Course analysis HL1016 – VT23

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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

There were no official meetings with the students or the student board. Throughout the course, I was in contact with one member of the student board with whom we regularly and frequently discussed about things that should be improved or that were not clear. As not enough students answered the LEQ questionnaire, I asked for advice from the student board member after the course about what should be improved.

3. Course design

The course consists of lectures, laboratories, and seminars. The laboratories are assessed via laboratory reports.

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

Design of sensor systems, Instrumentation, Noise, Temperature Measurement, Blood flow, Blood Pressure, Electric Biosignals, Concentration Measurement

Laboratories will include participation in the laboratory in a group and subsequent submission of a laboratory report.

Temperature measurement, Blood Pressure, Blood Flow and ECG measurement

Seminars will include two group projects including a presentations and critical review by a second group. 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 multiple quizzes on Canvas.

The course is now taught in the second year, instead of the third year of the högskolingenörsprogram. 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

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 enough. The lack of communication of expectations lead to the students feeling overwhelmed by the written exam and did not give enough chance to prepare well.

6. Students' answers to open questions

Unfortunately, not enough students filled in the evaluation for me to get access to the results. I inquired after the course with the student responsible for general feedback.

Is there a way I can prepare all students better next year for the exam in a similar way that I seemed to help you?

I would say solving some questions that are based on calculation such as Wheatstone bridge, cardiac output and amplifier. We did have a lot of equations and some were a bit hard, but my suggestion would be a bit longer lecture for calculation examples (The main focused/important ones). I believe that it is important to know what to draw as a preparation for the exam. Take me as an example, I did not answer Wheatstone bridge during the exam, another question was about drawing.

7. Summary of students' opinions

In summary, the students did not feel very well prepared for the exam in terms of the expectations being clear.

- Clarify Betygskala
- Incentivize students to take more time for the course
- Study guidelines from the start
- Add more exercises

8. Overall impression

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.

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 is the lack of clear expectations for the exam and not enough practice materials for calculation examples. 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. More calculation examples will be added during the lecture, or as home assignments.

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 introduce a mandatory preparatory 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.

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 course evaluation should be performed during the last lecture, or shortly after and ideally before the examination, however with the option to submit after.

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.