Course Analysis IS1300

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1 Description of the course evaluation process

The course evaluation process started in the first lecture on November 1st where we asked students to act as student representative. Unfortunately this course instance no student agreed to participate. However, regular feedback was obtained through discussions with students during the lab-sessions.

In the last lecture of the course on December 6, we aimed to establish a course committee. Two students agreed to participate and a course committee meeting was held in March after the course had finished.

The course evaluation using LEQ with 22 questions was available to students after the exam in the period 2023-01-13 - 2023-01-30. Feedback from 9 students was recorded. The LEQ summary gives separate diagrams per gender, type of student, or disability. The LEQ also gives the opportunity to write free comments

2 Description of meetings with students

Students were invited for the role of student representative as well as to the course committee meeting. In this course instance, no student representative could be found. However, feedback from students was informally obtained during the different laboratory occasions conducted throughout the duration of the course.

After completion of the course a course committee meeting was arranged with students to collect feedback on the past course instance but also on planned course development.

3 Course design

The course consist of 9 lectures (2h), 2 seminars (2h) as well as 6 laboratory sessions (4h, each with 3 opportunities to attend, respectively).

The course starts with an introductory lab assignment "PingPong" that introduces the students step by step to the Integrated Development Environment (IDE) that is used in the course, as well as to Test Driven Development and code documentation.

The two seminars focus on hardware development for embedded systems and software development for embedded systems respectively. Both seminars are connected to the project task PRO1 and prepare the students for this.

The project focuses on the development of an embedded system where hardware is provided by the teacher and students develop the software. The project is then basis for PRO1 that also determines the grade of the student on a scale A to F. Each student borrows a custom lab-kit for the duration of the course. The lab-kit contains the development board (Nucleo-L476RG) as well as a custom extension board, necessary cables etc.

The grade for the project and PRO1 is determined based on:

- Panning, architecture, structure, testing and documentation

- Complexity of the project (several features are requested from the students and can be selected. The composition of realized features determines the points for this part)

- Written report

- Utilizing a Real-Time Operating System for the project

The theoretical part of the course is structured in 9 lectures. The lectures cover all aspects of the embedded systems development, but focus most on hardware, software and real-time aspects. Lectures directly link to the practical aspects that are investigates in laboratory exercises and later in the project.

The oral exam has a Pass/Fail grade which is also required to pass the course.

Implemented development: The type of exam has been changed from written exam to oral exam. The project hardware has been newly developed as a custom extension board for the development board (Nucleo-L476RG) used in the course. The custom board is designed in a way that it offers possibilities for a variety of project tasks that can be altered every year.

One laboratory assistant was supporting the course during the laboratory sessions.

4   Students' workload

Based on the students answers in the course evaluation the workload differed between students, while the majority spent a reasonable time for the course. The average reported workload is around 20h which is as expected.

The reason that some students reported larger or smaller workload can be explained by the possibility to implement more or less requirements for PRO1 which affects the obtained points for one of the grading criteria. This has been mentioned as positive by students in the course evaluation LEQ.

5   Students' results on the course

The students perform well in the course. A clear majority of the students have passed the course. This instance, 49 active students participated (counted as active if the student completed any part of PRO1 or participated in the oral exam). Out of the 49 active students, 43 participated in the oral exam out of which 4 students failed and 39 passed.

6   Students' answers to open questions

The students highlighted the good combination of different learning activities of the course and the pedagogical structure and course material. It was also pointed out that the oral exam was appreciated.

To the question on advice to future course participants students answered to participate on all occasions (attendance is not mandatory in some lab sessions) and to start the work on the project early.

7   Summary of students' opinions

The KTH learning experience questionnaire has been used for the evaluation. The questionnaire has 22 questions, where students give marks from 1 (strongly disagree) via 4 (neutral) to 7 (strongly agree). The questions are grouped into the following three areas. 9 students participated in the questionnaire.

Meaningfulness - emotional level (Questions 1-6)
The course received high marks in this area (min: 5.7, max: 6.8, avrg.: 6.4). The answers indicate that students worked with interesting issues (Q1: 6.8) and could explore the subject on their own (Q2: 6.2). The course also allows students to explore own ideas (Q3: 6.7) and work in an interesting and stimulating way (Q4: 6.3). Students felt togetherness with other students (Q5: 5.7) and the course is open and inclusive (Q6: 6.8).

Comprehensibility - cognitive level (Questions 7-16)
The course received very high marks in this area (min: 6.0, max: 7.0, avrg.: 6.6). Students indicated that the intended learning outcomes are clear and helpful (Q7: 6.0) and that the was the course is organized is supporting their learning (Q8: 6.7). Material was presented clear and understandable by the teacher (Q9: 6.7) and concrete examples helped the learning process (Q10: 6.4) with focus on the understanding of key-concepts (Q11: 6.6). The alignment of the course and the ILOs was good (Q12: 6.6). Students understood what was expected for different grades (Q13: 6.0) and feedback was helpful and regularly provided (Q14: 6.1 and Q15: 6.9). All students agree that the assessment of the course was honest and fair (Q16: 7.0).

Manageability - instrumental level (Questions 17-22)
The course received good grades in this area (min: 5.1, max: 6.8, avrg.: 6.2). The students see their background knowledge as sufficient (Q17: 6.7) and students regularly reflected on what they learned (Q18: 6.1). The different learning activities in the course enabled students to learn in different ways (Q19: 6.3). The students answered very mixed to the question if they could influence the course activities, where the large majority is positive (Q20: 5.1). Students could collaborate with others (Q21: 5.9) and could get support when needed (Q22: 6.8).

Feedback from Course Committee Meeting
Students agreed that the course runs very well. Specifically pointed out were the pace of the

course and how the teaching moments align with practical moments from labs and project. It was also highlighted that the students appreciate the clarity of the project assessment and the newly implemented change to an oral exam was seen as very positive and suitable (given the Pass/Fail grade). As part of the project, students generate source code documentation. This was not seen as relevant for the students, partly due to the cumbersome tool that is used. Students suggested that a visit to a company or industrial guest lecture could be good to underline the industrial needs in this domain. The planned course development on automated assessment of the project task was seen as very positive.

8 Overall impression

The course runs well and students appreciate it. Students perform well and highlight the good structure and underlying pedagogical concepts of the course.
This was also the first course instance after the pandemic which was carried out completely as designed. In previous course instances large parts of the course had been adjusted to meet the requirements for remote education. The transition worked very well.
This instance a new custom hardware platform was used for the project. The platform was received very positively by the students.
The course has a large focus on practical aspects and a big part of the course are laboratory exercises and the project. This has a high administrative demand before during and after the course. Improvements are ongoing and will be discussed later on under "Prioritized course development".

9 Analysis

The course has received a positive evaluation from the students which indicates that it could create a good learning environment. There has been no big difference between the response of different student groups to the course evaluation.

10 Prioritized course development

The course currently is very workload intensive for the teacher and laboratory assistant. This is natural due to the practical nature of the course, with several laboratory exercises and project which are performed individual by the student. The new project hardware has been received very positively and will be used in future course instances as well. Efforts have been initiated to introduce an automatic assessment framework for the project task. An initial prototype of the project was created as project task in the course IL2232 and will be further refined in order to be used during the next course instance. The framework is based on a continuous integration (CI) pipeline and test automation framework. A custom hardware in the loop has been designed. The framework will allow students to submit their project to be evaluated automatically, followed by a test report that is returned to the student. This allows on one hand fast feedback for the student and on the other hand removes workload from the teaching staff which can then more effectively support students on their learning. The

development plans have been discussed with students during the course committee meeting and students agreed that the proposed assessment framework would be a very valuable extension to the course. Students also think that similar concepts could be part of other courses as well. In addition to the planned changes of the project assessment, it is also planned to incorporate a industrial guest lecture in the course. This has been suggested by students and can be used to highlight the industrial relevance of the course topics and put the different learning activities into context. A guest lecture could for example be given by Adjunct Professor Ingemar Söderquist from Saab on the topic of embedded system design.