Course analysis DM1588 – 2024

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1. Description of the course evaluation process

The students had the chance of picking **two representatives** to communicate directly with the course responsible but they did not choose any. The Study Board presented the feedback they had collected, at the programme's link meeting, and the course responsible took notes. Each student also had the opportunity of writing a non-graded individual reflection about their own experience in the course, as well as filling in the KTH course evaluations. As a course responsible, I reminded them about these different channels in class and via Canvas.

A **written individual reflection** was set up as an ungraded quiz assignment on Canvas, and one of the requirements to get a grade in PRO1. Students were told, however, that they did not have to answer all the questions if they did not want to, and that there were no right or wrong answers. The questions were complementary to those in the course evaluations: they were mostly about their personal experience while doing the project, their main take-away from the course, as well as any concerns/comments they had about their participation/learning. Responses were submitted by all of the students who took the course (one of the registered students did not take the course). Gender and disability data were not collected because it would not have been anonymous.

The KTH **course evaluations** were filled in by around 6.8% of the students (5/73); all Swedish students in years 1-3. The report shows the average response of students that identify as men, which means that at least 3 of the 5 respondents were men. This set of 5 students includes at least one student with disabilities, given that they have left a comment (about finding it hard to focus when consuming class material due to their ADHD in spite of the classes being good).

2. Description of meetings with students
Since students did not choose representatives, the only meeting about course feedback was the link meeting.

3. Course design
The course has:
- six classes consisting primarily of lecture and seminar material, led by the course responsible (except one with guest lecturers). In 2024, the first and the last one were in person, and the rest were asynchronous, via Canvas.
- five lab assignments to be done in alone or in pairs during six lab sessions where students get support from the course responsible and teachers;
- one project where two lab pairs collaborate to create an interactive installation;
- three supervision meetings towards the project;
- three technical assistance sessions towards the project;
- one presentation where students show a demonstration video and engage in Q&A with their peers.

According to the syllabus, students can miss up to 2 'seminars' (but we only had 2 class meetings in person in 2024, so this was not enforced), and attendance to the rest of activities is optional. The first week, the groups (self-made) are given a kit with all the material they need to complete the course. The students get extra support from teachers via email; from teachers and peers via the Discussions forum on Canvas; and from MIDDLA studio managers by booking slots with them on campus.

Regarding the constructive alignment, each of the classes and lab assignments contribute to one or more intended learning outcomes (ILOs) and building blocks of the project, so that succeeding in the labs equips the students to succeed in the project, where they further acquire team-work and presentation skills. The students receive continuous formative feedback when they submit each lab

until they get a "pass", as well as during project supervision. The project's grading criteria is designed to assess that the ILOs have been achieved, and the project is graded only after students have the opportunity of getting peer feedback and improving their final submission.

This year I further developed the course based on: my course analysis from 2023; last year's teachers/teaching assistants' experiences; and my own notes along the course. Changes that were implemented to improve the course include:

- Updating and improving the Kurs PM.
- Developing and offering a workshop session the first week of the course for students that want to refresh their knowledge of electricity, electronics, and basic circuits. The workshop was delivered by teachers and TAs.
- Replacing the in-person class meetings in the middle of the course which are theoretical content-heavy, for sequences of videos to watch at home flexibly at their own pace. This was done in response to student feedback from last year about preferring to come less often to campus. The videos had verified captions, for accessibility.
- Adjusting lab deadlines to allow students to consult with teachers in at least 2 sessions in a row before each lab deadline.
- Adapting the individual lab to be done on campus and with a longer deadline, as well as earlier in the course, together with the lecture material on DIY sensors and actuators.
- Updating the content of the classes as well as adding inspirational material to incorporate the latest technologies from academic research.
- Improving the description of the lab assignments and project assignment.
- Updating guidelines for project supervisors and teachers who provide formative feedback on labs.
- Maintaining the stock.

It is also worth noticing that this was the first year that the course ran in P3 rather than in P4. This meant that it was some weeks shorter and had to be compacted and adapted. It also meant that it ran in parallel with another course that also uses MIDDLA resources (space, recyclable materials, electronic components, access to personel, etc.), which is not ideal.

4. Students' workload

The course is 6 credits and the period lasts 8 weeks (plus exam week), which is equivalent to 20 hours a week on average, for a total of 160 hours. The course typically has 4 scheduled hours per week (except the first week which is heavier, as it also has the initial workshop, and an intro to the course). The project starts in the second half of the course. The time to complete the labs and preparatory tasks must also be accounted for within the total of 160 hours.
From those who filled in the course evaluations (5), one student perceived that they spent slightly more than what was expected (21-23 hours a week); one slightly less (15-17), and 3 significantly less (between 6 and 11 hours). Only one student commented on this, saying that they spent more time towards the end of the course to complete the project on time (which is expected).

5. Students' results on the course

All of the students who followed the course and submitted their work have successfully passed (73/73). One student registered but did not take the course and so they did not pass.

6. Students' answers to open questions

As the '**best aspect'** of the course, respondents highlighted the quality of the lectures and the pedagogical skills of the lecturer (course responsible); that it was *"fun and interesting"* to learn about the course topics; that they had *"freedom"* to adapt the assignments to what they wanted to do, and to choose partners; and that the labs were *"very educational"*.
Regarding **improvements**, three students wished that the lectures were mostly about the programming language syntax for each lab, as they only had familiarity with Python. One student suggested to delay the start of the project until all the lab deadlines had passed (there was a one week overlap), whereas two students recommended the opposite, i.e. that the project should start even earlier. One student

struggled with hardware components that were not in an optimal state. Finally, one student reacted against the freedom of choosing whether it was worth it to improve their deliverables for the final deadline, i.e. the student wanted the course responsible to grade all the projects in an initial deadline and then have a chance to increase the grade only if needed (it is unclear how the student expected this timeline to work given that they were, in turn, against having to dedicate time to the project during exam week).

7. Summary of students' opinions

The **course evaluations** (filled by **5 students**) show that respondents appreciated the course. Most (4/5) said they worked with interesting issues and that the course was challenging in a stimulating way; 3 said they got feedback without being graded (one answered "X" and one was neutral, commenting that they got "another try", probably referring to formative feedback); two perceived the assessment as fair an honest, two were neutral (it is worthy to notice that students had not been assessed yet at the time the evaluations closed); all declared they had been able to learn by collaborating with others; two said they got support when needed, one was neutral, and one commented on having too many deadlines.

The **personal reflections** (filled in by **73 students**) show a generalised positive outcome and constructive, specific, detailed information about each student's experience with the course and their learning. The reflections show that many students found the course *"fun", "really enjoyable", "interesting", "useful", "fruitful", "rewarding",* etc., and perceived that they *"learned a lot"*. This gave some students a positive outlook regarding their studies: *"Everything we learned during labs and lectures will definetily also hold some value in the future and it makes you realise even more that when we graduate we will know so much about so many things which is really exciting and motivating!"*

Students used the question about personal concerns about participation mostly to provide **suggestions** for future years instead. This included: more lecturing on e.g. communication protocols; delaying the start of the project, or having more time for the project, or starting the project earlier by eliminating some labs; getting taught about wiring in the context of packaging; testing each other's projects at the end of the course; being shown more examples of "interactive experiences" and "art installations" (to counteract their tendency to functional prototypes); wanting pictures in the lab instructions. One student found it hard to look for information but stated that the outcomes were worth it; and, one student struggled to work in teams.

Students listed a range of **take-away learnings** that align with the ILOs (such as learning to programme with sensors and actuators) but that also go well beyond them. Just as in previous years, some mentioned wanting to **continue** using Arduinos in the future, having their curiosity sparked, and having realised *"how much you can actually make if you just do some research!"*. They largely appreciated the **practical** aspect of the course (e.g., *"Working with sensors and actuators has really helped me seeing programing from a new perspective and making it a lot more real world experienced"*), including the ability to apply theoretical knowledge in practical contexts, as well as the ability to create their own components at home. One student describes having understood the value of active learning: *"I think what I understand more now after this course is that you really learn best when you get to do it yourself, rather than watching someone else do something"*. Students also highlighted the freedom to conduct their labs and projects in the topic they wanted (*"a project that you can design yourself"*), which they found **motivating**. Many declared getting a **broader understanding** of how software and hardware work (mentioning, as in previous years, that it stopped being simply *"magic"* but that was still *"fascinating"*). They also appreciated taking an iterative prototyping spirit. Besides the specific programming languages they learned to use in the course, students also mentioned acquiring knowledge on *"engineering", "programming", "debugging"* and *"troubleshooting"* in general, and found being exposed to an array of resources *"very eye opening"*. For example, one student says they understood *"the iterative nature of engineering"*. And, another noted about physical interaction programming: *"In other courses, we have learned to program to produce different outcomes, but I think this course provided more knowledge in programming because one could see with the eye how different instructions and data used from the sensors affect the*

actuators. It provided direct feedback on what was right and wrong in relation to what one wanted to achieve".

Moreover, several mentioned acquiring or improving **general skills** such as: **time and project management** (in the whole cycle of a project), **looking for information, problem solving** (including details about dividing them into smaller problems), **teamwork, communication skills, creative thinking, understanding complex systems,** and **patience**. This is the first year that students, umprompted, provided reflexive detail about teamwork. Several students stated having learned what roles they tend to play in groups, and even trying new roles (e.g., *"Working in a group where I take a more active approach has been very interesting. I usually let other people paint the larger strokes while I make changes and add details/refine. I learned how it feels to be in this position*"). They also highlight obtaining *"valuable lessons on what to think about in those scenarios",* learning to **trust** the people in the team, and how these skills will be useful after their studies, in the **workplace**. This all goes one step further in terms of awareness, agency and self-efficacy –and it is very likely to stem from the JML intervention on teamwork that I carried out.
Crucially, and in line with the previous two course instances, many students spontaneously reflected upon an increase in their **self-confidence** when it comes to programming and building. For example, students wrote: *"I've become a better programmer and more **secure** in myself as an engineer"*; *"I would have never **dared** touch an arduino before this. Now I feel like I have some base knowledge upon which I can **decide** to learn whatever I need to learn for whatever I want to build"*; and *"This course gave me a whole new look on electronics and the making of them and I realised it is very possible to just build real and functioning electronics **yourself**"*. Students also state being glad to have found out through this course new things in which they are good at. A sense of achievement and pride at the end of the project was, this year again, evident in the reflections (e.g., including as a takeway that this course made them realise that *"anyone can create interesting interactive designs regardless previous skills")*. Students also highlighted their newly acquired ability of incorporating sensors in technical solutions during their future studies, as well as becoming aware of the pervasiveness of sensors and actuators in daily life. The liason with MIDDLA was again highly appreciated.
Finally, students praised **course planning, course structure and progression, content selection and delivery (including lecture material and labs), communication with and support from teachers and course responsible**. For example, they commented: *"The labs, especially the first and last was a great foundation and really helpful for the end project!"; "I'm really impressed with this course over all, it is really though out.", "The lab sessions increased well in difficulty and covered subjects to give a feel for the most fundamental things before getting thrown into the challenge of completing this project"*. Students highlighted the flexibility that pre-recorded material offered them to consume at their own tempo (with one student finding it too distracting instead).

In the **link meeting**, the Study Board representative provided student feedback suggesting that perhaps the video material could provide students with bonus points towards a final grade. I will consider implementing a version of this for next year, as a way of assessing the theoretical part of the course as a 'bonus'. Students found the course relevant for the programme and appreciated the 'many useful sources' provided in the labs, which they found to be the main learning moment of the course. During the meeting, the representatives realised that the course indeed has higher workload than the other courses in the period, as it is the one that gives the most credits. They also realised that it was the first time the course ran in a shorter format (fewer weeks). I will highlight this next year in class.

8. Overall impression
My overall impression is that the course was well received this year again, given students' feedback as well as the quality of their participation, and their final grades. Students' input largely shows they acquired not just the course ILOs but also engineering and general skills. The changes to course design (described in section 3) worked well, as well as the JML intervention (described in section 9).

9. Analysis
In the course evaluations, students did not comment on gender. This year, based on previous years' experiences (documented in my prior course analyses), I implemented a JML intervention for

teamwork: Students were introduced to and encouraged to agree on their own ‘terms of engagement’ at the beginning of the course, and revise/discuss these terms as the course progressed. The goal was for them to establish how to work together, being aware of task division and how this affects their learning. Based on their reflections, the intervention seems to have been successful. A closer analysis comparing data from several course instances or across courses might be worth it to be conducted.
Regarding disabilities, a student with ADHD commented that they found it hard to consume material at home (they prefer in-person lectures). For next year, I will further analyse trade-offs of different options.
Finally, very few students (5) completed the course evaluations, which might suggest they were satisfied with providing feedback to the Study Board and through the individual reflections. Another possible cause might be that they were busy with other courses towards the end of the term.

10. Prioritized course development
A set of improvements will be prioritised as development for next round:
- Renewing the stock so that the components are in optimal state.
- Further considering what is the best format for classes (e.g. videos, in person, or both), and considering implementing bonus points for a higher grade so students engage with theoretical content deeply (via Canvas quizzes).
- Providing more examples of non utilitarian interactive installations.
- Providing more introductory material on language syntax.
- Developing material about wiring in the context of packaging their installation, as well as more material on reading datasheets.
- Reassessing lab deadlines to minimise overlap between the last lab and the beginning of the project (this will include considering the removal of a small lab, to further adapt to the fact that the course is shorter in P3).
- Synchronising the release of formative feedback across teachers (they started doing this towards the end of the course, but next year we will do it from the beginning).