Course analysis HL1203 – H22

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1. Description of the course evaluation process

The course was evaluated using the standard questionnaire provided by KTH. The survey was sent out directly after the examination. This is the first time the course responsible was coordinating and teaching the course. No specific aspects of gender or disabled students were investigated in this round of course evaluation.

2. Description of meetings with students

Before the start of the course, the course responsible met with all the other teachers in the civilingenörsprogram of medical technology during a workshop organized by the students. After the start of the course, the course responsible Studienämden CMEDT2 met two times with three student responsible, once after each term. Additionally, there was frequent communication via email to solve issues with regards to scheduling concerns and examination.

3. Course design

The course consists of lectures, laboratories, and seminars. The laboratories are assessed via laboratory reports. The examination is split into a home-exam after P2 and a written exam after P4.

Lectures will include presentation of new materials.The lecture will be followed by voluntary assignments to train on the material yourself.

P2: Design of sensor systems, Instrumentation, Noise, Temperature Measurement

P4: Blood flow, Blood Pressure, Electric Biosignals, Concentration Measurement

Laboratories will include compulsory preparation, simulation, participation in the laboratory in a group and subsequent submission of a laboratory report.

P2: Instrumentation, Lab Report Writing, Simulation using OrCAD, Pacemaker Circuit, Temperature measurement

P4: Building your own circuits for Blood Pressure, Blood Flow and ECG measurement

Seminars will include two group projects including a presentations and critical review by a second group. You should be present for both your presentation and the presentation of your peers.

P2: One seminar will discuss an organ and one will discuss a medical device and a respective sensor to monitor it.

Important: Changes since the last course offering

The course was taken over by a new coordinator and new teacher. All teaching materials were updated to state-of-the-art and supported with additional reading material and literature. Furthermore, English-Swedish language learning material was provided along with a multiple quizzes on Canvas.

The course is now taught in the second year, instead of the third year of the civilingenörsprogram. Furthermore, the course is now split in between P2 and P4, instead of previously the consecutive terms P3 and P4. For this reason, the examination was split into a home exam after P2 and a written exam after P4.

Lectures are taught in English, with Swedish subtitles. All assignments, questions, and exams are available in both languages.

4. Students' workload

The workload of the students was lower than the amount of course credits given in the course. There was insufficient communication to the extent of out-of-classroom learning expected from the students.

5. Students' results on the course

The overall performance of the students in the course was not satisfactory. However, given the organizational challenges faced, the performance was ok. In comparison to previous course offerings the performance was less, however, the type of exam was changed from home exam to written exam. The usefulness of the cheat sheet that students can bring to the exam was not communicated and emphasized well. This lead to the students feeling overwhelmed by what was expected.

6. Students' answers to open questions

I cannot find the LEQ results on the KTH homepage at this point. The results are summarized as below.

7. Summary of students' opinions

The meetings mostly brought up organizational concerns. The laboratory groups were too large in P2, such that we halved the number of students per laboratory in P4. The students perceived the teacher as not very approachable. The students critized the inclusion of state-of-the-art research as a part of the lectures, as this did not get assessed in the examination.

- Clarify Betygskala
- Smaller groups in laboratories
- Incentivize students to take more time for the course
- Clarify course structure
- Study guidelines from the start
- Inspiring person seminar => leave out
- Speak less about research and more about content
- Add more exercises

Summarize the outcome of the questionnaire, as well as opinions emerging at meetings with students.

8. Overall impression

The overall impression is that this course offering was chaotic for many reasons, which resulted in an uncomfortable experience for both teacher and students. The course was not scheduled, as it was not integrated in the KOPPS environment. The number of students to previous years had increased by 20%, which made the laboratories crowded. The course was for the first time offered in the second year, instead of the third year of the degree program. Because of this, many students had not passed the pre-requisite HE2000 for the course. Additionally, because of COVID students had a lower level of experience in the electronics laboratory then previous generations. HL1203 is now the first class, which the students take where the lectures and most of the learning material is in English. While an important experience in preparation for the later years, the learning of the language simultaneous with the content poses an additional challenge, when engaging with the learning material. Finally, the teacher although with best intentions was not familiarized and experienced with the inter-active learning style common at KTH. Also, the communication between teacher and students

was limited by cross-cultural misunderstandings.

9. Analysis

The strength of the course HL1203 is in the complementarity of lectures, seminars, and laboratories leading up to joint learning outcomes. The structure and content of the course is strong, however learning outcomes and constructive alignment could be better communicated to the students.

The primary weakness of the course was organizational. Secondly, the course materials are targeted at a very traditional style of lecture teaching, which is not ideal for student engagement and learning. More digital learning opportunities should be provided, supporting learning at individual pace.

Detailed next steps to improve the course are outlined below.

10. Prioritized course development

The first priority to improving this course is to integrate it in KOPPS, such that modules are scheduled automatically and that communication is improved between the students and the teacher. Familiarization with the teaching culture at KTH will also be facilitated through the teacher and course responsible taking the Teaching and Learning course in Higher Education and integrating with the course content. A second priority is to increase the number of learning activities both in person, but also for at home. The students should be provided with more information, offering additional lectures giving enough time for calculation examples.

Significant improvements to the course and its materials are required in the **short-term** and within the next course offering. In particular, more information on the ´Betygskala´ should be added in the course PM.

Course scheduling and pre-requisites

The first priority to improving this course is to integrate it in KOPPS, such that modules are scheduled automatically. The split of the course in two non-consecutive terms (P2 and P4) is not ideal for the learning outcome of the students. Because of the re-scheduling almost half of the students in the course did not achieve the pre-requisite. In the short-term, there should be additional material provided for students to be prepared for taking the course HL1203, even if they have failed the pre-requisite HE2000. At the same time, I will improve communication about the responsibility to spend extra time catching up on the materials from HE2000.

Lectures:

Lectures need to be structured more inter-active to increase learning and engagement in the classroom. Additional materials on design of a sensor system will be covered, to inform that new structure of the seminars. The aspects of noise and noise reduction should be covered in more details to prepare students for the laboratories. A lecture on the pacemaker should be added.

Seminars:

The seminars have been adapted. As the organ is covered in the previous course in the program, we will here focus more on designing a sensor system. The sensor system should 1) address a disease of a specific organ and 2) be helpful in ensuring safe operation of a medical device.

Laboratories:

Students were not well prepared to follow the laboratories. We will increase the number of lectures in order to provide more background. At the same time, we introduce a

mandatory quiz. The quiz is a requirement to participate in the laboratory and we will check completion of the quiz before entering the laboratory. The aim is also to equalize the amount of time student prepare for the laboratory, with the goal to bring everyone on the same page. Finally, we will provide more clear criteria for the evaluation of the laboratory report. While in P2, we will focus on the structure of the report, we will focus more on the content in P4.

ILOs	Pass	Time
describe the characteristics of different sensors and identify expected disturbances and noise	Describe at least one sensor type, its characteristics, advantages and disadvantages and potential disturbances.	Every Lab
Illustrate, summarize, and explain the results of the labs in form of a structured written report.	Illustrate and reflect on your observations in the laboratory in a conclusive written report with reference to theoretical concepts discussed in the class.	Every Lab
use a few sensors, such as thermoresistors, thermistors, thermocouples, piezoelectric, optical, and electric to measure physiological signals.	Use at least one sensor physiological signal using sensors in the laboratory.	Sum of all Labs
build medical instrumentation circuit	Build and test a functional measurement circuit based on the circuit sketch with support.	Final Lab

Course evaluation:
The meeting with the student representatives after P2 was very helpful and should be kept up. The final evaluation requires improvement. The course evaluation should be performed during the last lecture, or shortly after and before the examination.

In the **long-term,** it could be interesting to add a laboratory, where students have more freedom to design their own system. Also, once a good course content, structure, and appropriate learning materials is ready, consideration should be given to how the way that students choose their groups can affect their learning and ability to collaborate with new members of the class. This will include considerations regarding diversity, inclusion, and equal opportunities. In the long-run the order of the courses should be adjusted, such that students have one more opportunity to redo the exam for HE2000, before enrolling in HL1203.

Finally, also in the long-term, I would like to change the grading criteria of the laboratory beyond pass or fail. The pass or fail criteria was not found detailed enough to guide student learning in a constructive way, as the only thing necessary to pass the laboratory was presence in the lab and submission of a report in a group. This resulted in poor quality of the reports, superficial trouble shooting by the teaching assistant who was present in the laboratory, which was indicative of surface learning, and little transparency in grading crucial to an inclusive learning environment. New grading criteria were accordingly developed reflecting the four intended learning outcomes respectively, while preserving a trustful learning environment and building up students skills using multiple steps of formative feedback (Weurlander *et al.*, 2012). The main goal of the lab is or each group to independently build their own circuit – first with support and feedback from the teaching assistants and finally in an independent way. The students can choose what level of independence they want to aim to achieve and how many circuits they want to understand, thereby allowing a degree of self-regulation (Nicol and MacFarlane-Dick, 2006). To assess the first two ILOs, the feedback to the students focuses on the description of the sensor concepts and their analysis and reflection on their preliminary results in the written report. The focus of this early feedback will thus be on their ability to illustrate and reflect and not the building and evaluation of their circuit. In this way, I distribute the student learning across the weeks and make teachers a partner in their learning as suggested by (Brown and Race, 2021). The third ILO students are being internally motivated to create a system to measure a physiological signal by themselves in 1, 2 or 3 out of the four laboratories. The teaching assistants are there to support them in this process in a formative way. The fourth ILO assesses their independence in building

measurement equipment which they have obtained at the end of all laboratories. For this reason, the last ILO will only be tested in the final laboratory giving all students time to catch up on their circuit building skills, while being supported by teacher and assisting student. In this way, students will hopefully ask questions to the coaches which focus on understanding rather than on fixing their circuit.