

E-A×M+S 2022

A flipped learning classroom using MATLAB grader

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Who we are?

- I graduated from the PGCert, PGDiploma, and Master's Degree in Teaching and Learning in HE courses in UCC in 2017, 2018 and 2020.
- A member of Physics Education Group at Imperial College London, with 11 members.
- Working on “Active Learning Project” since 2019.
- Two main themes of the project:
 - Enabling student learning and engagement prior to instruction in a blended learning environment
 - Physics demonstrations to create active learning



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Introduction

- A flipped learning classroom approach has been adopted for 2 undergraduate physics courses at Imperial College London over the last few years.
- Our detailed studies shows that most students found pre-reading materials and quizzes very useful to enhance their understanding [1].
- A postgraduate MATLAB course has been recently designed based on blended learning and flipped classroom approaches.
- All the formative and summative assessments in this course were carried out using MATLAB grader that was integrated into Blackboard platform.
- A detailed study has been performed to gain a better understanding of the efficacy of these novel active learning methods and tools used in this course.

Introduction; Flipped classroom

- In flipped classrooms, the sequence of the learning arrangement is literally flipped. Students start with a self-study phase usually supported by multimedia material in which they acquire knowledge at their own pace [2].
- The direct instruction moves from the group learning space to the individual learning space. Learners have flexibility to choose when and how to engage in out-of-class activities, advocates stress the advantage of the active involvement and application of knowledge during in-class activities [3-4].
- Studies showed that flipped classroom improves achievement, motivation and self sufficiency of students [5].

[2] Lage, et al. (2000) The Journal of Economic Education, 31(1), 30–43

[3] Huang, et al (2019). Interactive Learning Environments, 27(8), 1106–1126.

[4] O’Flaherty and Phillips (2015). The Internet and Higher Education, 25, 85–95

[5] Bazelais and Doleck, Computers in Education, vol. 5, no. 1, p. 67–94, 2018.

Introduction-Using technology

- The pandemic provided us with an opportunity to start using a wide range of tools and applications to improve students' engagement and enhance their learning.
- It has been shown that the use of technology enables learning relevant skills for students' future careers [6].
- And the incorporation of technology in the classroom enhances actual student learning and that this relationship is moderated by student characteristics [7].
- Moreover, in the Universal Design for Learning (UDL) platform we need to provide multiple means of (1) representation, (2) action, and (3) engagement in our teaching, to address learner differences and variability [8].

[6] Bhute, Vijesh J., et al. Education for Chemical Engineers 39 (2022): 58-66.

[7] Krentler et al., Journal of Education for Business, (2005) 80(6), pp.316-321.

[8] CAST (2018). Universal Design for Learning Guidelines version 2.2.

Outline

Course
structure

MATLAB
Grader

Students'
performance

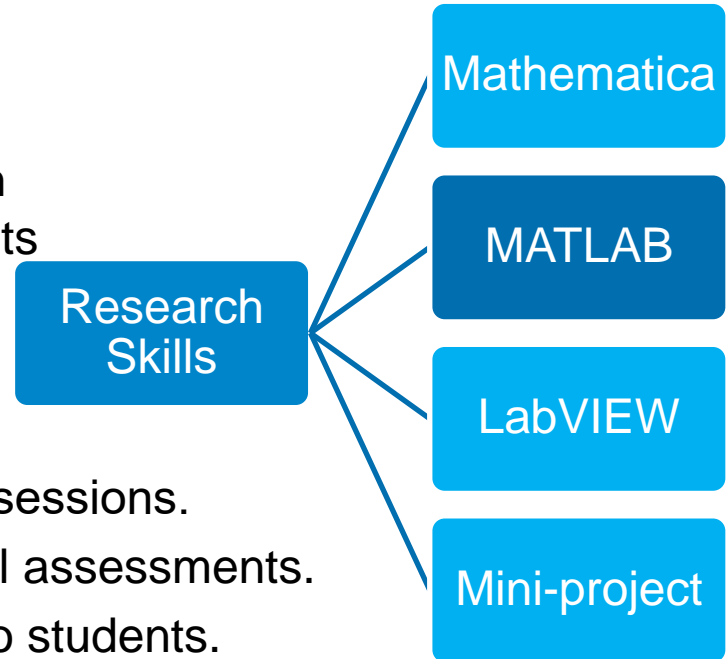
Students'
perspective

Course structure; previous years

- The MATLAB course is part of the Research Skills module Taken by MSc Physics students
- Delivered in 4 weeks in term 2.

Challenges:

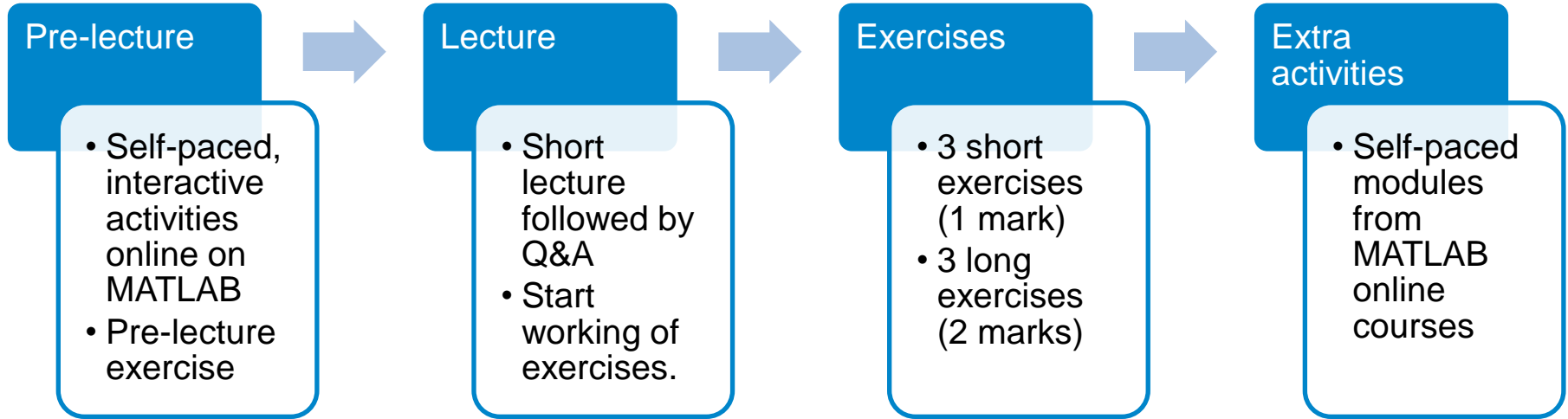
- Students didn't have enough time between sessions.
- 30% continuous assessments and 70% final assessments.
 - Takes a long time to provide feedback to students.
- Students have wide range of MATLAB and programming experience.



Course structure; 2022

- 51 students enrolled in the course.
- Consists of 9 lectures;
 - Delivered over 7 weeks (Previously 4 weeks).
 - The first two lectures were delivered in-person in a computing room,
 - The rest were delivered online on MS Teams.
- The course was designed in a blended learning format.
- Provide all course materials on Blackboard.
- Use MATLAB Grader to automatically grade all exercises.

Flipped learning classroom



Assessments

- Each lecture carries 10% of the final mark.
 - Pre-lecture exercise: 1 mark; submitted before each lecture.
 - Each short exercise: 1 mark (3x1)
 - Each long exercise: 1 mark (3x2)
- Final assessment: 10%
 - 5 exercises
 - Regraded, to make sure students followed good programming practices
- All exercises submitted on MATLAB grader integrated to Blackboard

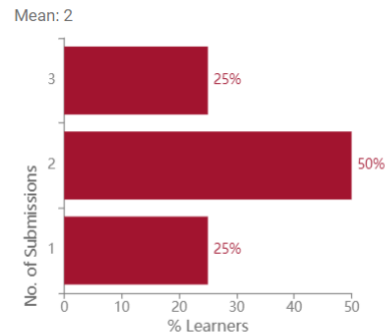
Assessments

- In the first few sessions students could submit unlimited number of attempts.
- Then limited to 2 attempts.
- Only 1 attempt for the final assessments.

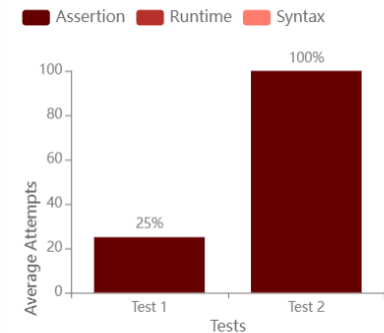
Not Solved:

4 Learners have submitted solutions but haven't yet solved the problem.

Submissions Made Attempting to Solve the Problem



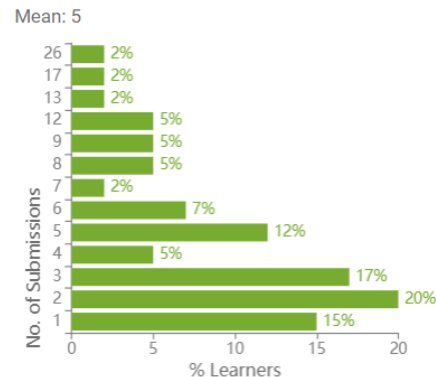
% Learners Still Failing Each Test



Solved:

41 Learners have solved the problem.

Submissions Required to Solve the Problem

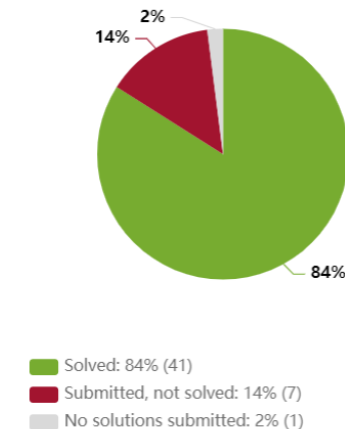


Average Submissions Required to Pass Each Test



Status Summary

49 Learners have accessed the problem.



Click bars for distribution details.

MATLAB Grader advantages

- Automated assessment tools; so immediate feedback.
- Provide a flexible learning environment that successfully adapted to face-to-face and remote-online learning modes.
- Facilitates delivering a course in Blended Learning environment.
- Possible to use the already-made sample problem sets of MATLAB Grader
- It is possible to integrate into Learning Management Systems (LMS)
- No need to install MATLAB
- Can be easily used for formative and summative assessments.
- Students found it a useful and fun way to practise coding.

MATLAB Grader limitations

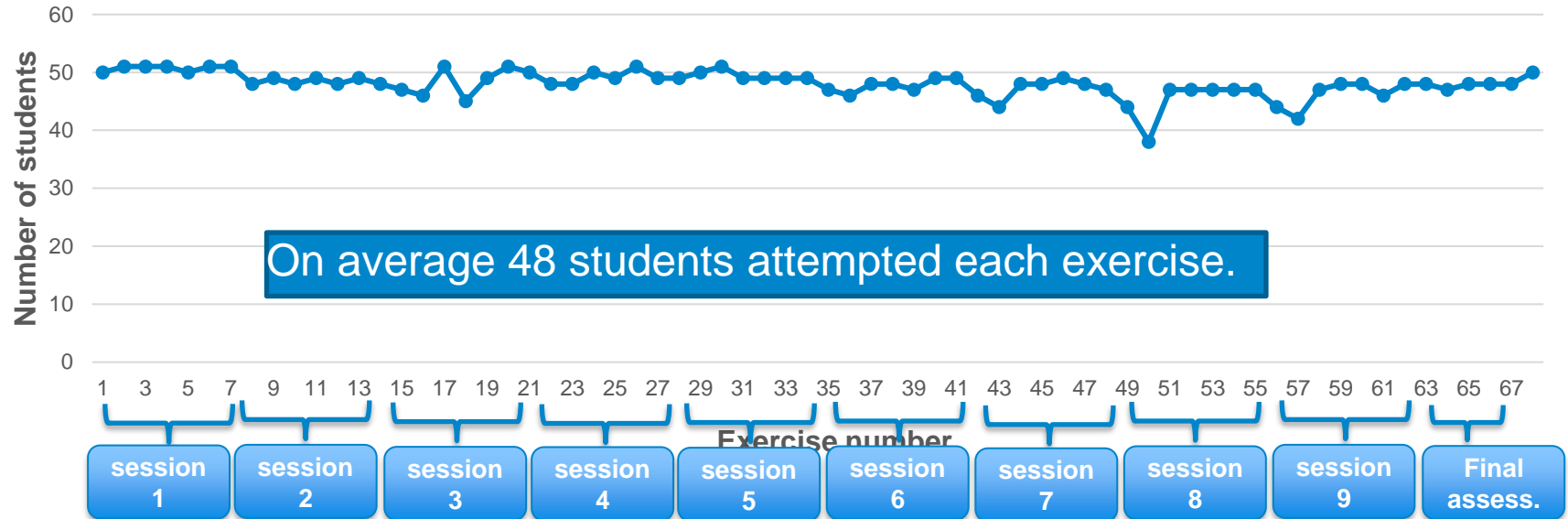
- It is not possible to limit the number of submissions in MATLAB Grader.
- In order to find a submission by specific students, I needed to ask them for the solution ID of the submission.
- Not possible to assess good programming practices.
- Some students may be frustrated by the 'strict' testing used by Grader.
 - It is a good practice to use pre-test feature for early part of the code.

Students Reception

- Students' performance;
 - Data from Blackboard and MATLAB grader.
- Students' perspective
 - Data from students survey, ran at the end of the course.
 - 51 students were enrolled in this course, and the survey has been completed by 19 students so far.
 - We have just started to carry out focus groups as well

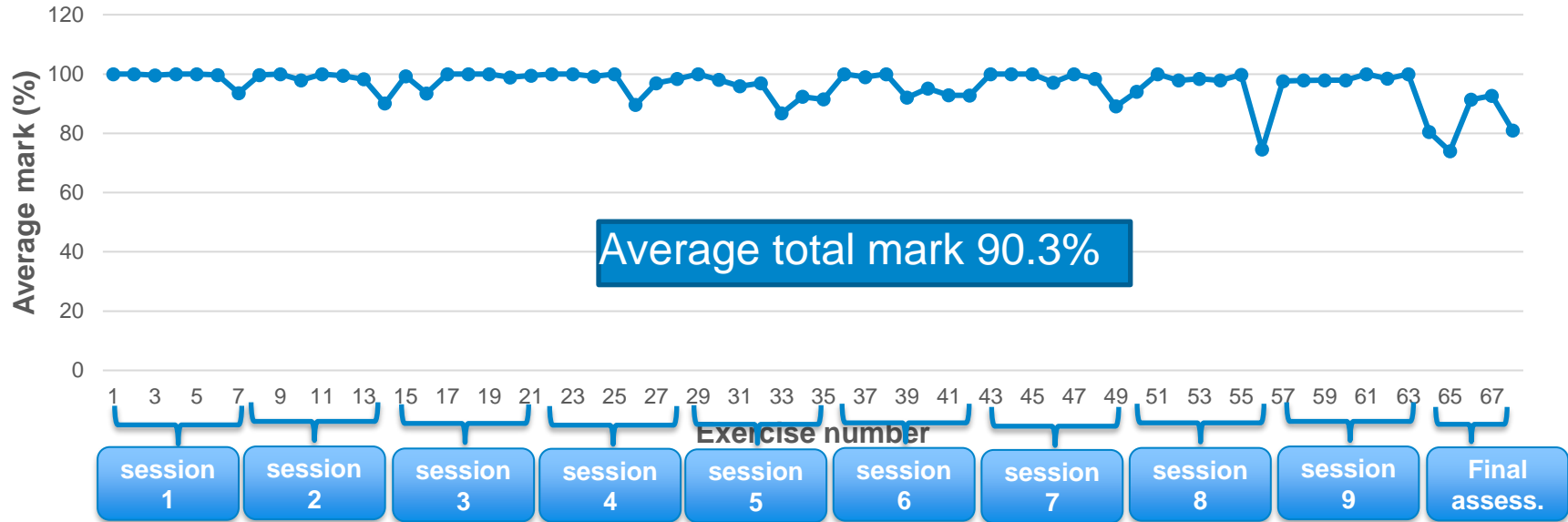
Students performance

Total number of students who submitted solutions for each exercise.

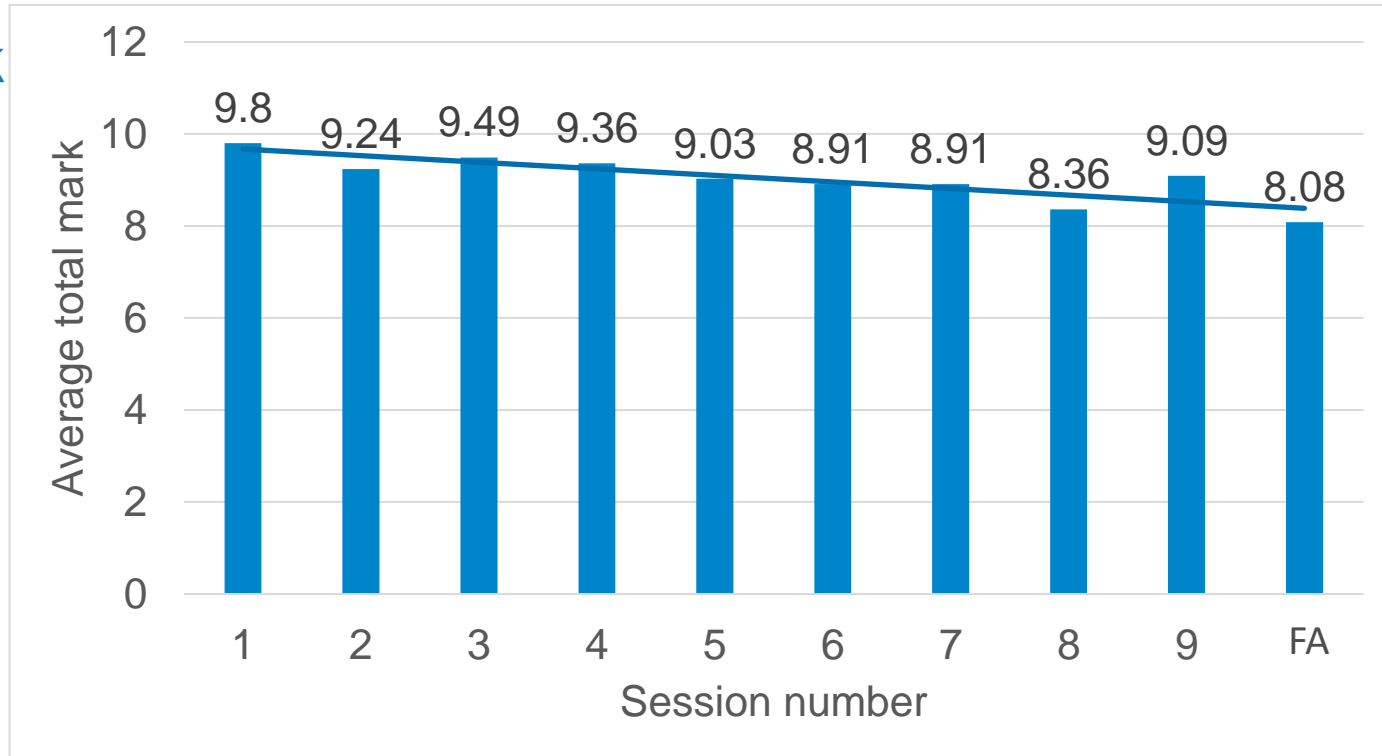


Average mark

Average percentage of the mark for each assessment

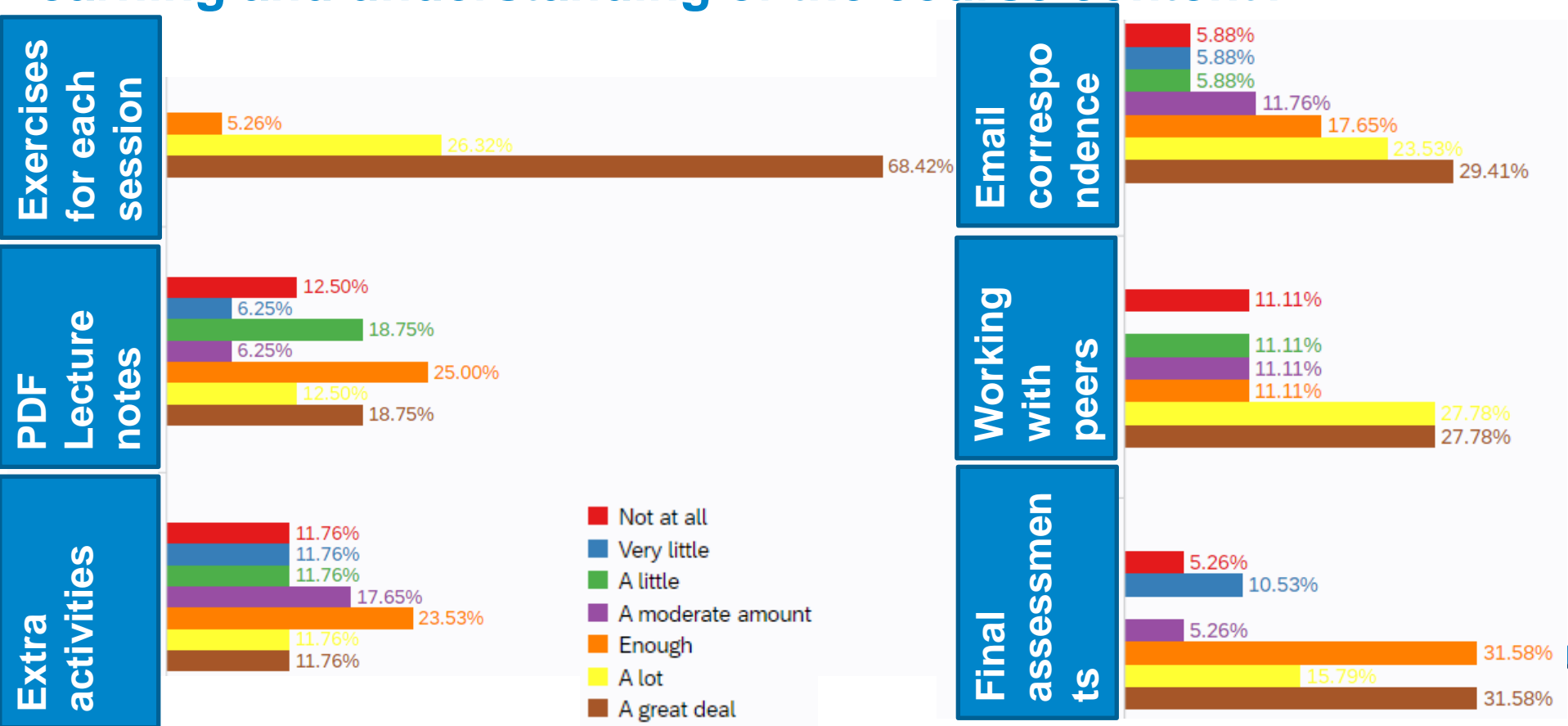


Average mark



How much did each of the following help your learning and understanding of the course content?

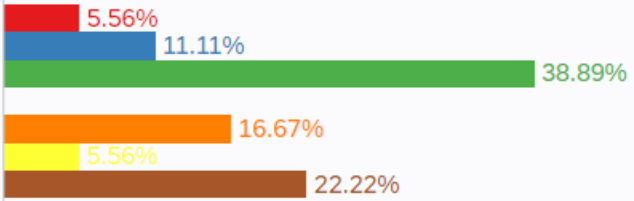
EAMS2021
22/06/2022



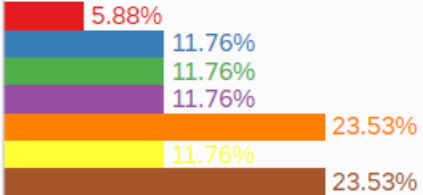
How much did each of the following help your learning and understanding of the course content?

EAMS2021
22/06/2022

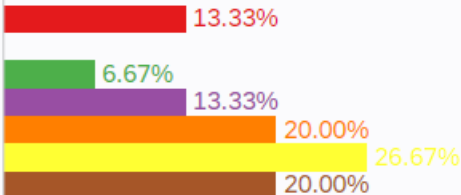
In-person lecture



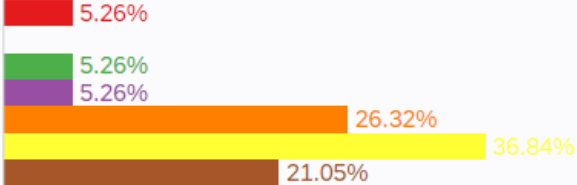
Live lecture on Teams



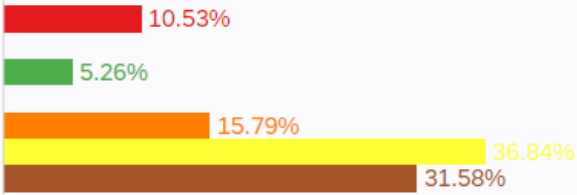
Recorded lectures on Blackboard



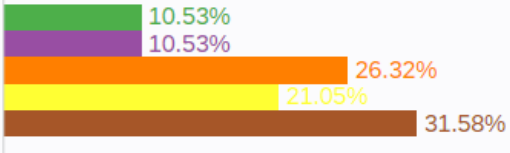
Pre-lecture activities



Pre-lecture exercises

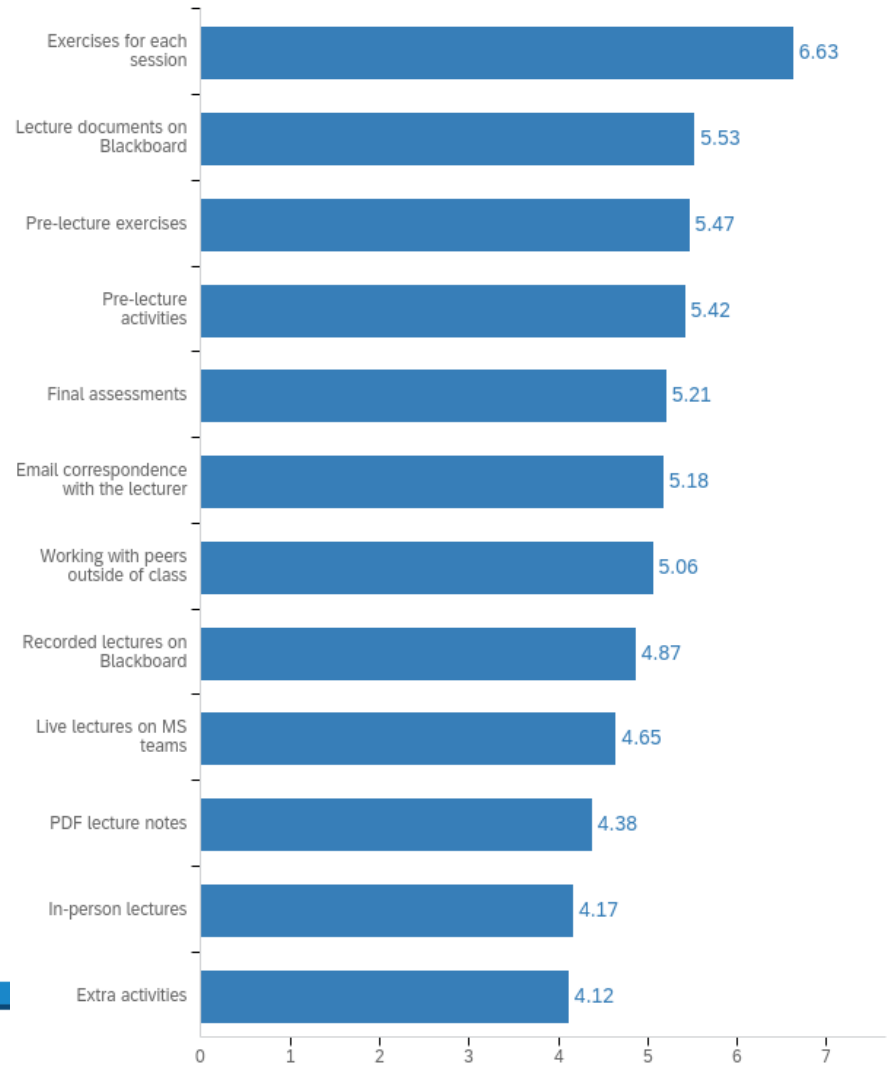


Lecture documents on BB

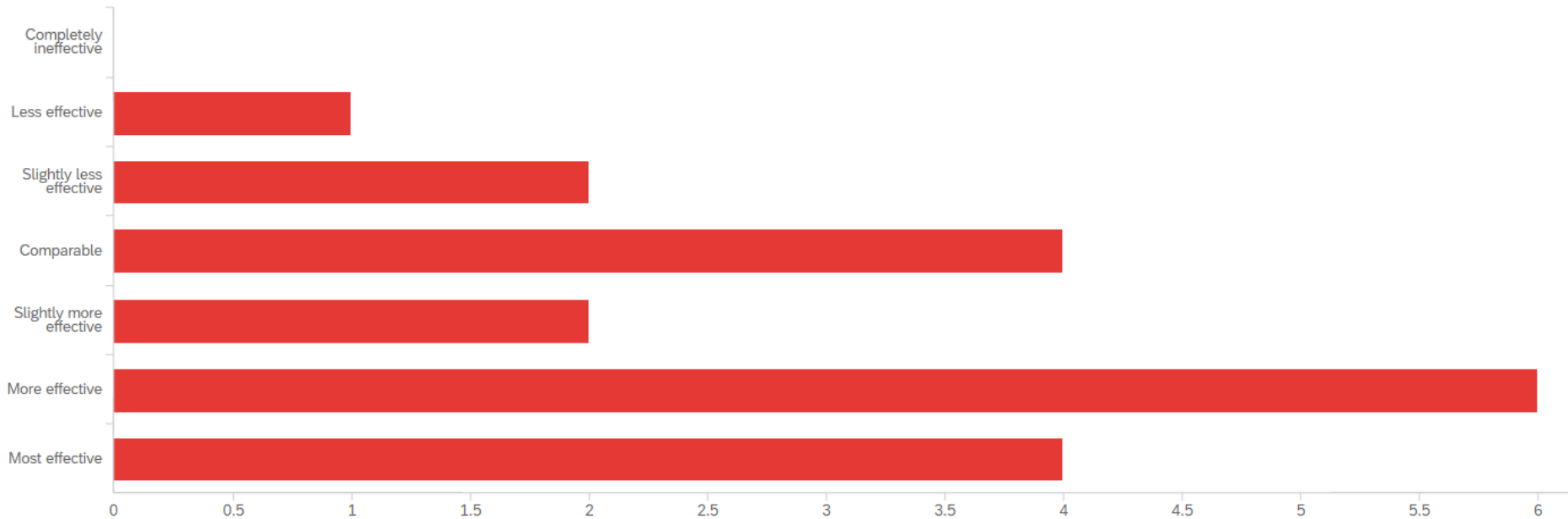


- Not at all
- Very little
- A little
- A moderate amount
- Enough
- A lot
- A great deal

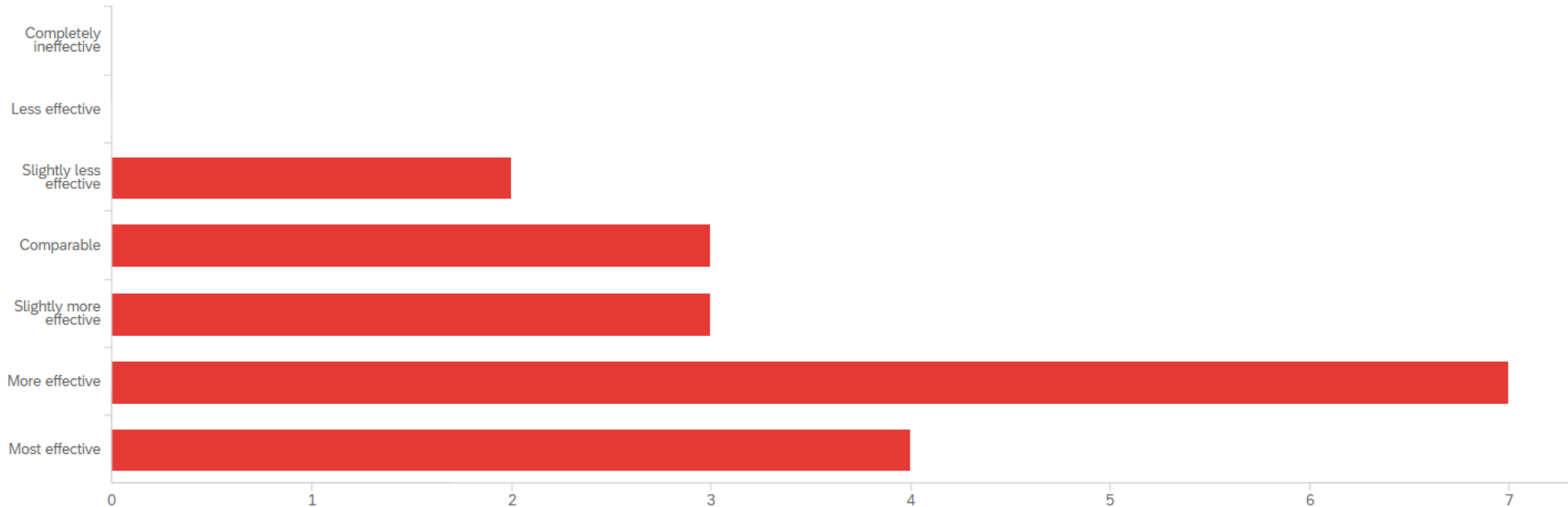
How much did each of the following help your learning and understanding of the course content?



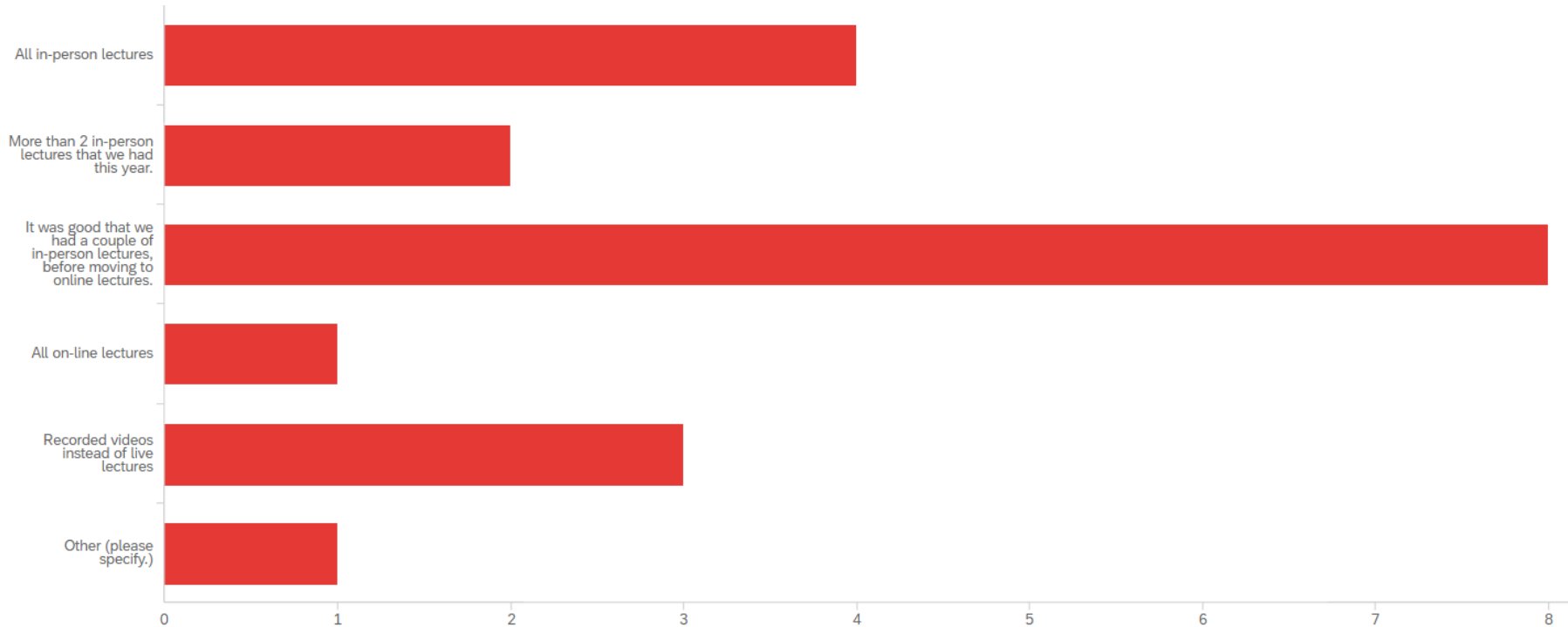
How effective do you perceive the pre-reading material and exercise to be, compared to other more passive learning activities and methods?



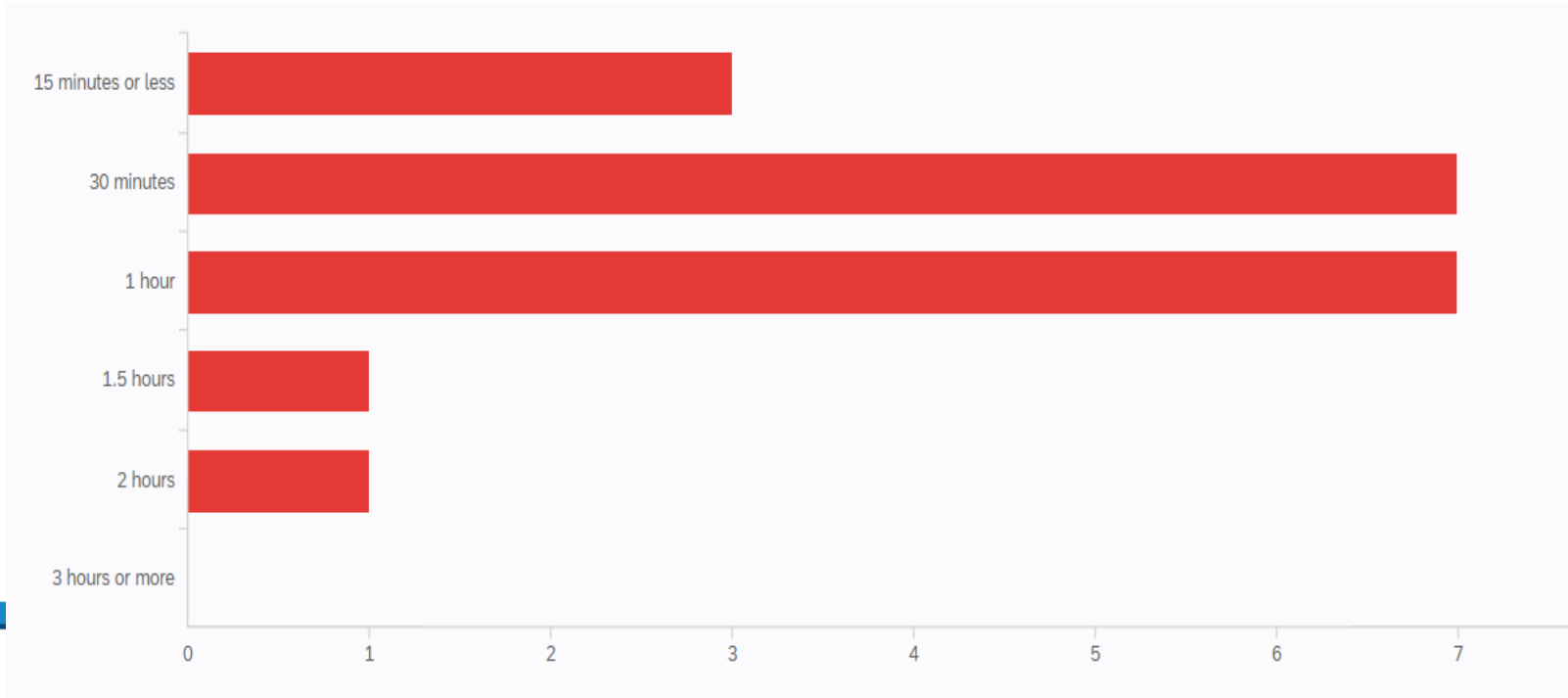
How effective was MATLAB Grader in auto grading the exercises and assignments, compared to ordinary methods, where students submit the codes, which will be assessed by instructors later?



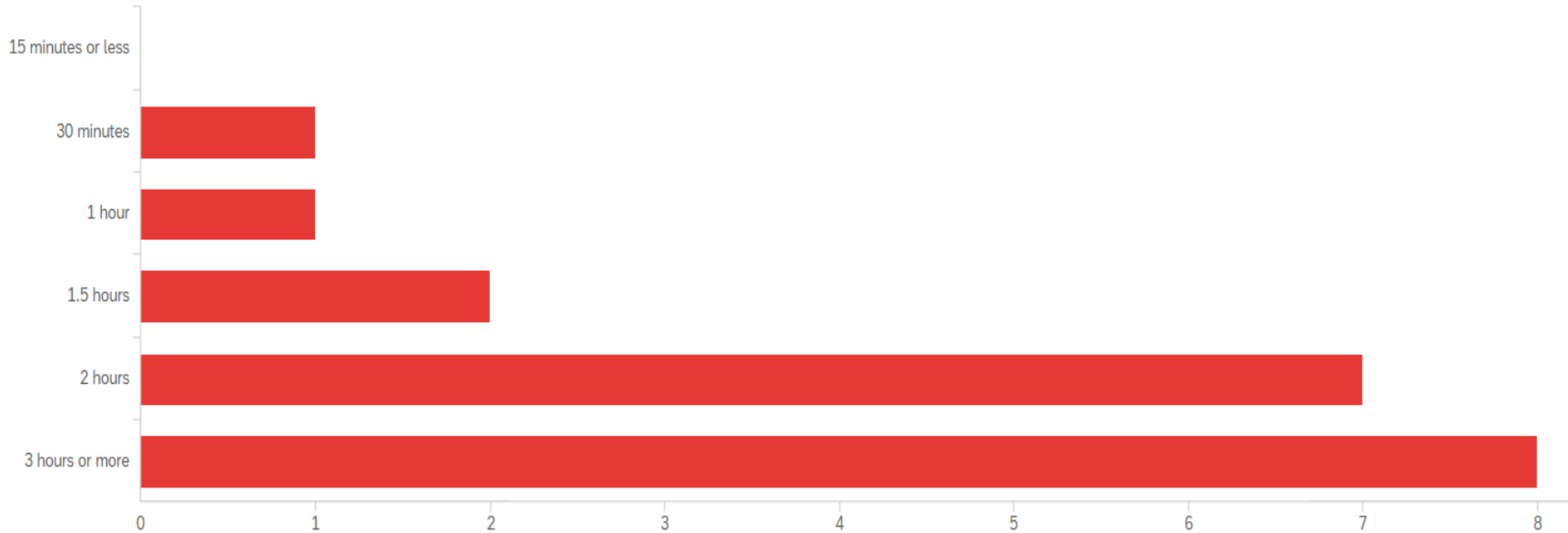
Which type of lecture do you prefer?



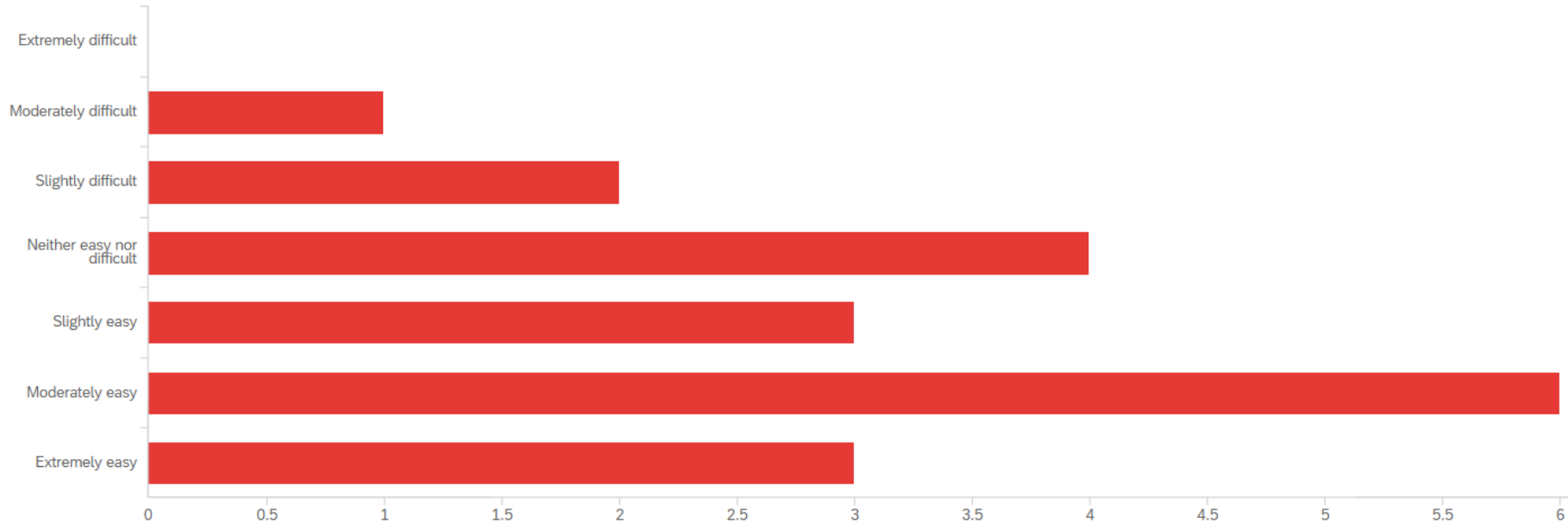
On average, how much time did you spend on pre-lecture activity and exercise prior to each lecture?



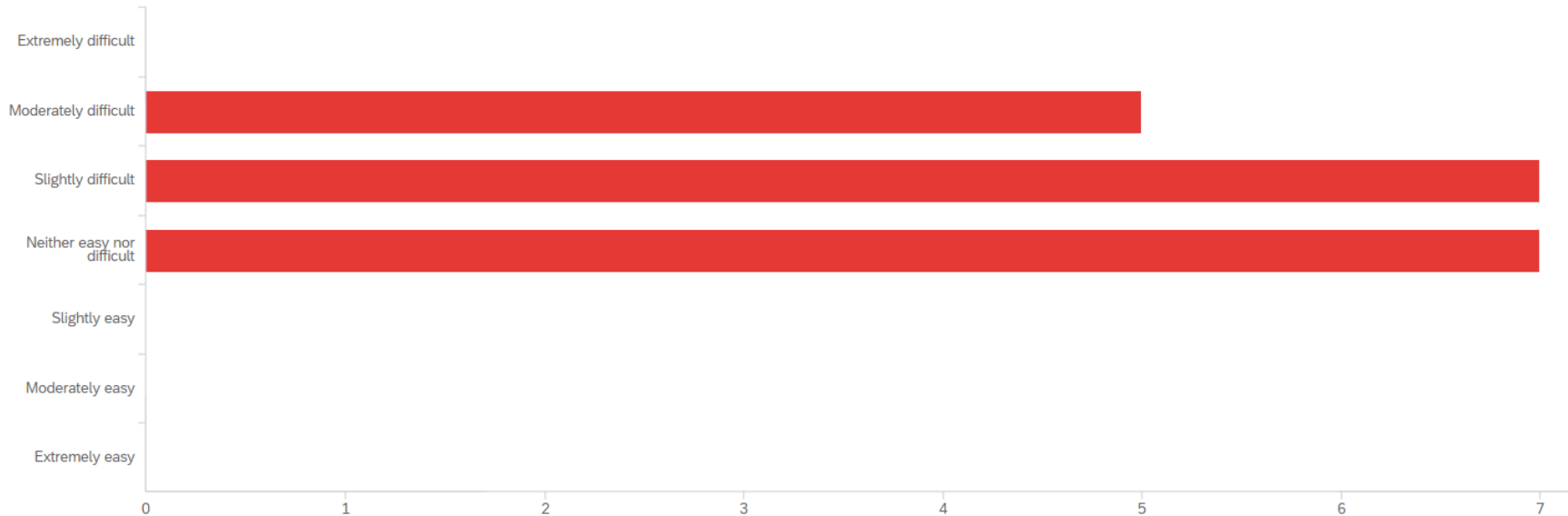
On average, how much time did you spend on exercises 1-6 in each session?



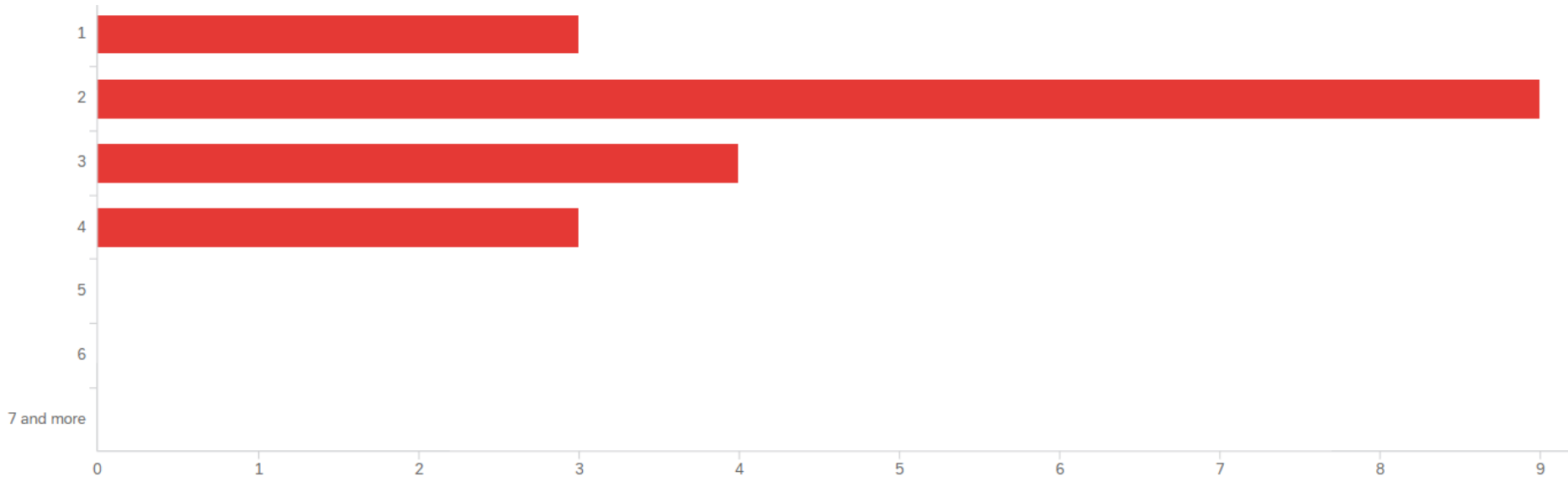
On average, how did you find the pre-lecture activities?



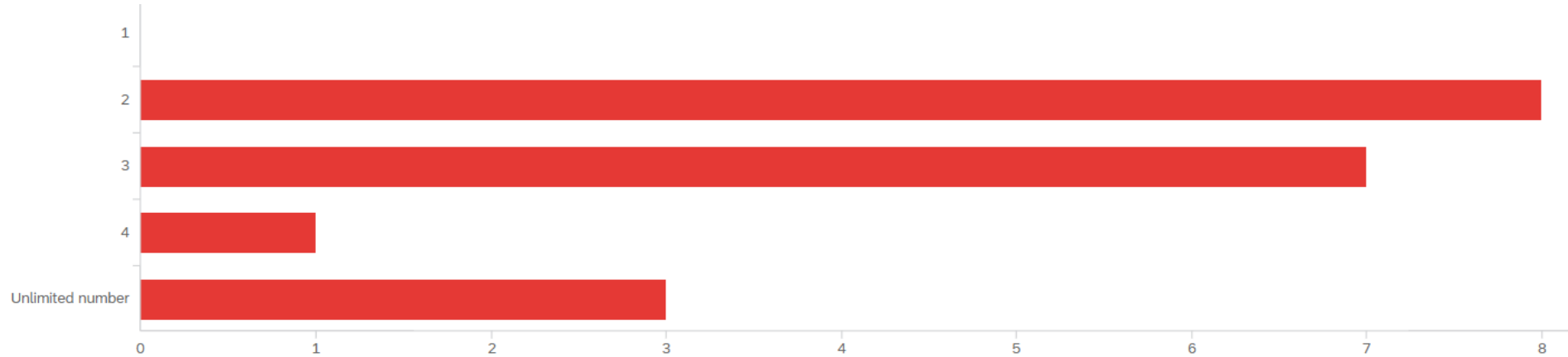
On average, how did you find the exercises in each session?



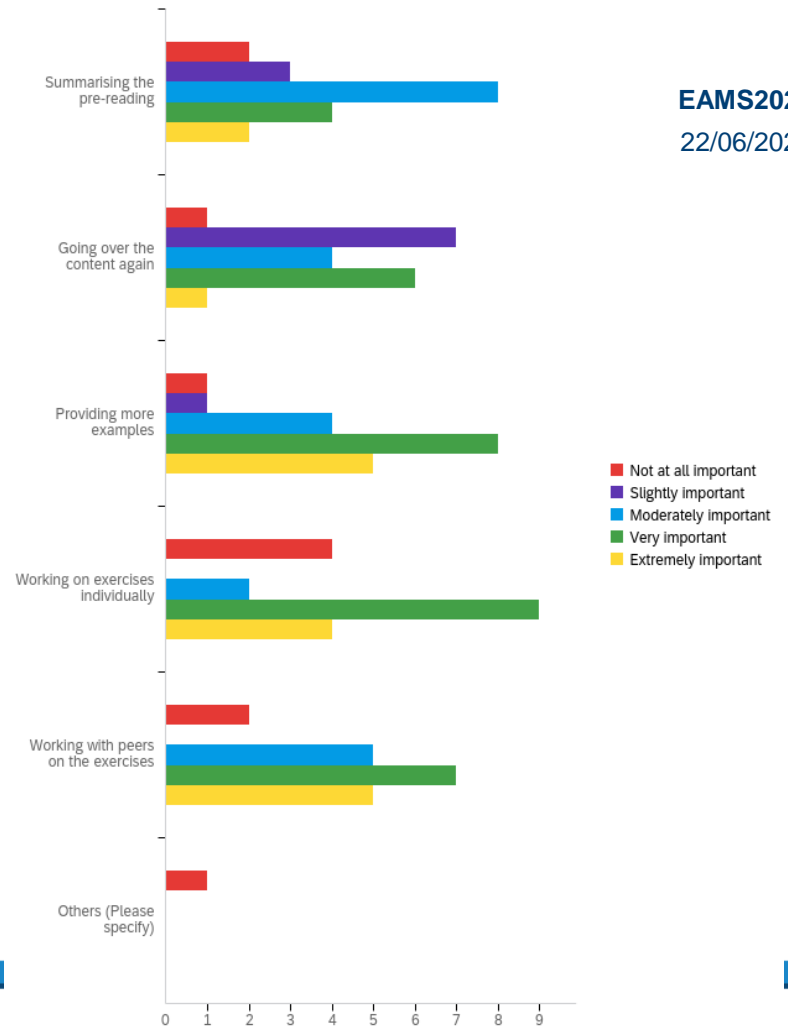
On average, how many attempts did you submit for the exercises?



How many attempts would you like to have for each exercise, in the later sessions?



How important would you rate each of the following activities during the lecture?



How effective did you find the pre-lecture exercises?

It was effective, but I didn't see a big difference between the pre-lecture exercise and the other exercises.

I see them just as a small test for whether doing the pre-lecture material or not because they are usually really easy.

Positive

Negative

It helped me get an understanding of the weeks problems

Very good for introducing the focus of the week

4 x Very effective/ really useful/ good

3 x The best/ useful way to introduce the topic

there was no need of having them

Too easy and not helpful



How did you find the self-paced pre-lecture materials?

It allowed me to go at my own pace rather than trying to go faster and now understand.

very engaging and helpful

Helpful but not much

It was really useful though it was unclear initially how much we were supposed to do before each session

Useful

3 x Good / Very good

The best way to learn something new.

Useful but too easy

What do you think about the exercises for each session? What did you like about them? What need to be changed?

Very helpful, but may be better if you give more details about how the answer is rated.

I liked them though I thought they took a long time to complete because the instructions/task descriptions were sometimes quite confusing.

They were clear enough to understand.

They can be quite time-consuming and some had mistakes

some problems are too long and complex, I am not good at reading in English so it is challenge for me

The exercise are the best part of this course, leave them and remove lectures and final assessment then the course it's perfect

Really helpful in learning.

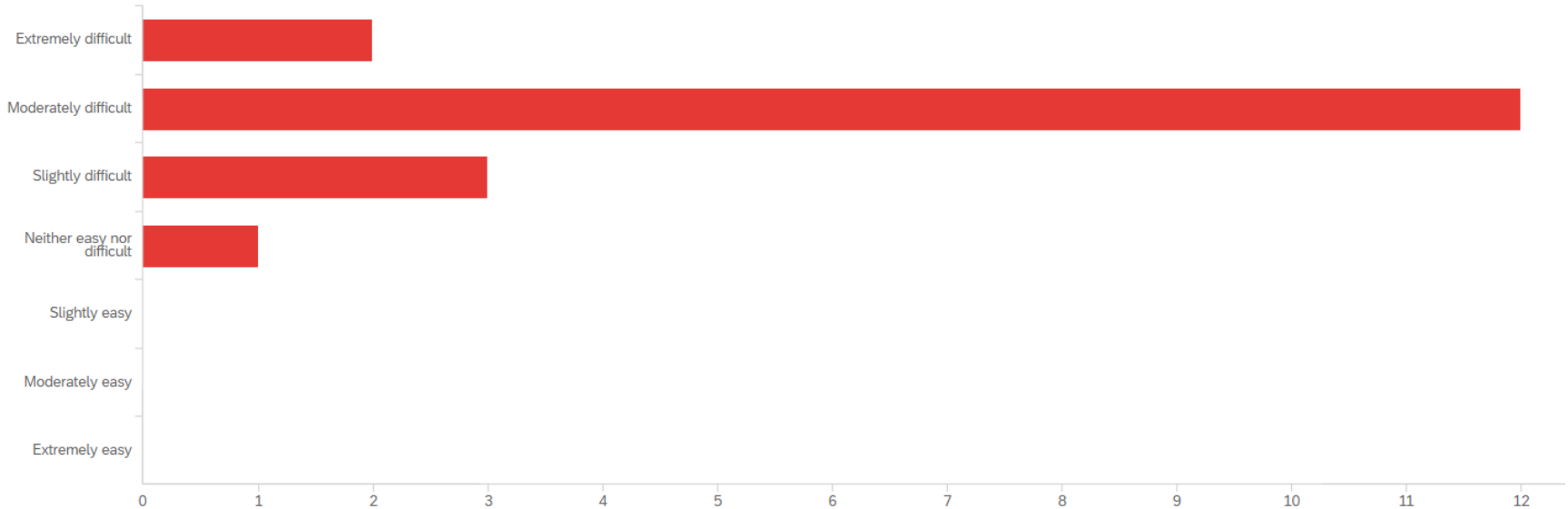
Good

A few of them were slightly unclear or difficult to understand, but overall they were good.

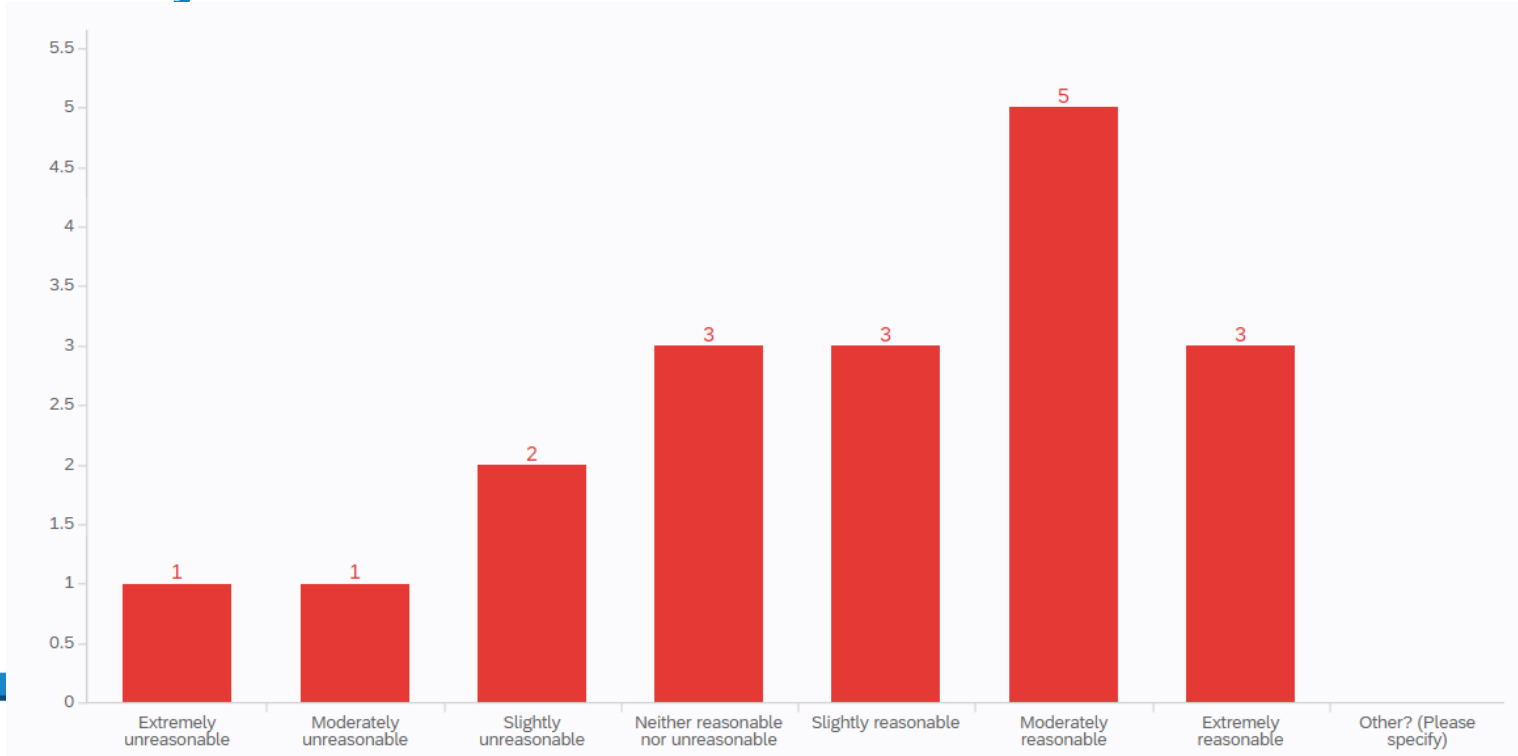
Very engaging and- especially the second half of the sessions- required a good level of thinking.

They are questions about understanding the questions and the physics instead of coding

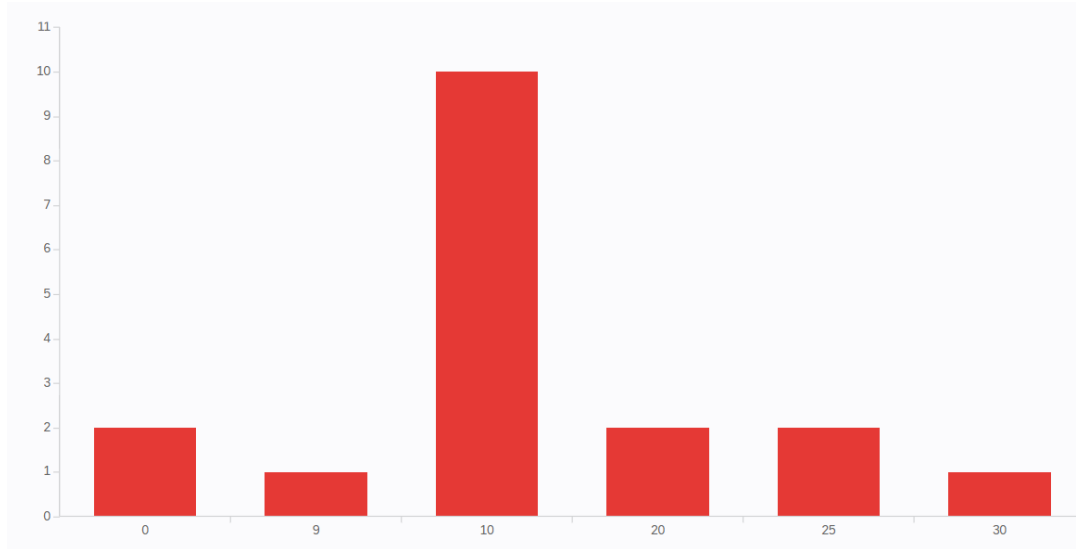
How did you find the final assessments of this course?



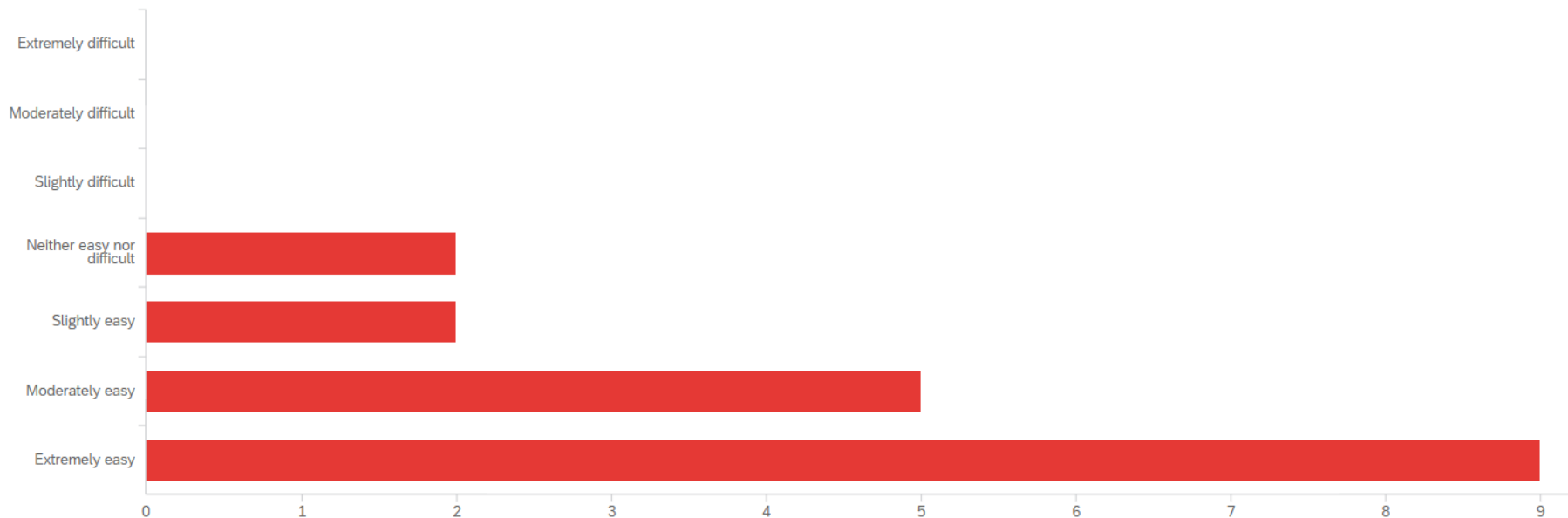
What do you think about the assessment in this course?



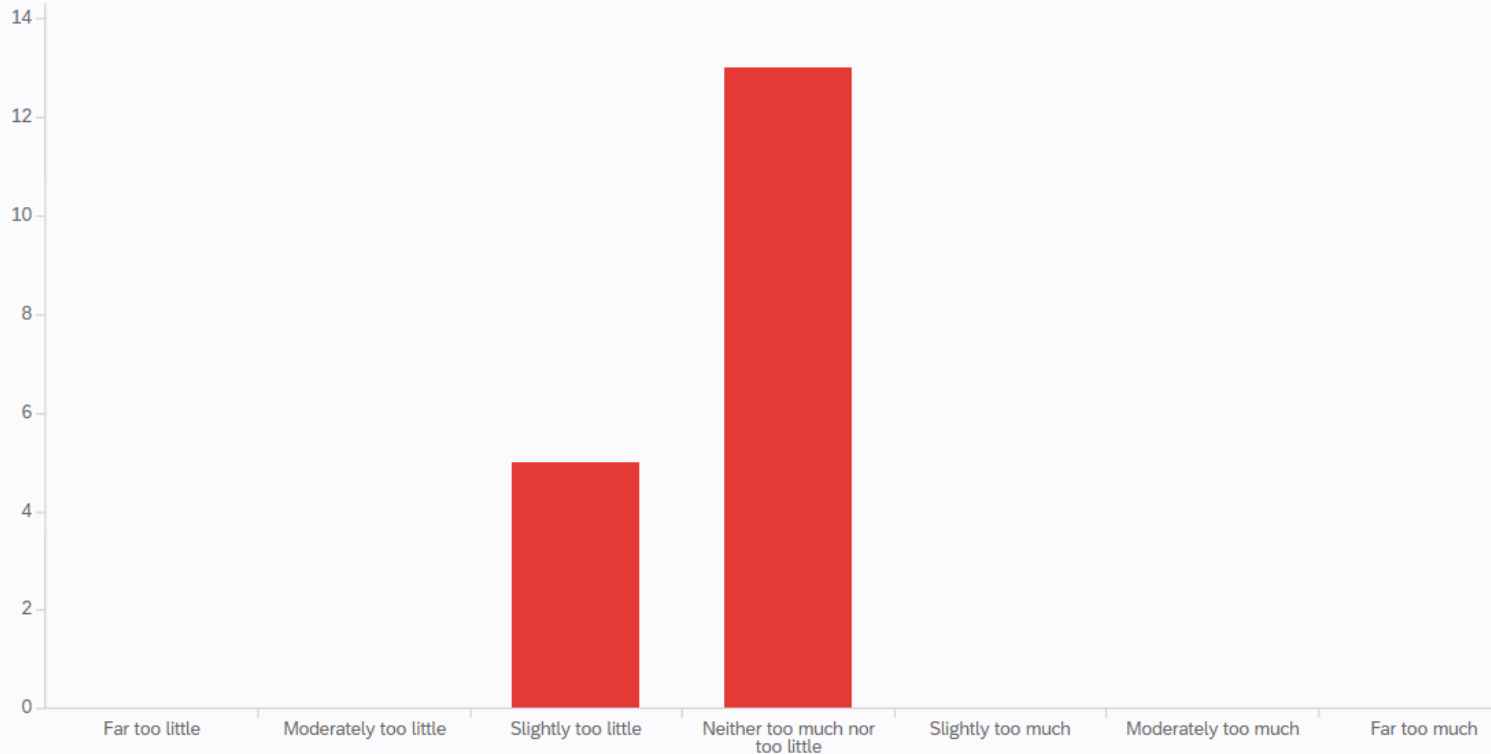
This year, the final assessments counts for 10% of your final grades. What percentage do you suggest for the next year (0-100)?



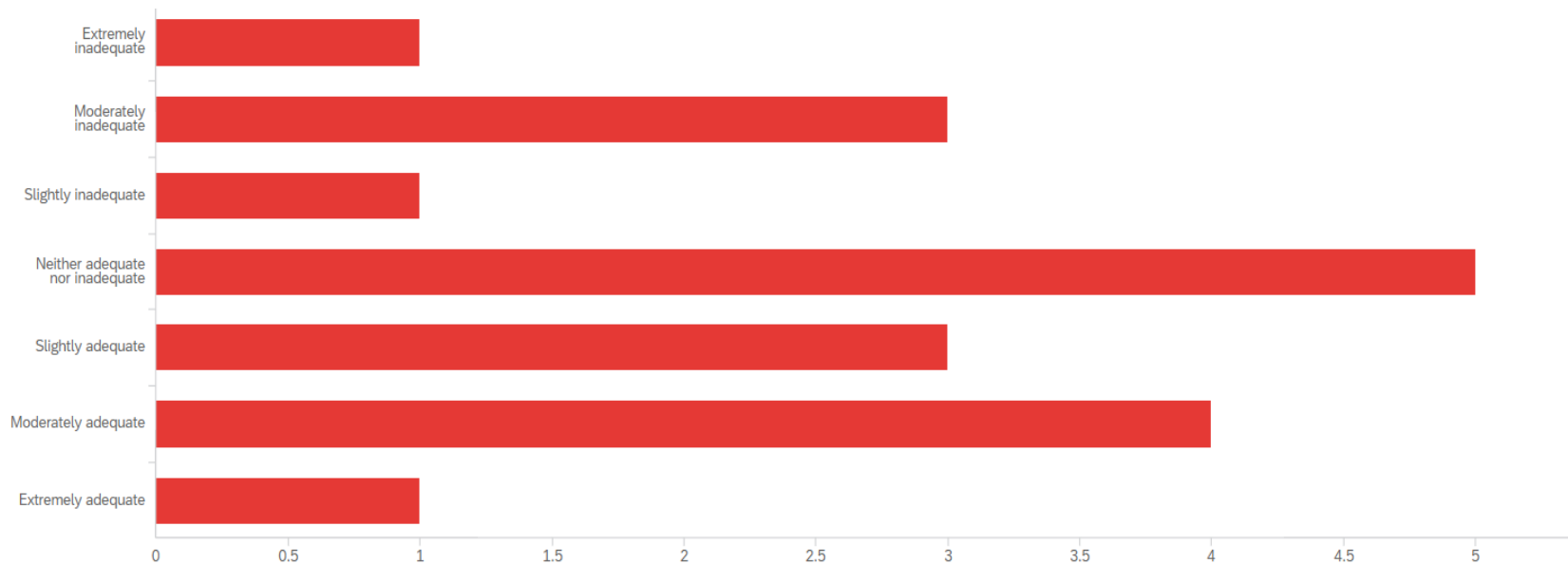
How easy was to communicate with the lecturer outside the class?



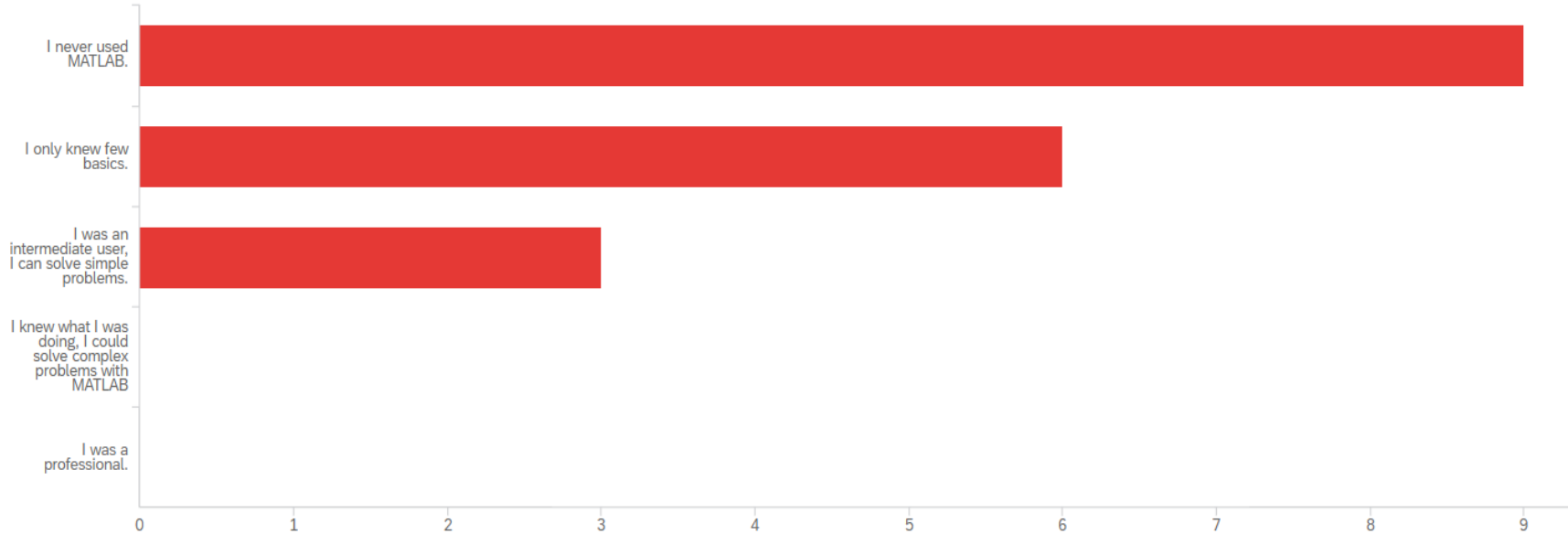
How did you find the range of the topics covered in this course?



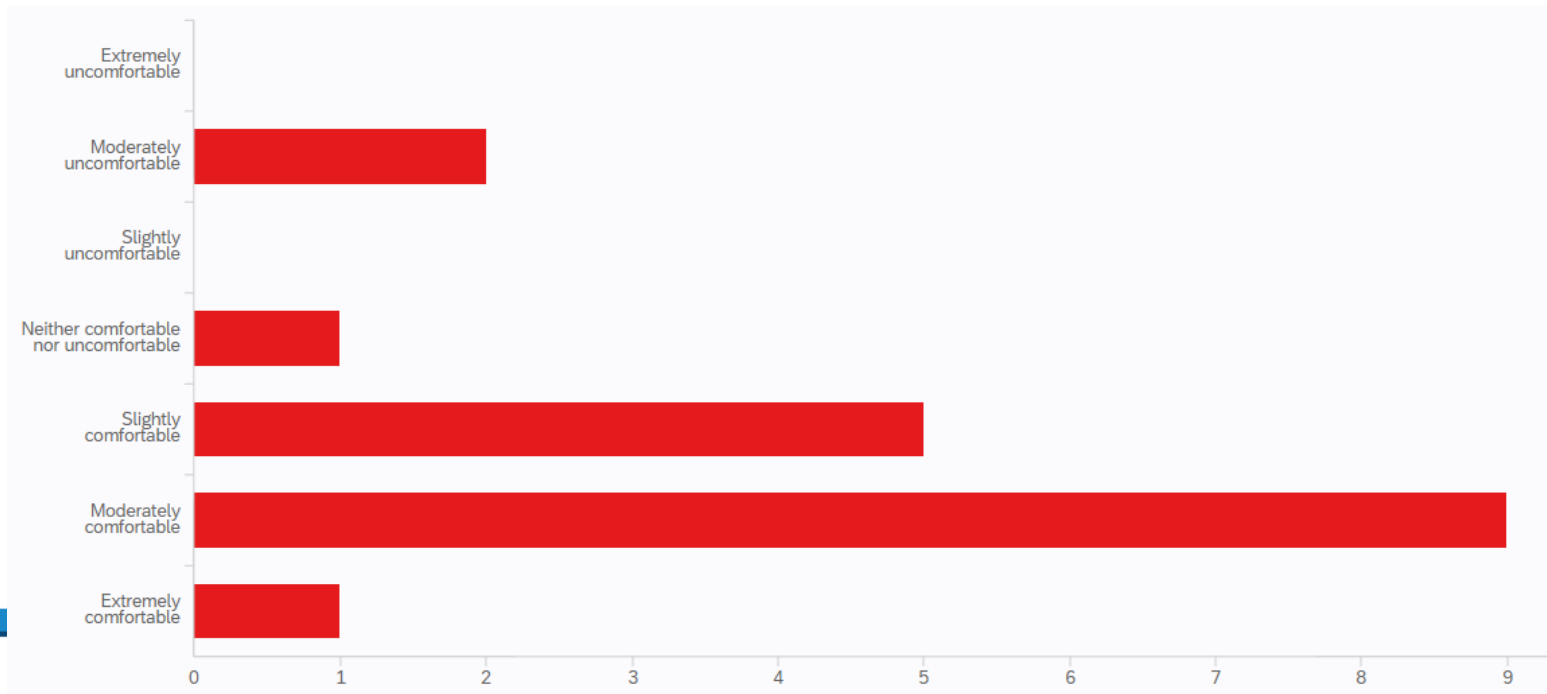
How was your programming experience before attending this course?



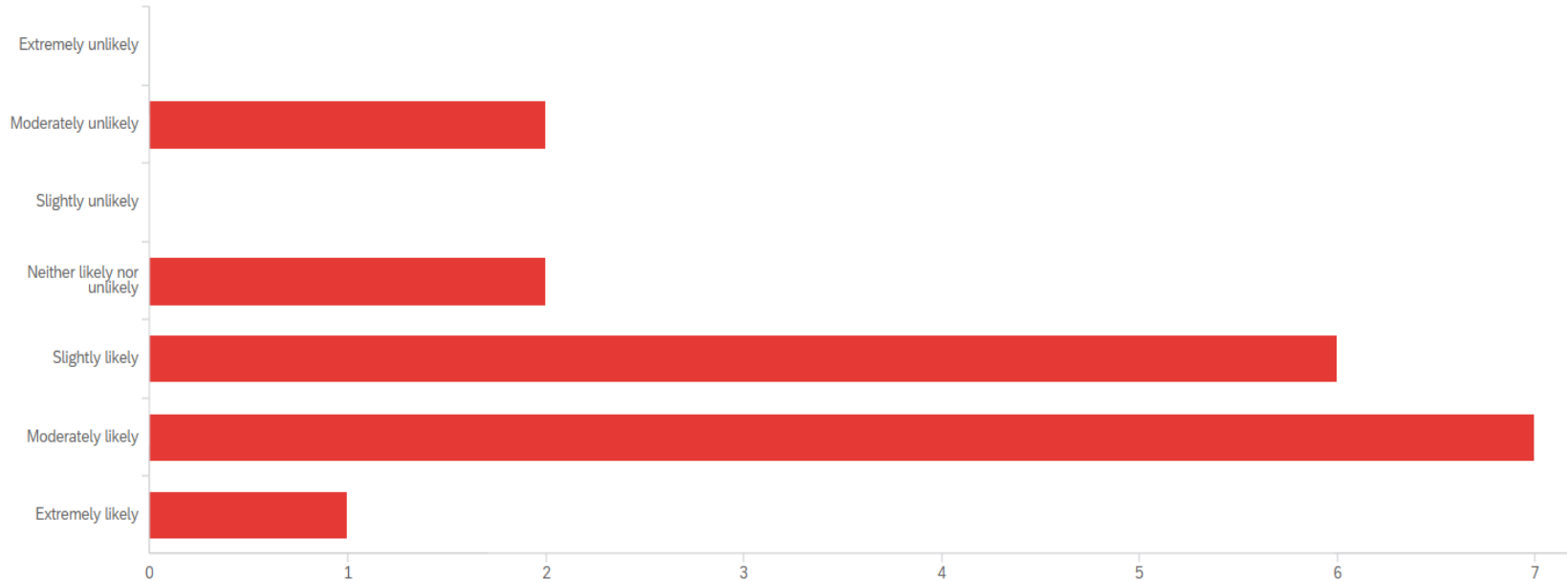
What was your MATLAB experience before attending this course?



How comfortable you are with MATLAB programming after attending this course?



How likely is that you use MATLAB in future (in your study, research or work)?



In general, is there any aspect of this course you have strong feelings about, either positive or negative?

Positive: the professor was always there to answer any doubts on exercises Negative: The final assessment exercises were due together with other staff from other courses and they were not helpful as for code practise.

I think it is very good that we can get in touch with the teacher in time in this class.

the course was well paced, and the difficulty was increasing gradually in the right proportions

I appreciate the effort of the lecturer. However, I really could not learn much from looking at a lecturer demonstrating matlab on the screen.

The later part of the course was a bit to intense compare to the first part, maybe redistribute the materials will create a better learning experience.

What did you like about this course?

I like the combination of the exercises and the pre lecture stuff. I liked that the tasks were varied.

MATLAB is an interesting programming language I liked learning a new language.

The lecturer has put lots of effort to put together a great course

Communication with teachers is good

It teaches me a new skill

Liked the active learning approach and the consistency of the structure of pre-lecture activities, pre-lecture exercises, lecture and exercises

I like some of the exercises that are strongly related to physics, such as solve differential equations.

A great range of exercise for practice.

Likewise, please note deficiencies of the course that can be improved upon.

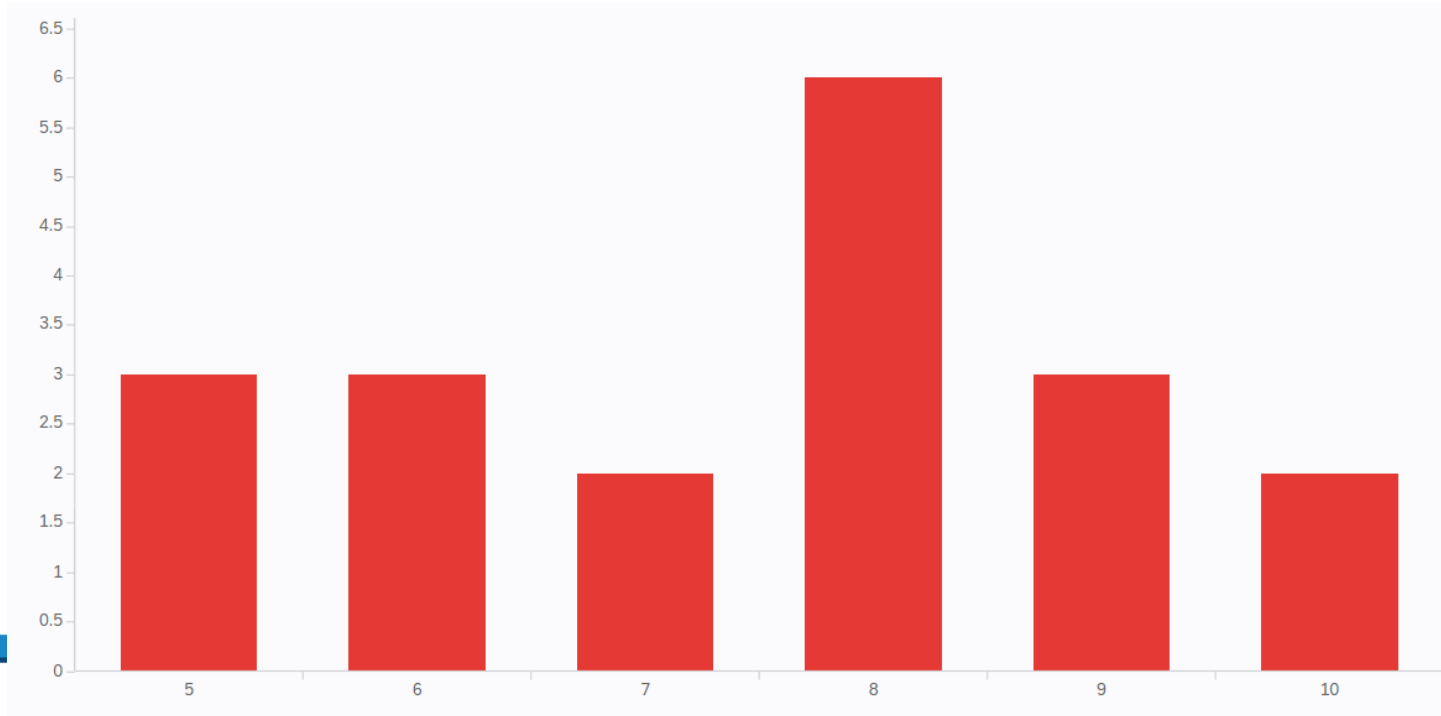
Sometimes the error messages confused me and sometimes did not know what to change. Maybe looking into examples as to why the code does not work sometimes

I think online classes are hard for programming as you get stuck easily without help sometimes.

It's too challenging to submit assignments only once

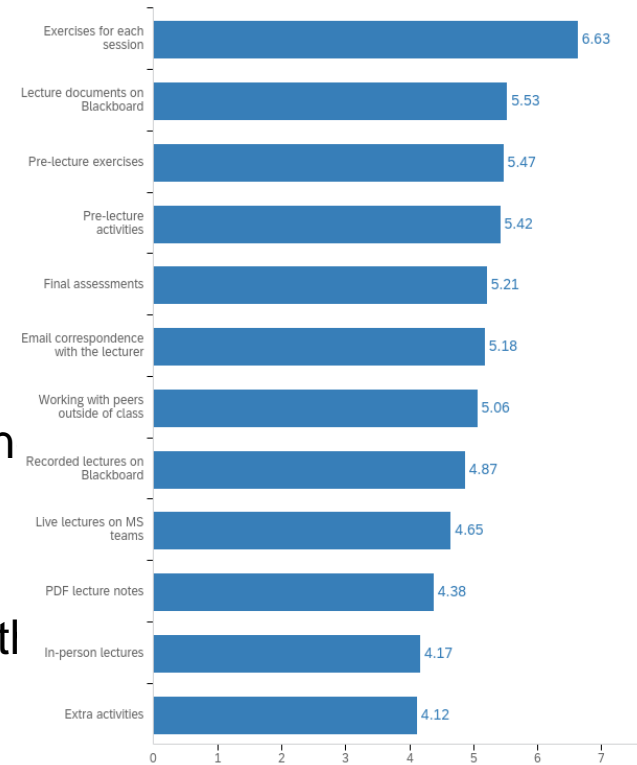
Could be better if we can get more details about how the answer is rated.

How would you rate the MATLAB course overall? (1-10)



Summary

- A flipped learning approach has been adopted.
- On average, 95% of students attended each exercise, with the total mark of 90.3
- Most students found pre-lecture activities and exercises very useful to enhance their understanding
- They found MATLAB grader a very effective tool to provide immediate feedback on their submissions.
- A majority of students said they feel comfortable with programming with MATLAB after attending this course, and will use MATLAB in the future.



Future work

- We are conducting some focus groups, to further elaborate students opinion on different aspects of this module and the tools used during this course.
 - We will then use this information to improve the course for the following year and extend the use of similar tools to other modules across the department.
 - I am going to set up a discussion board for next year.
-

Thank you for listening!

Any questions?
