User Interface Technology as a case study: Reducing perceived workload by highlighting congruence between day-to-day work and exam topics

Valkyrie Savage

Department of Computer Science
University of Copenhagen

Abstract

The User Interface Technology (UIT) course at the Department of Computer Science (DIKU) blends lab skills, programming skills, and theoretical analysis in 8 weeks of work on a final group project. Students historically have complained about a too-high workload; by highlighting congruence between day-to-day activities and their final exams and projects through lecture activities, restructuring projects, and providing rubrics, I saw students report the same amount of time spent on coursework (16-24 hours per week for >= 60 % of students) and a lower perceived workload (from 3.8±.73 in 2023 to 3.4±.64 in 2024, both on a 1–5 Likert scale). They also saw greater connections between individual sub-elements in the course (from 3.4±1.15 in 2023 to 3.8±.94 in 2024, also on a 1–5 scale) and gave qualitative feedback supporting the congruence as important. Overall, the intervention appears to have been successful and will be reused and iterated upon in future years.

Introduction

User Interface Technology (UIT) is a 7.5 ECTS MSc level course in the Computer Science Department. Students typically take this course in block 4 of their first year of Master's studies. The course is 8 weeks long, with no maximum specified enrolment (2022: 21, 2023: 42, 2024: 18). Daniel Ashbrook, an associate professor, is the course responsible. I have been his co-teacher for 3 years. The first year that I co-taught this course,

2021–22, was also the first year that it was ever taught in person, due to the COVID lockdowns. Physically, the course takes place in the Human-Centred Computing section's research labs and makerspace at Sigurdsgade, which is a bit outside of Nørrecampus; in 2023 we also had a separate lecture classroom on campus.

The course is focused on teaching student's lab skills and research skills through execution of a group research project. The exam consists of the project report (60%) and an individual 3-day take-home exam (40%).

According to surveys, students are so-so about logical connection between the different course activities (in this case: lectures, lab work, project work), and they perennially feel the workload of the course is too high. I suspect that these two things are related to some extent: each year we present the graph from evaluering.ku.dk which shows the prior year's reported workloads. Each year, students report the same workloads, which are aligned to the expectation for 7.5 ECTS (7.5 ECTS * 27.5 hours/ECTS / 8 weeks = 25.8 hours/week), yet they always evaluate them as too high. Why is this? There are many possible answers (e.g., other courses, home life), but here we focus on one that is within the control of the course. Given that students seem to feel disconnection between course parts, I can imagine that the cost of task switching feels high to them. Other work has shown that "study intensity" (i.e., hours spent on study-related work) is a poor correlate of learning outcomes or student engagement (Ulriksen & Nejrup, 2021), and that students consider task *value* when deciding whether to do work (Eccles & Wigfield, 2002).

With this in mind, this year I developed and trialed a new system which explicitly links course sections in multiple different ways:

- a smaller number of individual lab assignments which are directly linked to a group's chosen project
- a rubric for the final group project presented early and often in the course
- explicit in-class opportunities to connect each week's lecture material to the group project.

I measured the impacts both quantitatively and qualitatively through a few different metrics. At a high level, the students performed similarly on the exam, reported a similar quantitative workload while also reporting a

significant reduction in experienced workload, reported greater logical connection between individual sub-elements of the course, and described their appreciation for linking lecture materials to the final exams.

Motivation

This class is a relatively unique one in the curriculum of the computer science department, as students are asked to use their programming skills to make something that happens in the real, physical world. This makes it popular and beloved by students, and therefore worth improving.

Many prior studies have explored time spent while studying and how students perceive it, especially Ulriksen has examined the pitfalls of "study intensity" as a metric of education quality (Ulriksen & Nejrup, 2021) and students' experiences of work effort and mental effort as different constructs (Ulriksen & Nejrup, 2021).

Ulriksen also describes that "the way time itself is perceived should be considered as well as its bearings on how students' engagement and learning outcomes can be understood and assessed," (Ulriksen & Nejrup, 2021) further implying that the actual clock time spent on work is not the only consideration (Ulriksen, 2018). Indeed, students consider task *value* when deciding whether to do work (Eccles & Wigfield, 2002), and if they experience irrelevancy or a lack of congruence, they might decide to skip class (Ulriksen, 2016). The block structure within which SCIENCE at KU operates has also been studied and found especially high-paced and punishing in terms of time (Nielsen & Ulriksen, 2016).

On the positive side, "timeless time [refers] to transcending time through immersion in work" (Ylijoki & Mäntylä, 2003), and students do report this experience in the right circumstances. I hoped to bring congruence to the course and thereby make it worth students' while to attend, while hopefully inspiring a greater experience of timeless time in their hours on the group project.

Method

I focused on three ways to improve congruence in the course: restructuring individual lab assignments to link a student's chosen project,

providing a rubric for the final group project early in the course, and providing explicit in-class opportunities to connect lectures to the group project.

Motivation

In 2022 and 2023 we received significant qualitative feedback that the individual assignments were too heavy, leaving little time to focus on the groupwork component of the exam. In reality, we try to use the individual assignments as ways to build practical lab skills that support the project work. Currently, however, that fact is hidden from students.

In particular, previously we attempted to have students learn all of the skills in the lab (i.e., “our lab has a 3D printer, therefore you should learn to use it”). While they liked the practical nature of this work, what happened was that students would engage with the first couple of skills and then drop the remaining ones (in qualitative feedback, students noted that this was because they were ungraded) in favor of spending more time on their group projects.

This year, I instead worked to link lab skills to a student's chosen final project (i.e., “your project requires 3D printing, therefore you should learn how to use a 3D printer”). In this format, each student was responsible for learning 4 lab skills that would aid in their project work, and for becoming an expert in a single lab skill, by going beyond what was covered in the basic usage module. For this particular course, students choose projects from a list curated by the teachers, so this was a natural extension: the list to be selected from shows students details of possible projects including title, research questions, related work, possible goals, and lab skills involved.

These lab skills modules were implemented as self-assessment skills on Absalon, where students followed a flow, made a product, and explained it in a video. Alongside the video submission, students were given a checklist of the competences they needed to have to work with a machine, such that they could self-check their own ability.

Rubric and Partial Submissions

Last year, my co-teacher and I developed a formal rubric for the final projects, but very late in the semester. This rubric was highlighted in student qualitative feedback as helpful, so I elected to see how far it could be pushed this year. I did not change the rubric from what it covered last year: it still offered four levels of mastery (insufficient, adequate, proficient, nailed it) across four different project components (research idea, execution of idea, evidence, related work).

I introduced the rubric on the very first day of class, as we talked about what the exam format for the class would be. I also introduced it for partial project submissions.

For the partial project submissions, previously students had to informally present plans for different components of their work to us throughout the course. This year, we instead asked them to submit e.g., a draft of their related work section one week, and a draft of their evaluation section two weeks later for review with us. I linked the rubric to the submission pages for these drafts. Although I had planned to refer to it during feedback sessions with students, this did not happen as formally as I had hoped.

Lecture

In prior years, our lectures were approximately 1–1.5 hours long with mainly a teacher-driven presentation. This year, we restructured the course to be more of a seminar, where students would read 1–2 papers and come prepared to discuss them after about 30 minutes of introductory lecture. In particular, students had to work in their project groups and discuss how the papers related to the projects they were doing, often by providing plans for how they would structure their future project work (e.g., their evaluations) based on the day's lecture.

This required some significant restructuring of the content and a fundamentally different use of the teaching room from before. Less time was spent talking about a larger state of the (research) world, and more was spent applying specific concepts to students' own projects. In my teaching of these seminars, I made significant use of the whiteboard, where I would create a table with groups as rows and discussion points

as columns; as the groups wrapped up their discussions on each of the project points, I copied and offered feedback on their points.

Results

I measured several different indicators relevant to the goals, both qualitative and quantitative. At a high level, they support that the changes made impacted student *experience*, although not student *performance*.

Reported rubric usage

Students reported using the rubric to varying extents during the course, in preparation of their materials, with most students saying they used it at least to some extent (see Fig. 1) There was no qualitative feedback about rubric usage provided in the free text areas of the evaluation. Anecdotally, I had a few different students ask for additional details on the rubric during the course using the messaging system we implemented. In the future, it could be possible to have students give peer feedback based on the rubrics to engage with them more closely.

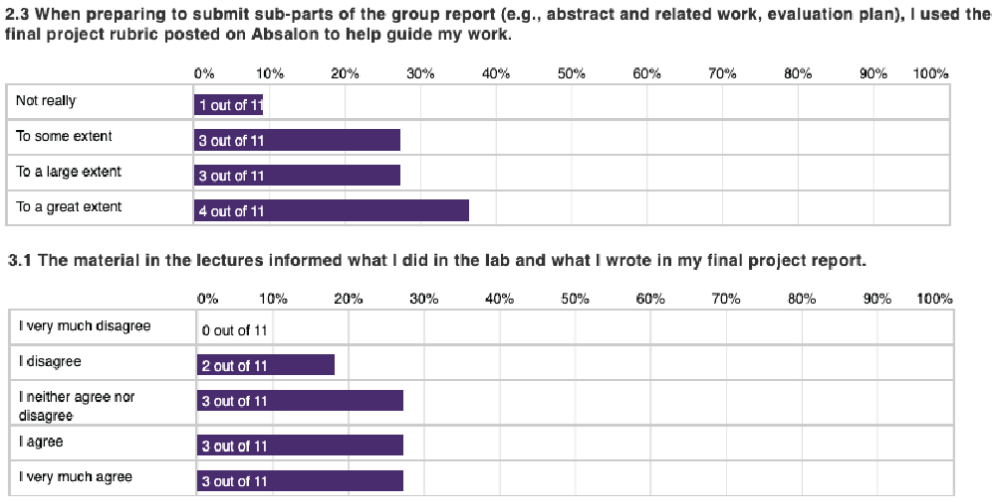

Fig. 1. Students reported varying usage of the rubric in their project preparation, and most students felt that the material in lecture influenced their project reports to a neutral or better extent.

Workload and congruence

Students reported the same amount of time spent on coursework (16-24 hours per week for >=60 % of students) and a lower perceived workload (from 3.8±.73, N=20 in 2023 to 3.4±.64, N=11 in 2024, both on a Likert scale from 1–5). The change in workload was unfortunately not statistically significant: p=.08. They also saw greater connections between individual sub-elements in the course (from 3.4±1.15 in 2023 to 3.8±.94 in 2024, also on a 1–5 Likert scale) and gave qualitative feedback supporting the congruence as important (see Fig. 2). The connection difference was also not statistically significant: p=.27.

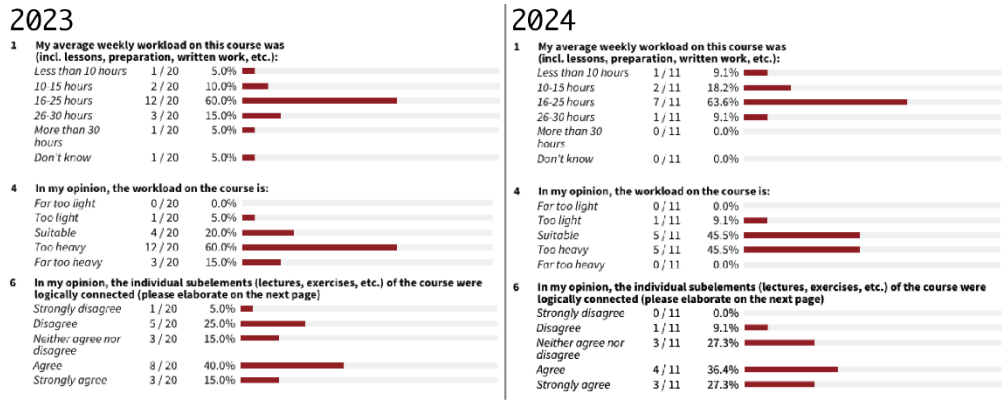

Fig. 2. Workload in hours was reported to be roughly equivalent between 2023 and 2024, while workload in perception was reduced. This came alongside an increase in perceived congruence in the course.

A few highlights from positive student qualitative feedback, that the congruence between lecture and project work was well-received:

> I liked the discussions we had in class based on the readings and how they relate to our project.

Another student commented:

> I appreciate the way we actually discussed how the different papers in the lectures actually relate to our chosen projects and the way she was giving us suggestions.

(Note, I am the “she” in this case, as my co-teacher is male.)

On the negative side, some students found the flow and ordering between lectures challenging:

> It can be difficult to suddenly adjust your workflow to fit in the material from a lecture. I think most focused on just trying things out instead of attempting to fit in a toolkit or similar from the lectures just for the sake of it.
>
> For some groups, lectures that were especially relevant to them came too late to make use of it.
>
> Personally I find it easy to forget what might be relevant to use from a lecture when there is no strong incentive to apply it right after a lecture. It becomes especially challenging when the focus shifts each week. It might be nice to have a more bite sized representation of things to consider.

Another student said:

> It can be difficult to apply material from the lecture in the report when we go to the lab afterwards and work on something else. For example ways of evaluation can be forgotten quickly when we are not at a state where we evaluate yet. It's true that we do discuss these things such as how we could evaluate our own project in class, but I think it is easy to forget by postponing adding it to the report by prioritizing the lab work.

Performance

Actual student performance in the course was also a relevant side metric I was interested in. While it certainly does not tell the whole story, I collected these numbers to determine if student performance was impacted by the changes made.

In 2023, the final grades in the course were 5.95±2.86 (on the Danish 7-point grading scale). In 2024, final grades were 6.08±2.50. Note that final grades are not completely settled for 2024: these numbers do not take into account students who were failed on the final exam due to use of LLMs.

Given the close means and strong overlap in these distributions, it seems that performance was neither positively nor negatively impacted in a significant way by the changes.

Discussion

The various modifications in course structure seem to have worked well, and the students came out of the course with seemingly-equivalent learning, a larger impression of congruence, and an greater experience of course workload well spent.

Given the outcomes, there are opportunities and momentum to build on what was created this year.

Limitations

I was not able to execute all the plans I had in time for the course. I also planned to talk through the rubric each time I gave students feedback, to encourage students to write a note on their final report describing how they had edited previously-submitted subsections based on my feedback, as well as to implement greater peer-feedback structures for the individual lab skills assignments (as per Seery, et al. (Seery, et al., 2017)). None of these happened, although they could all still happen in the future.

In particular, I think that using the rubric for feedback would be impactful. This would give the students a chance to hear my narration of how I will grade their final submission, as well as give me an opportunity to fine-tune it in a way that makes it more transparent to students.

Another limitation is that each year many things change in this class in a rather uncontrolled way, that the sample size is small, and that it is only a single data point; the adaptations mentioned in this paper are not the only updates that were made (we also change the available projects, add new machines and materials to the lab, update reading materials and discussion of state-of-the-art research, arrange lectures around annual conference schedules, experience larger and smaller class sizes as DIKU shifts its admissions policies, etc.). It is therefore challenging to tease out what impacts are from this work and what are due to external factors. There is also certainly a motivational effect in the teaching, related to my being observed a few times during the course as

well as my preparation of this manuscript, which could affect interpretation of the data.

Possible improvements and future steps

The course's flow could be changed to better accommodate just-in-time content. We expected students to work on their projects in a particular order, but this did not completely happen as anticipated; we could shift a few of the lectures around to get conceptual material first (thus giving the projects a clearer foundation) and then more practical "here's how you finish your project" second. This does certainly carry the risk that students do prototyping work upfront that is not well-grounded in the requirements for the course. I think there are also more opportunities in getting students to apply the lecture material to abstract problems, of the sort that are on the individual written exam. Restructuring the lecture sequence to acknowledge different student stages in the project process may be useful; this could parallel the lab skills modules that students are informed in the beginning that they will need to master to complete their work. By explicitly noting that the skills will be helpful at some point and finding a way for students to practice applying them, even if their project is not ready for it yet, this could aid in competence building.

The seminar activities could be even more tailored. In particular, students were displeased that some of the papers lacked clear, high-level introductions, and they had the impression that some of the reading selections were more for people who "already know what is going on." It may be that providing a short introduction to students before they read will aid them in unraveling the domain-specific terms. I believe that this could help students connect material more easily to their existing knowledge, and therefore learn more of the needed concepts rather than being distracted by domain-specific terminology.

Upon discussion with co-teacher

My co-teacher and I discussed the report in September. He appreciated the initiatives I developed for it, including the ones that I did for my own lectures that did not impact the overall course design (e.g., the

whiteboarding and asking students to discuss papers relative to their projects) which he was not aware of when we taught. He also was interested in the concept of students wanting to find value in something in order to put effort into it, and we pondered how we can ensure that students find more value in reading papers and attending lectures—the winning idea here was to find ways that output of lectures can be compiled into the project reports.

In our conversation, we ideated other ways in which congruence could and should be enhanced for the course. Since the report was written, we received an A evaluation for this year's course, but with a caveat that the local teaching committee had considered a lower score given “the GPA is alarmingly low, and has been consistently falling.” On this topic, we talked about ways in which the congruence with the other portion of the exam (the individual component) could be brought into better congruence with the project component that was mainly covered here, by making it easier and by linking the two more clearly. We also discussed reducing variance in project specification levels (some projects are very clearly specified, while some still left students confused) and how we can iterate on these in the future.

Finally, we discussed whether there were topics and ideas that should be removed from the course to enhance congruence. Since both my co-teacher and I also research in the field of this course, there is constant temptation to include the latest and greatest along with our favourite projects. We agreed to return to ILOs and re-examine them for the course, lectures, and exam with an eye towards minimizing the content presented. While this is challenging to do with perfect transparency (due to the extraordinary lag time on changing published ILOs for courses), we can plan to have in-course ILOs that we work from and present to the students from daily lectures, which take the generic ones on kurser and make them more clear and actionable: given the fast-moving nature of a research course, this feels like a sensible balance.

References

Jacquelynne S. Eccles and Allan Wigfield. 2002. Motivational Beliefs, Values, and Goals. Annual Review of Psychology 53, Volume 53,

2002 (Feb. 2002), 109–132. https://doi.org/10.1146/annurev.psych.53.100901.135153 Publisher: Annual Reviews.

Katia Bill Nielsen and Lars Ulriksen. 2023. Following rhythms and changing pace–Students' strategies in relation to time in higher education. Teaching in Higher Education 28, 8 (2023), 1903–1917. https://doi.org/10.1080/13562517.2021.1940926 arXiv:https://doi.org/10.1080/13562517.2021.1940926.

Michael Seery, Hendra Agustian, Euan Doidge, Maciej Kucharski, Helen O'Connor, and Amy Price. 2017. Developing laboratory skills by incorporating peer-review and digital badges. Chem. Educ. Res. Pract. 18 (July 2017). https://doi.org/10.1039/C7RP00003K

Lars Ulriksen. 2016. Students' time budget practices: This was the time of our lives. Newport, Wales, Great Britain. https://www.ind.ku.dk/ansatte-automatisk-liste/?pure=da%2Fpublications%2Fstudents-time-budget-practices-this-was-the-time-of-our-lives(dc987148-0ac3-4ef4-9de6-506f5ca47c8f).html

Lars Ulriksen. 2018. Time for Studying - A Question of Quantity or Quality? Celtic Manor, Newport, Wales, Great Britain. https://www.ind.ku.dk/ansatte-automatisk-liste/?pure=da%2Fpublications%2Ftime-for-studying--a-question-of-quantity-or-quality(5f4dd5ad-b951-4d7a-bd6f-ce324d337797).html

Lars Ulriksen and Christoffer Nejrup. 2021. Balancing Time – University Students' Study Practices and Policy Perceptions of Time. Sociological Research Online 26, 1 (March 2021), 166–184. https://doi.org/10.1177/1360780420957036 Publisher: SAGE Publications Ltd.

Oili-Helena Ylijoki and Hans Mäntylä. 2003. Conflicting Time Perspectives in Academic Work. Time & Society 12, 1 (March 2003), 55–78. https://doi.org/10.1177/0961463X03012001364 Publisher: SAGE Publications Ltd.