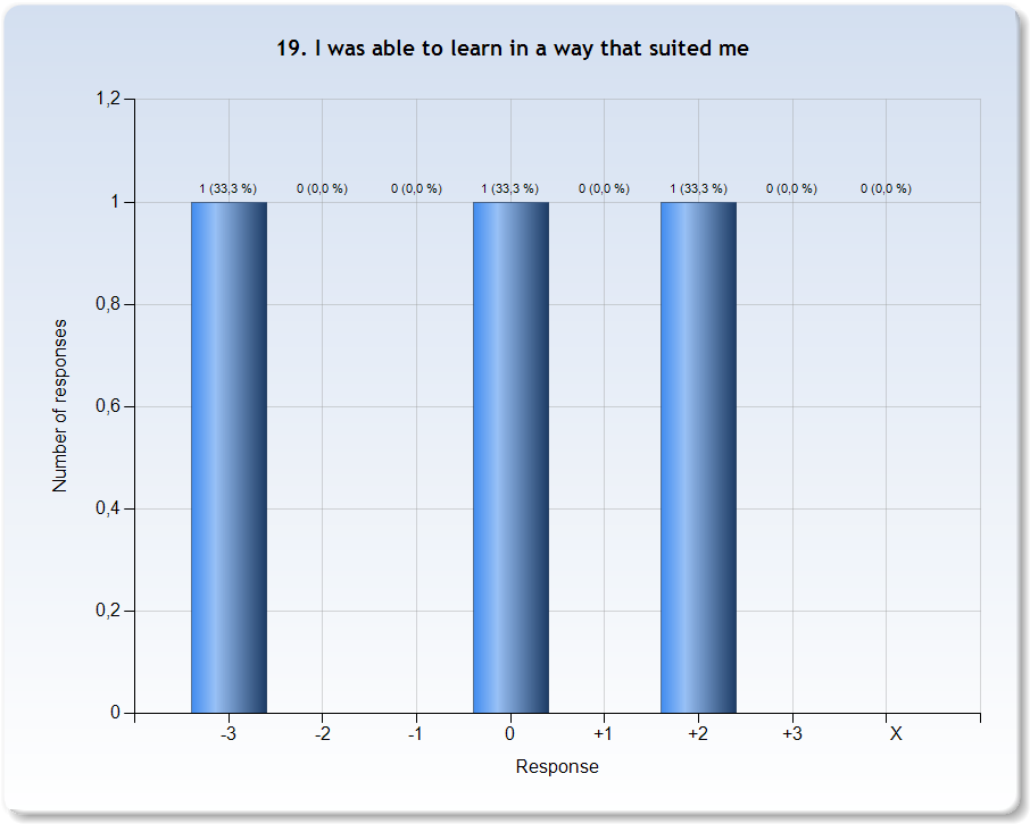
Comments (My response was: +2)
My background was sufficient but the time span I would say is limiting for a deeper understanding



Comments

Comments (My response was: +1)

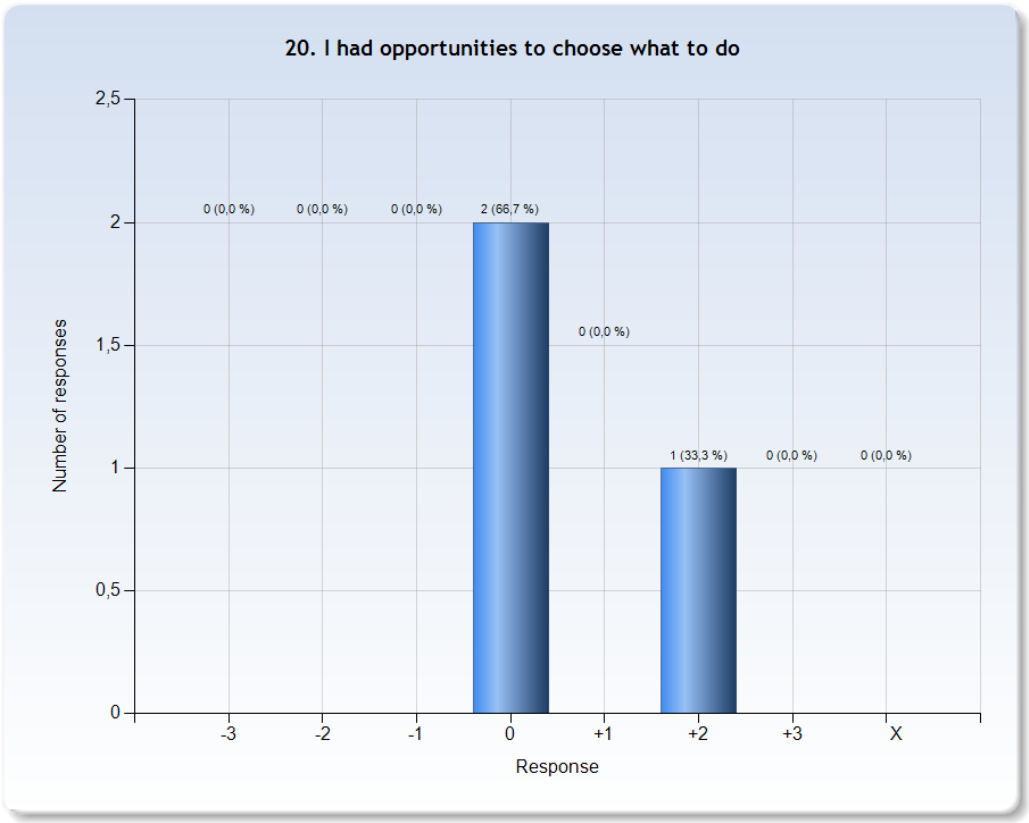
Felt kind of rushed most of the time - like there was too much content for the period of time given.



Comments

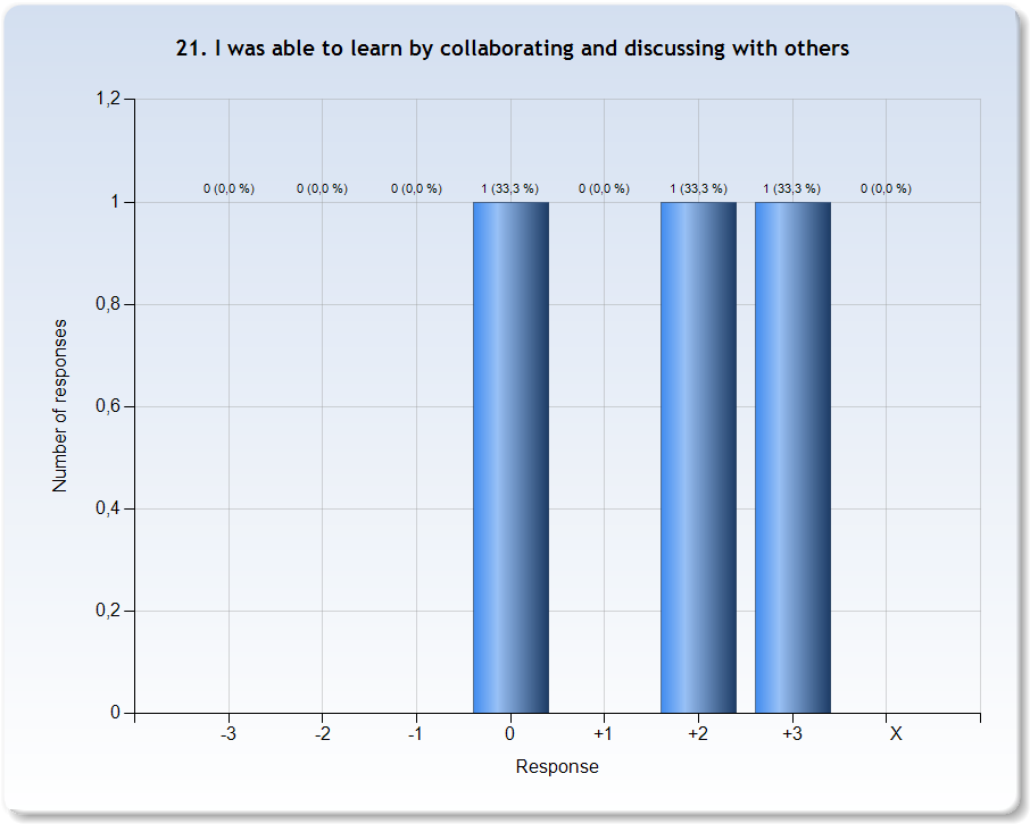
Comments (My response was: -3)

This is because I am not at all an auditory learner and having to rely primarily on verbal lectures and power point slides has never been very easy for me. I really like when professors do hand written notes in class - it keeps the pace reasonable and I follow material way better when revising.

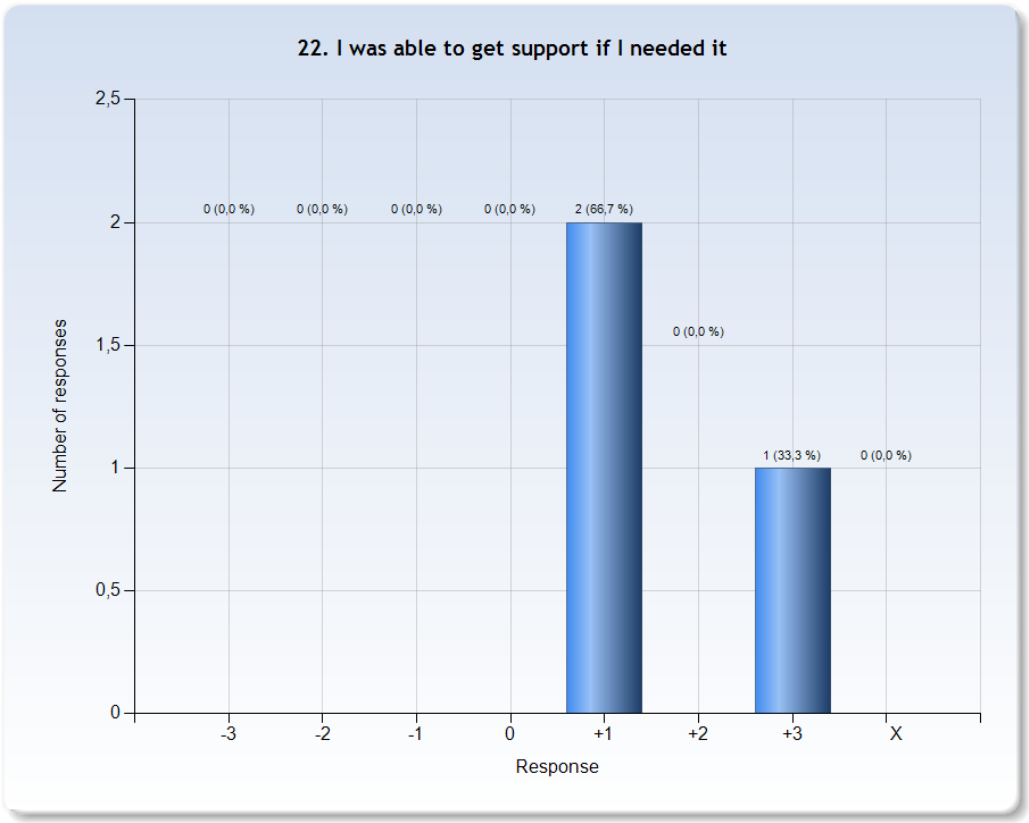


Comments

Comments (My response was: 0)
Not really sure how to answer this


21. I was able to learn by collaborating and discussing with others
Number of responses
1,2
1
0,8
0,6
0,4
0,2
0
0 (0,0 %)
0 (0,0 %)
0 (0,0 %)
1 (33,3 %)
0 (0,0 %)
1 (33,3 %)
1 (33,3 %)
0 (0,0 %)
-3
-2
-1
0
+1
+2
+3
X
Response

Comments


22. I was able to get support if I needed it
Number of responses
2,5
2
1,5
1
0,5
0
0 (0,0 %)
0 (0,0 %)
0 (0,0 %)
0 (0,0 %)
2 (66,7 %)
0 (0,0 %)
1 (33,3 %)
0 (0,0 %)
-3
-2
-1
0
+1
+2
+3
X
Response

Comments