

## ID2203-2021

### Course Evaluation

Paris Carbone <parisc@kth.se>

#### 1. Overview

This year the course changed the responsible, teacher, and examiner to Paris Carbone. Paris had previously developed content for this course as a TA for Seif Haridi. These include the automated model checker, the Zeppelics programming environment, and the auto-grader used in the programming assignments of the course back in 2016. Several introductory slides were also developed by Paris in the same year. The programming tools encouraged self-assessment and exploration of distributed protocols and further allowed this course to scale to over 9000 students back in 2016 and 2017 via its successful edX installation titled “Distributed Reliable Algorithms”.

In 2021 the course had several important updates including enhanced visual examples, a new course project structure, the addition of automated model checking and tools (i.e., TLA+), new use-case analyses on distributed systems used at Google etc. and a new final chapter on distributed data management with a focus on distributed data processing.

This year we also had to adapt to the COVID19 pandemic restrictions and compensate for the lack of physical interaction, the limited teaching environments, and focus on web-based evaluation.

#### 2. Course Development Updates

The course already contained a dense set of theoretical content focusing on distributed algorithm theory proving and fundamental abstractions. However, in the past several students repeatedly expressed their need to connect the theory to practice. Observations in the exam also showed evidence that students could not adequately answer reasoning questions due to their inability to grasp the fundamental properties in practice. After a lot of consideration, we made the following major changes to the course to address these needs.

**TLA+:** In the last years the use of model checking software has increased, especially in applied distributed algorithms in data systems. The Temporal Logic of Actions (TLA+) is a formal specification language contributed by Leslie Lamport that emboldens the clear articulation, verification, and validation of distributed systems' behaviors. Embedding TLA+ within the Distributed Systems course curriculum has the potential to significantly enhance the students' conceptual understanding, analytic skills, and practical acumen. A vital advantage of TLA+ is its

ability to bridge theoretical concepts with practical implementations. Through TLA+, students can visualize the operational semantics of distributed algorithms, thus better understanding how theoretical concepts materialize in real-world systems. We decided to incorporate TLA+ first into a dedicated lab but also as an alternative method to the main course project.

**Distributed Data Processing Chapter:** Among lecture enhancements a new chapter was added this year with a focus on scalable data processing systems and their integration of distributed system algorithms. To implement this chapter we used prior knowledge we acquired in building state-of-the-art systems such as Apache Flink. The chapter focused on distributed snapshotting algorithms and their implications in data management systems.

**Final Exam:** The final exam this year switched to an online-only exam due to the covid19 restrictions. The format of the exam remained the same as in previous years' paper written exam, yet, we had no effective means to check if students consult external or course material. Instead, we slightly increased the difficulty of the exam with composite questions and shuffled the version of the exam across students to discourage collaboration. Being aware that the expected grades would be higher this year, we compensated with a stricter examination of the main project.

**Piazza Forum:** We chose to make our communication with the students more encouraging through anonymization as well as motivate peer answering between students. For this reason, we made all communication of the course in Piazza, a popular platform (primarily within US institutions) for student boards and discussions that boosts incentives for students to anonymously collaborate and express their thoughts and opinions.

## 3. Course Evaluation Analysis

For reference, we attach the student feedback at the end of this report.

### 3.1. Analysis of Student Feedback

Students praised the course mostly for its content, interesting lectures and good execution. Furthermore the choice of Piazza was well perceived by all students. Some of the main opportunities of improvements indicated by the students include: the addition of more tutorials covering programming languages etc covered in the course as well as better TLA+ coverage. Furthermore, students indicated that the content is too large and it could even fit in two courses. Finally some students mentioned that the workload is sometimes too high, especially considering programming assignments, as well as a project.

### 3.2. Reflection on Student Feedback

The course indeed has much content, making it hard sometimes to follow up on everything. We explicitly warned students that this course requires full attention and careful planning. However, we did not anticipate the time it would take for students choosing a TLA+ project to learn the

model checking framework and then translate algorithms in that. In practice it was proven that the model checking variant of the project was in fact harder to learn than a new programming language (e.g., Scala or Rust).

## 4. Grade Distribution

This year we noticed that the exam grades were highly skewed towards high marks (A and B). That is primarily due to the change of the exam to an online version which provided students with the right of access to all course training material and online content too. On the other hand, the project was harder and we chose to be more strict to compensate with the high skew of the final exam. We also planned on ways to improve this in the upcoming versions of the course.

## 5. Plans for next iteration

We decided that several actions need to be taken to further improve the course in the upcoming years. Those include

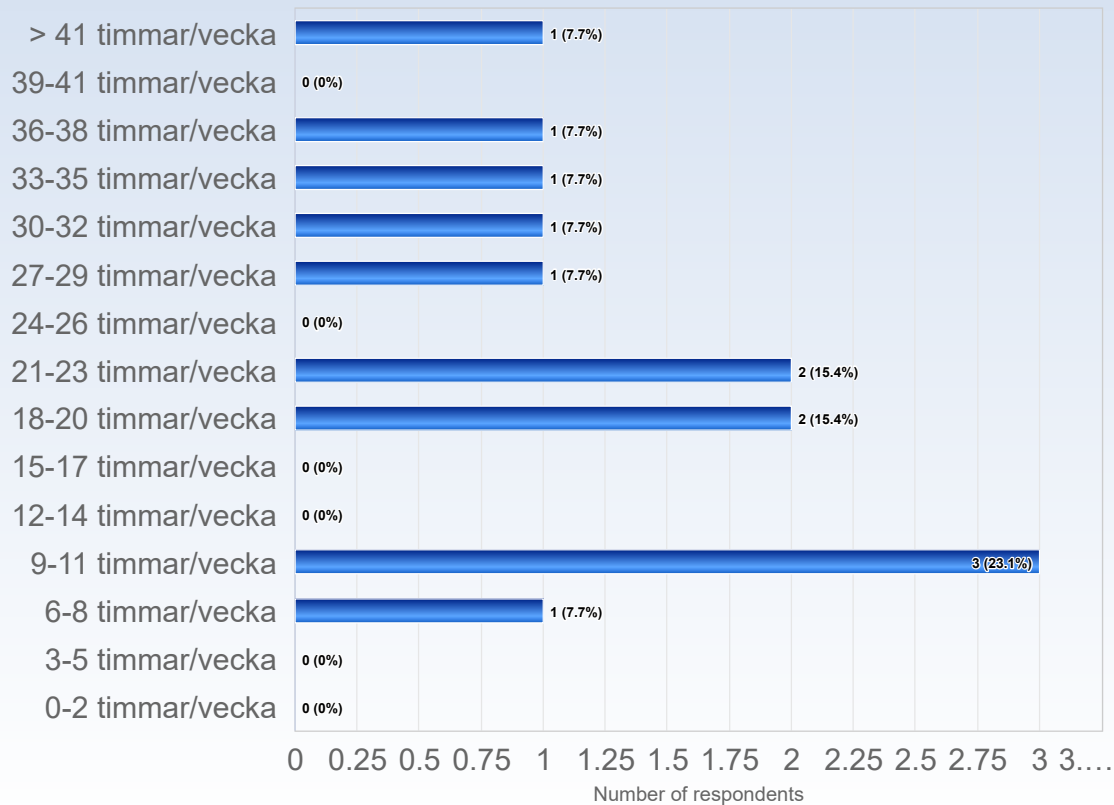
- Addition of more training material aiding students with model checking
- A more flexible project structure, allowing students to adapt to their respective interests
- Switch back to a physical paper exam
- Expansion of content on Scalable Data Systems (e.g., distr databases) due to popular demand and current trends in the open source / industry landscape
- Active application of grading criteria in all assessments planned

# ID2203 - 2021-04-19

Antal respondenter: 42  
Antal svar: 13  
Svarsfrekvens: 30,95 %

## ESTIMATED WORKLOAD

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



## Comments

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

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Acceptable workload. Can learn the course content through different quizzes and programming exercises

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

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It was quite intense to keep up with the syllabus, but also rewarding.

I really enjoyed the practice-oriented course and how well the teaching team managed the amount of tasks.

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

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It was a reasonable amount of time.

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

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really intense

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Comments (I worked: 33-35 timmar/vecka)

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The workload is not reasonable at all. The course is very interesting and the we learnt many new things. But this workload does not reflect the workload of a 7.5 credit course. The course needs to be either a 15 credit course or it has to be divided into two.

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Comments (I worked: 36-38 timmar/vecka)

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reasonable workload for such a high-demanding course

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Comments (I worked: > 41 timmar/vecka)

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There are way too many labs, project and quizzes for its own good, after all that we still need to start for an exam. If its a 9 credit course I would have no problem with it, but for a 7.5 its hard to justify the amount of work we need to do.

Also TLA projects does not provide enough help session or lab session given that its a brand new language with completely different syntax and approach.

TLA sample code were not complete and have bugs 3 days before the original deadline!

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## LEARNING EXPERIENCE

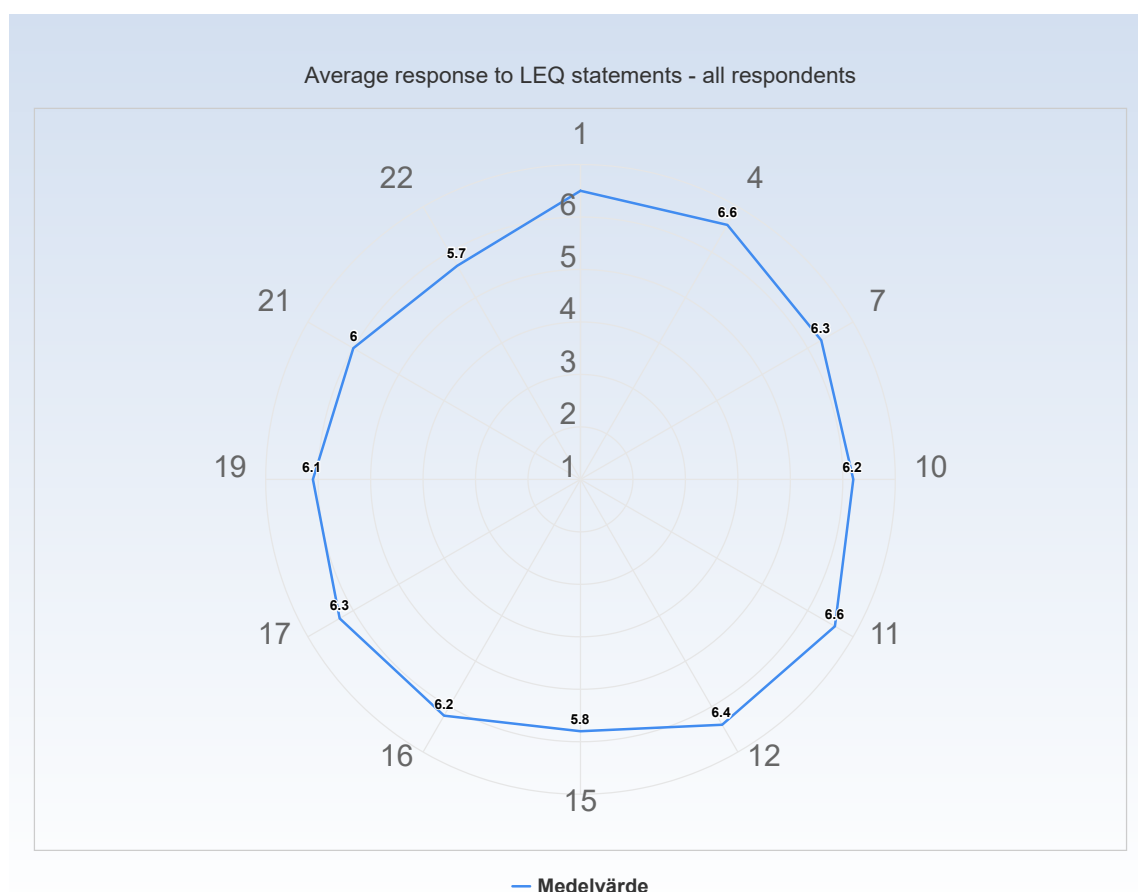
The polar diagrams below show the average response to the LEQ statements for different groups of respondents (only valid responses are included). The scale that is used in the diagrams is defined by:

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.

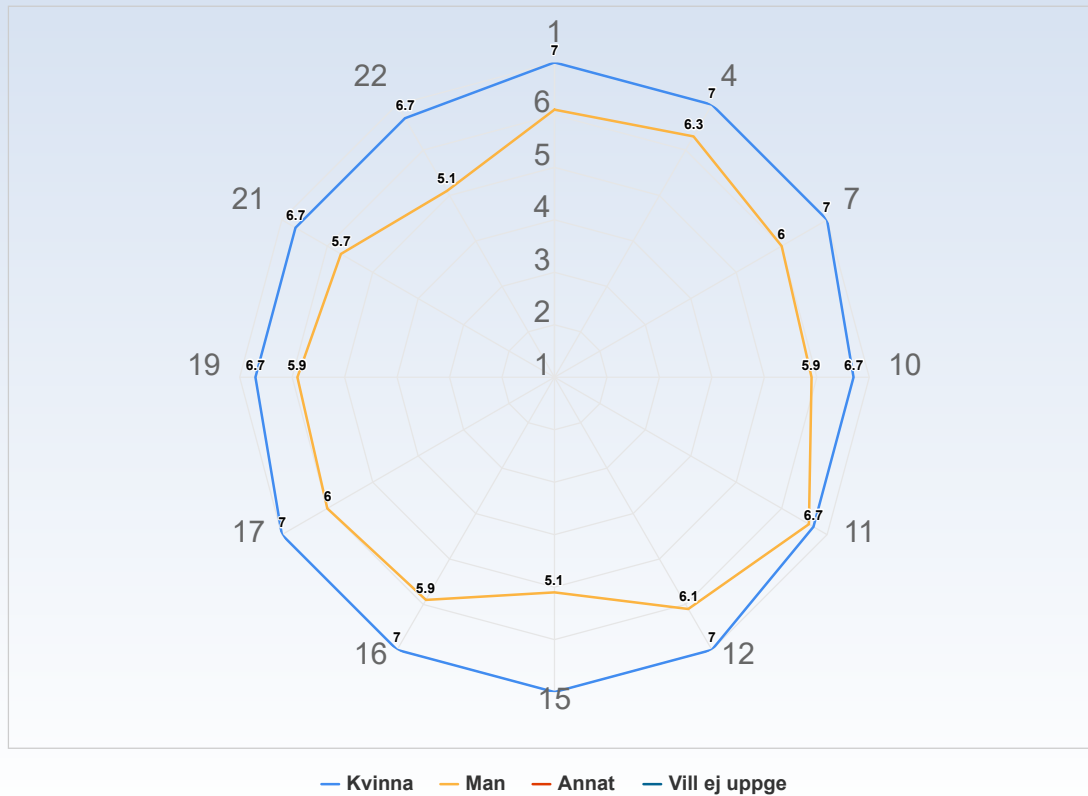
Biggs J. & Tang, C. (2011). *Teaching for Quality Learning at University*, Chapter 6, pp. 95-110. Maidenhead: McGraw Hill.

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

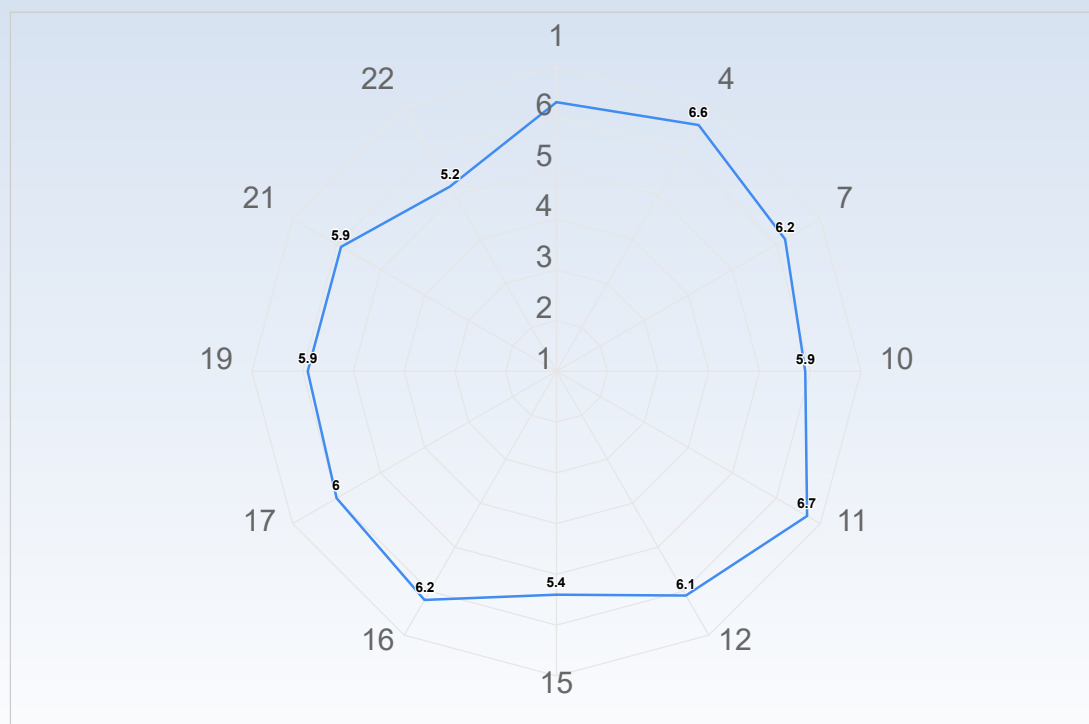


#### Comments

Comments (I am: Man)

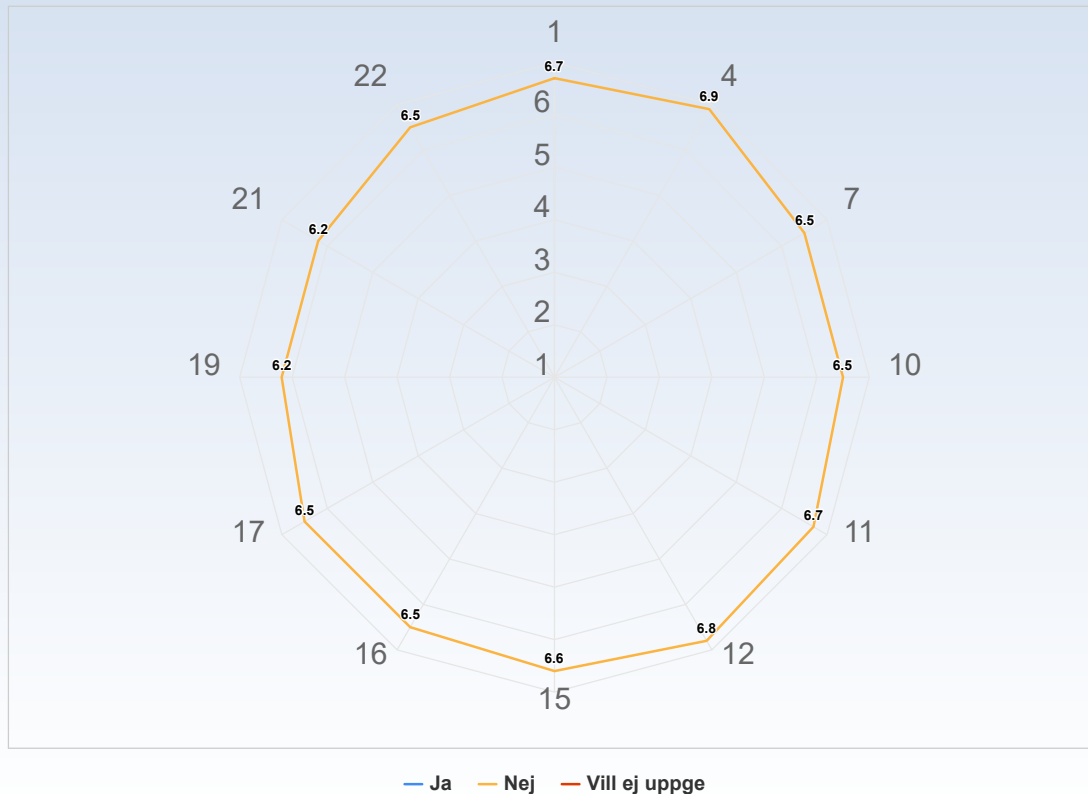
I think my gender had no effect on my experience of the course, but that is to be expected when I'm in the norm.

Average response to LEQ statements - per type of student



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

Average response to LEQ statements - per disability



## GENERAL QUESTIONS

What was the best aspect of the course?

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

Course content is useful for me to study in distributed system.

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

Piazza was the very good surprise of this course

The syllabus was interesting and delivered in a clear manner.

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

The general topics/concepts and how well they were explained.

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

I lot of coding

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

The interesting concepts and theory was delivered very effectively and thus made it significantly less difficult to grasp

What was the best aspect of the course? (I worked: 36-38 timmar/vecka)

Very good course. The project enable me to achieve a deeper understanding of the knowledge.

What was the best aspect of the course? (I worked: > 41 timmar/vecka)

The lecture structure



## What would you suggest to improve?

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

The professor and TAs should reply students' questions and problems more often.  
Sometimes when we write a question, they don't usually reply in a week or even ignore our questions.  
It made us so helpless.

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

For the project, maybe we should considering a session or tutorial on how program advanced tests for the Kompics Project  
The end of the course felt a bit like rushing to cover too many topics, compared to how "slow" the first part was.

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

It was perfect.

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

Perhaps the TLA+ project will need some more polishing, which makes sense since it was the first time it was part of the course (if I recall correctly)

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

--> clarify instructions for the project, what is needed for X amount of points  
--> More programming assig. where you connect several components together would be beneficial. While doing the project the focus was on "making it work", and less on what is the best way  
--> A lecture before/after the project on architecture decisions of implementation is a good idea. So you learn how other implemented the key-value store and what professor find are good design.

--> The amount of time the project took was almost like a whole project course, and extending the project deadline last minute is not a fair way to go for us who have prioritised the course and spend the time to make it in time. My recommendation is to have tighter schedule in beginning, and give people at least 3 weeks for the project. Meaning, be totally done with all topics, so student can have the whole picture when starting with the design.

The course as a whole was fun and gave me lots of knowledge. Big thanks you! :D

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

Although the course takes a considerable amount of time, I don't think the course workload should be reduced as it is very interesting and complements the theory. I think the course should ideally be a 15 credit course or divided into two

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What would you suggest to improve? (I worked: 36-38 timmar/vecka)

The lectures are a little bit too fast to follow. A lot of content to learn.

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What would you suggest to improve? (I worked: > 41 timmar/vecka)

TLA projects does not provide enough help session or lab session given that it's a brand new language with completely different syntax and approach.  
TLA sample code were not complete and have bugs 3 days before the original deadline!

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## What advice would you like to give to future participants?

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

Stay up to date from the beginning; otherwise, it will be too much.

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

The same as were given to us: start the project in time!

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

Do not take the course unless you have a considerable amount of time to invest in this course alone

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What advice would you like to give to future participants? (I worked: 36-38 timmar/vecka)

to know a little about scala would be better for the course

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What advice would you like to give to future participants? (I worked: > 41 timmar/vecka)

Do not take TLA if you do not have time to not only learn a new language (as well as its IDE) but also learn its approach on defining distributed systems.  
Labs will not help TLA project but will help on the Kompics one.

Quizzes are good for gaining more understanding so I recommend try to understand the reason for each answer.

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## Is there anything else you would like to add?

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

Thanks for a very good and interesting course!

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

For me personally the programming assignments didn't give a better understanding on the algorithms. The reason being that due to the high workload, I never really had time to understand the algorithm completely and try out different combinations to see how it works. Instead I was more or less working like a code monkey writing every line of the pseudocode in Kompics. I think this was the case for many people. It would have been a much better experience if I also had the time to play around with the algorithms without just writing it to pass.

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Is there anything else you would like to add? (I worked: 36-38 timmar/vecka)

no

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## SPECIFIC QUESTIONS

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## RESPONSE DATA

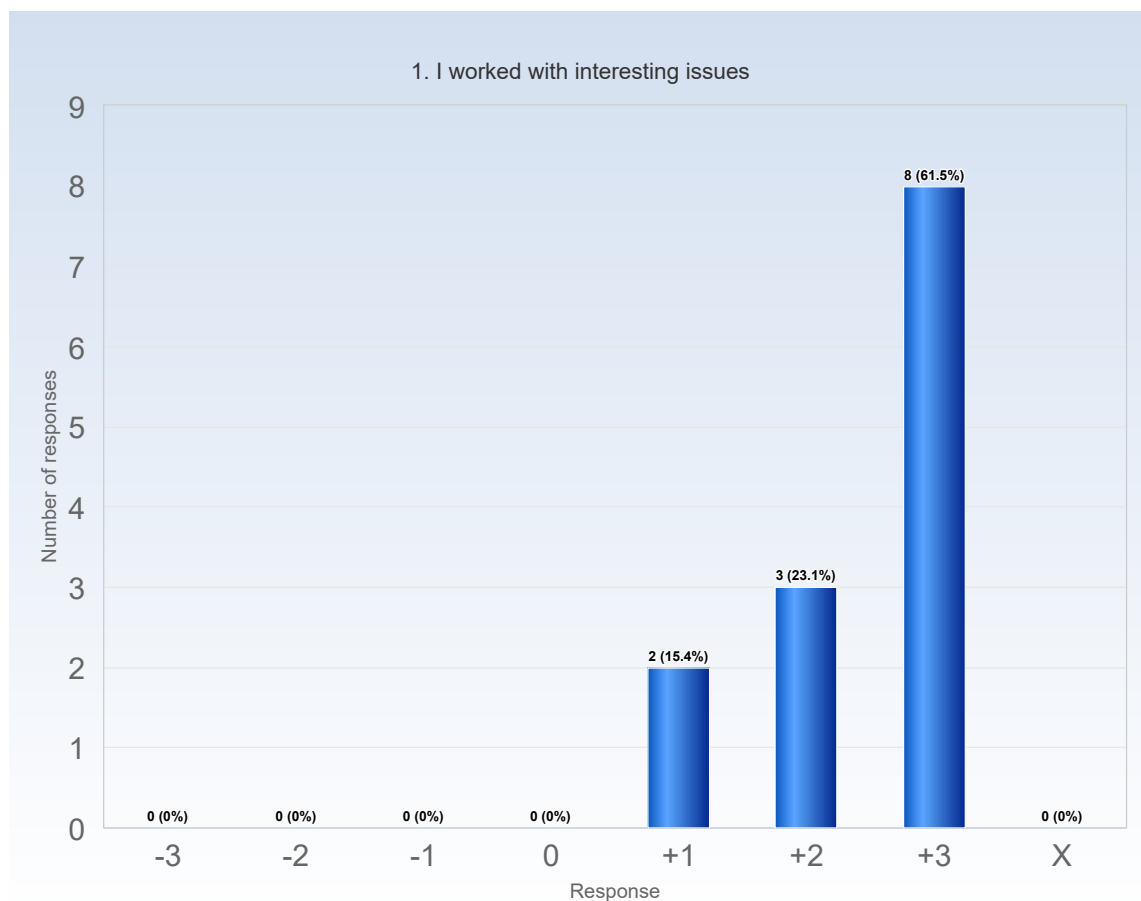
The diagrams below show the detailed response to the LEQ statements.  
The response scale is defined by:

-3 = No, I strongly disagree with the statement

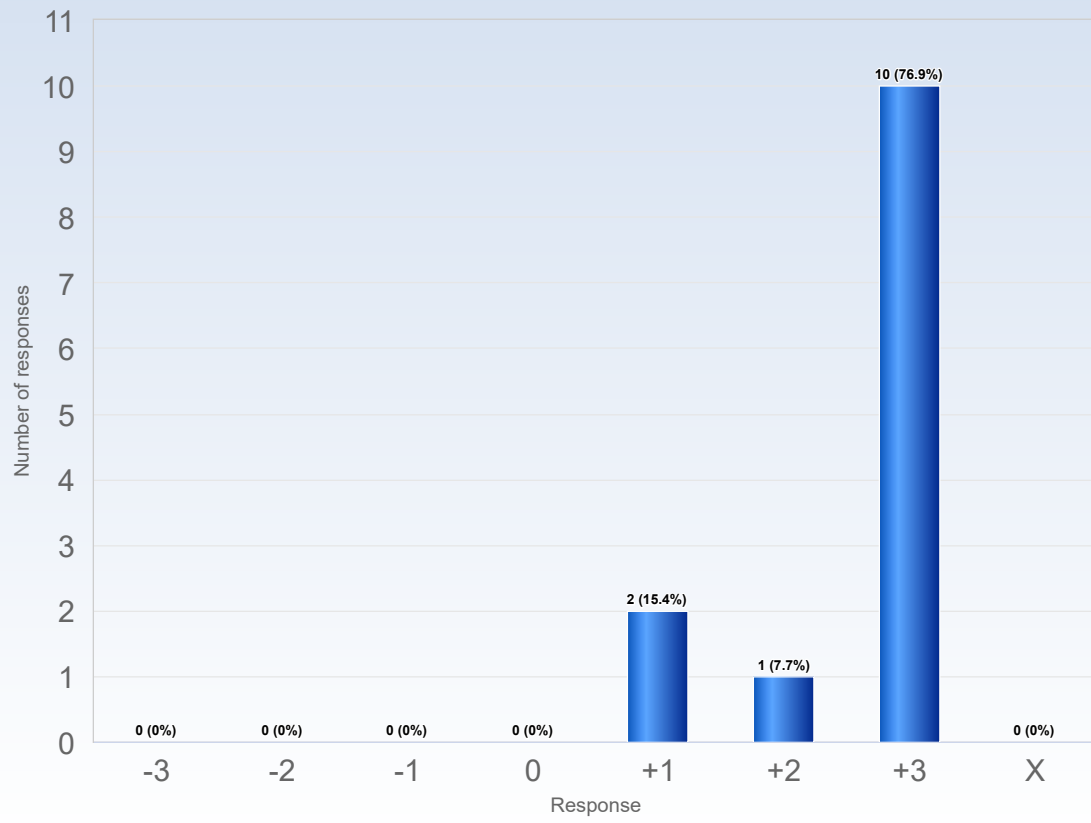
0 = I am neutral to the statement

+3 = Yes, I strongly agree with the statement

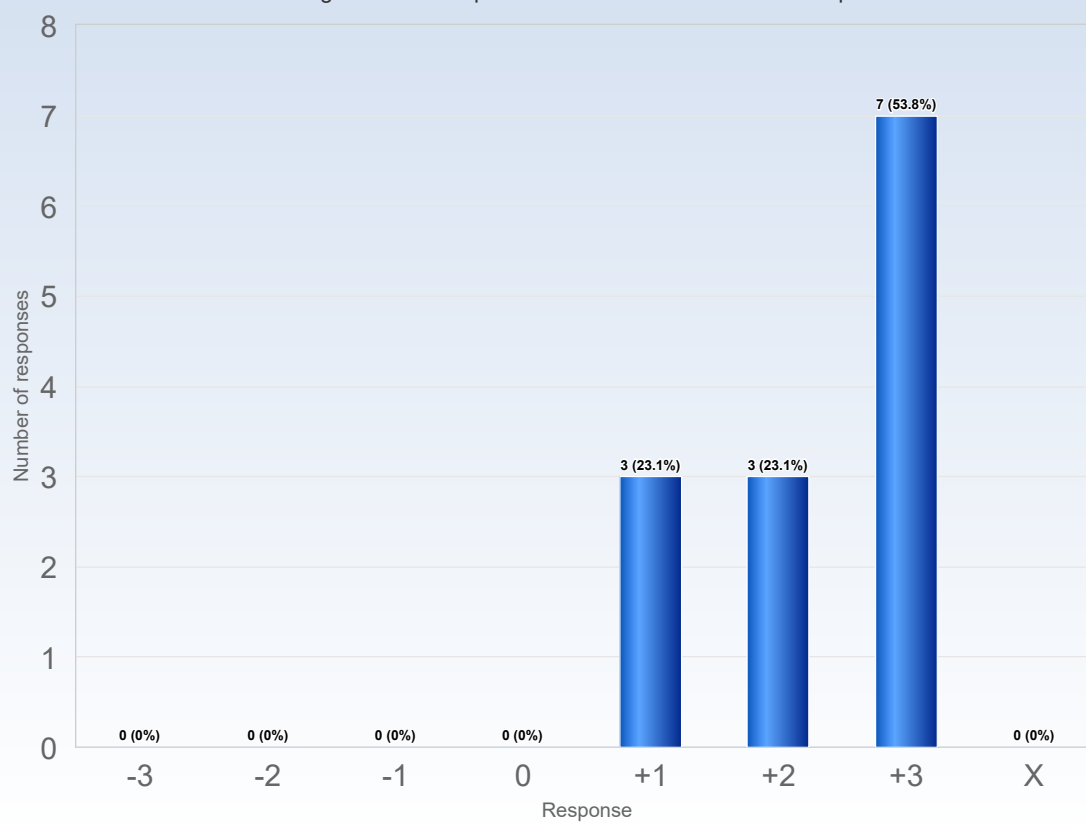
X = I decline to take a position on the statement



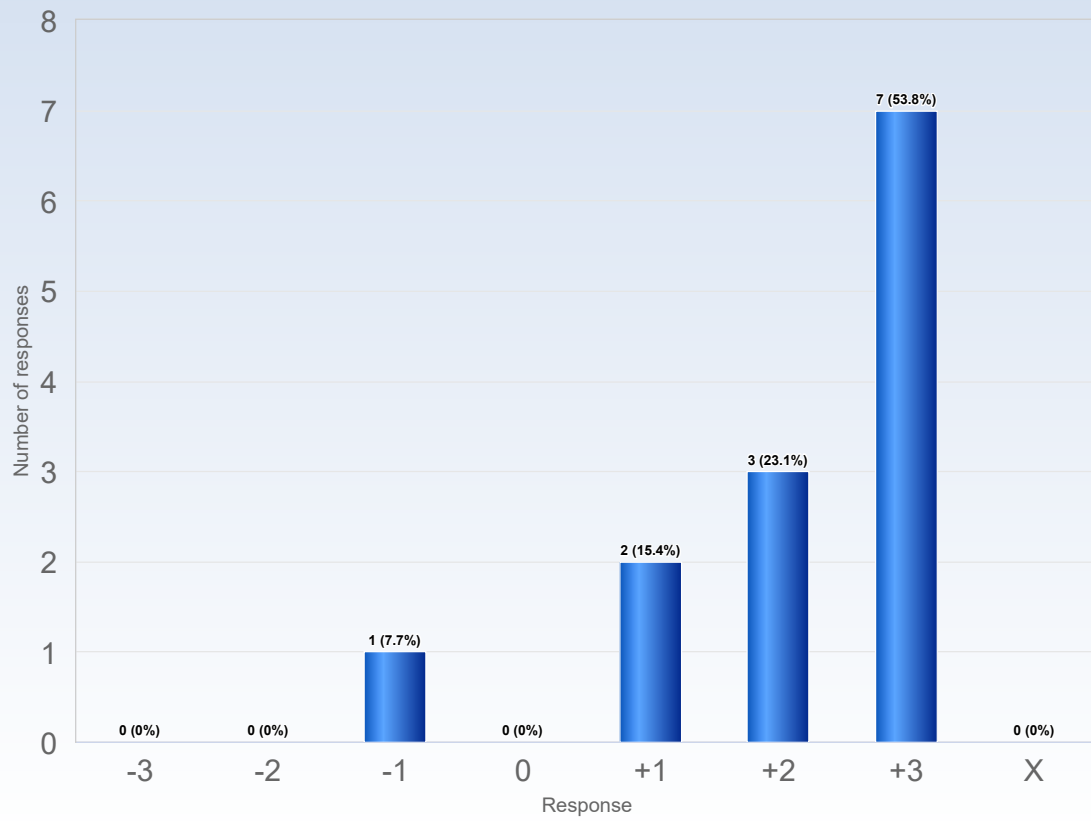
#### 4. The course was challenging in a stimulating way



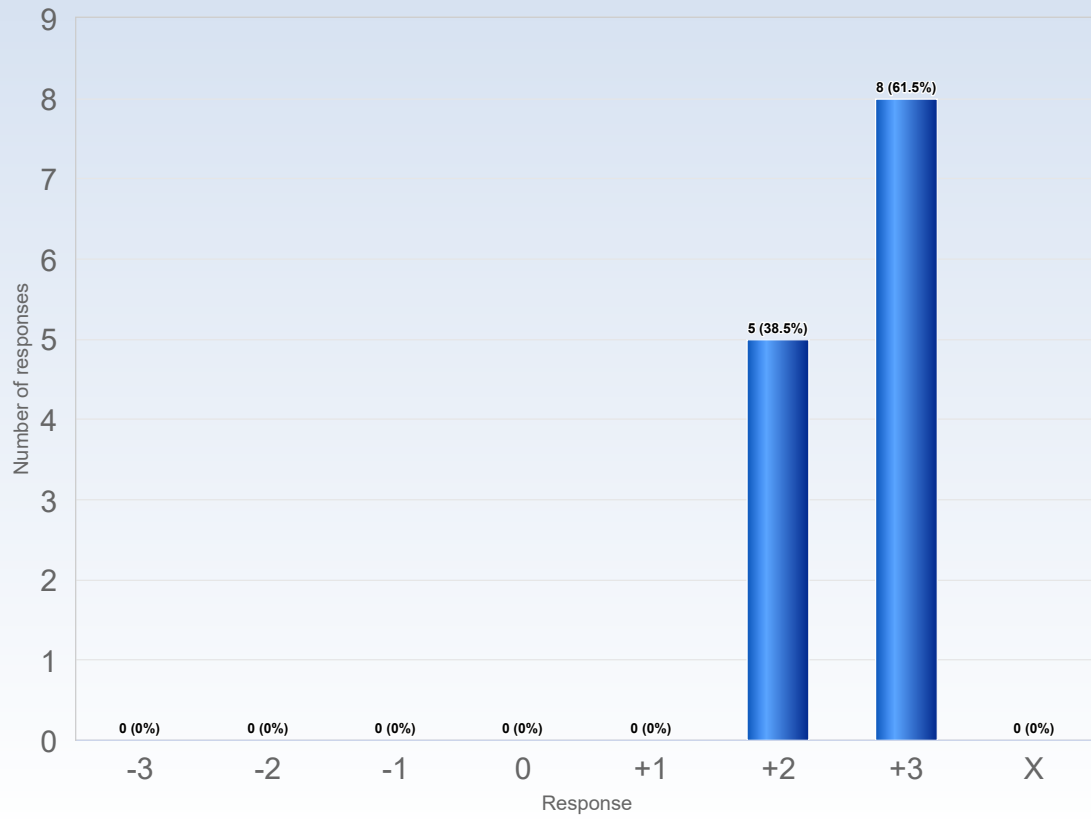
7. The intended learning outcomes helped me to understand what I was expected to achieve



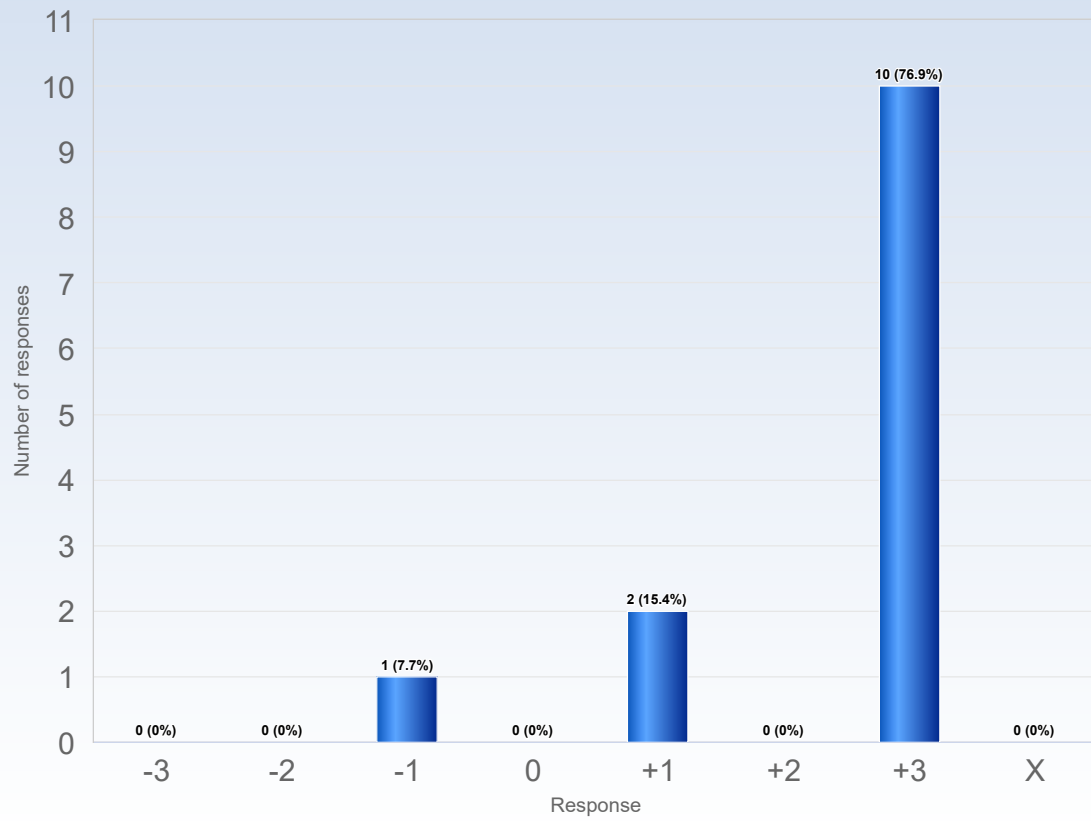
10. I was able to learn from concrete examples that I could to relate to



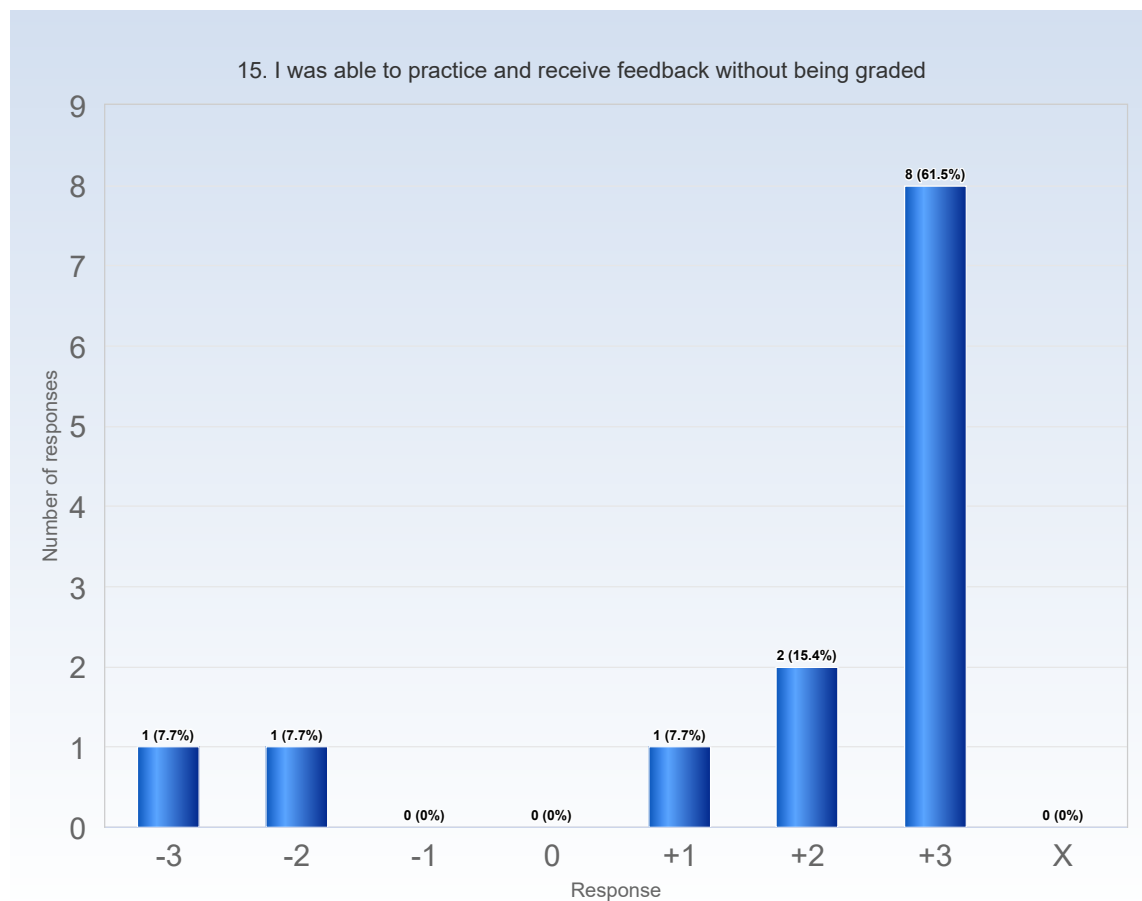
11. Understanding of key concepts had high priority



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



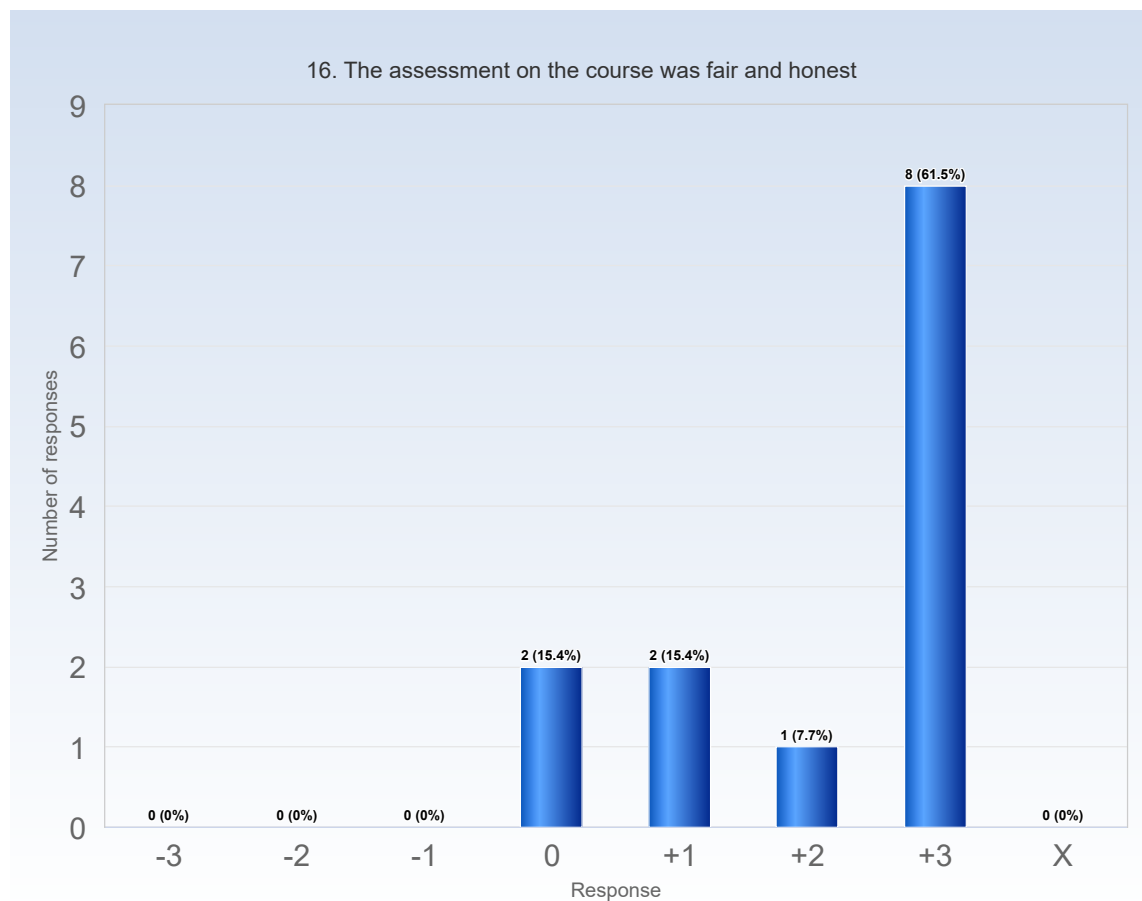




Comments

Comments (My response was: +2)

Not for the last units.

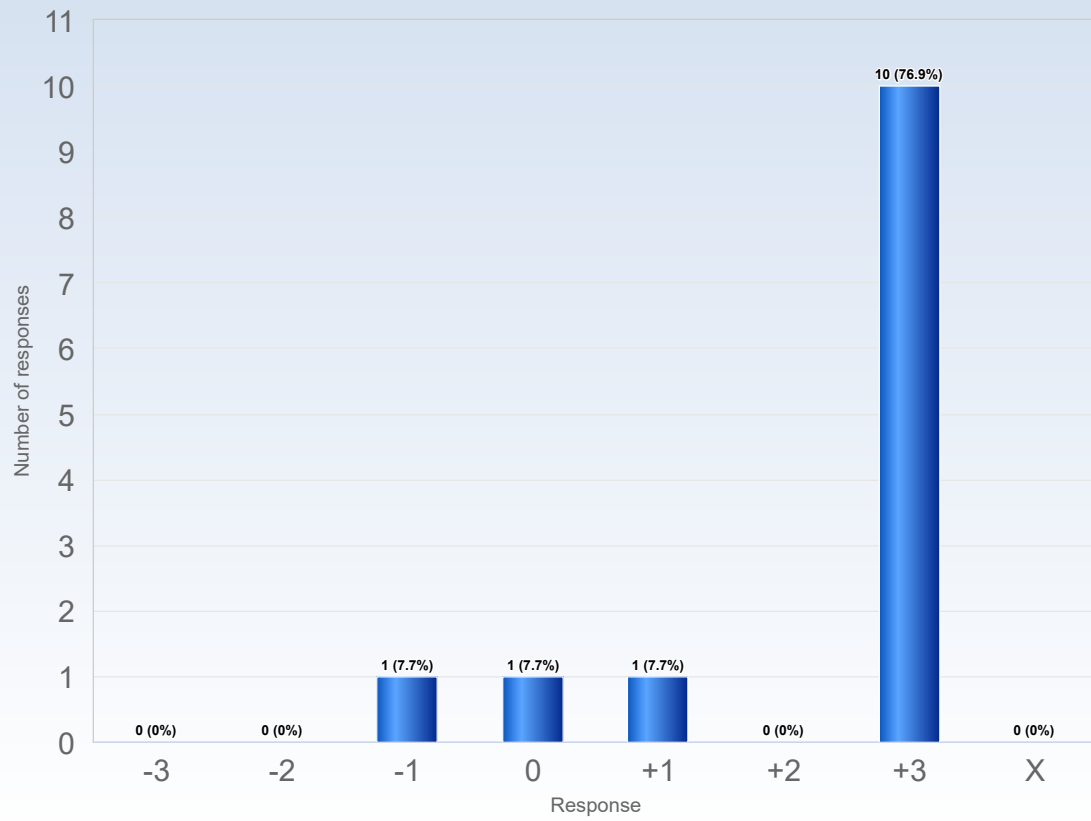


#### Comments

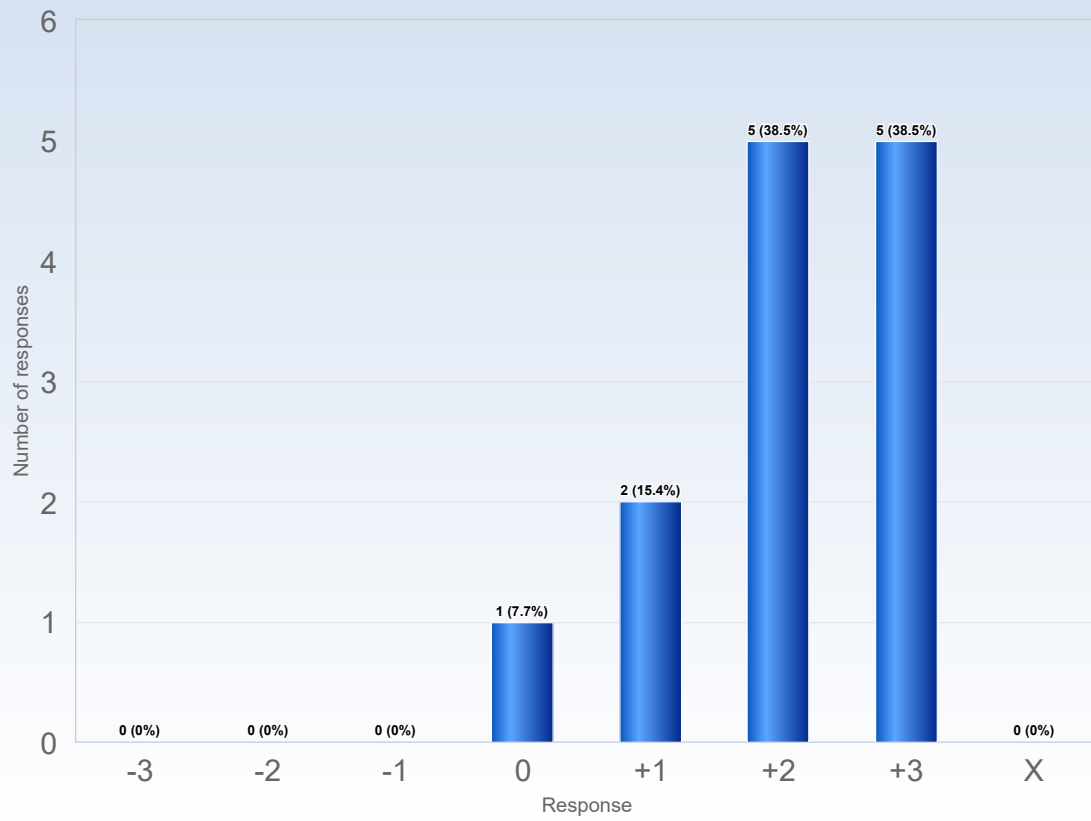
Comments (My response was: +1)

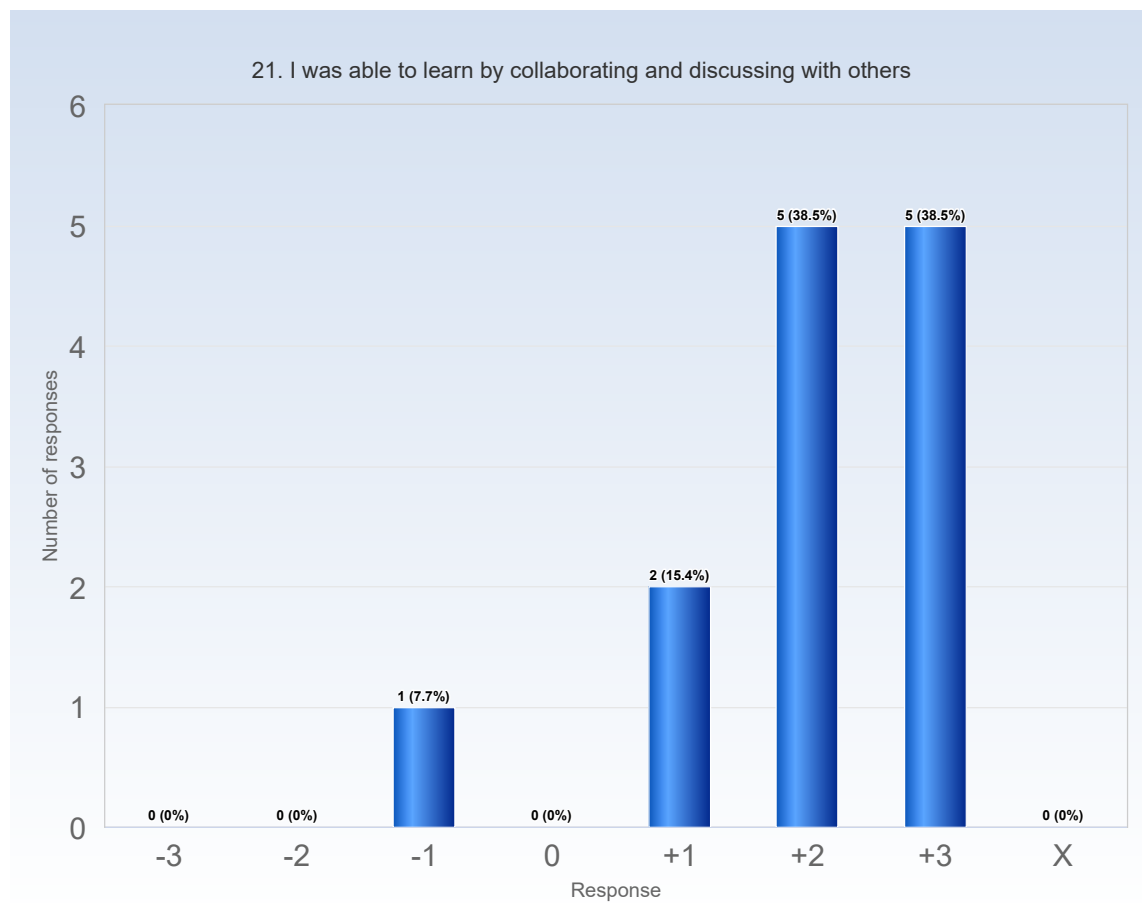
I did not quite like the final exam; it did not show if you knew what you were talking about or just practised the quizzes a lot...

17. My background knowledge was sufficient to follow the course



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





Comments

Comments (My response was: -1)

The project being individual was a downside.

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

