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Focus, Structure, Reflection! Integrating User-Centred Design and Design Sprint

Virpi Roto¹, Marta Larusdottir², Andrés Lucero¹, Jan Stage³, and Ilja Šmorgun⁴

¹ Aalto University, 00076 Aalto, Finland
virpi.roto@aalto.fi, lucero@acm.org

² Reykjavik University, 101 Reykjavik, Iceland
marta@ru.is

³ Aalborg University, 9100 Ålborg, Denmark
jans@cs.aau.dk

⁴ Tallinn University, 10120 Tallinn, Estonia
ilja.smorgun@tlu.ee

Abstract. Google Design Sprint (GDS) is becoming a valued tool for interaction design practitioners today. Although GDS has some similarities to User-Centred Design (UCD), it does not study user needs before generating solutions. On the other hand, UCD provides little guidance on producing design solutions. We saw the two processes would nicely complement each other. This paper reports development of an intensive two-week interaction design course where UCD was combined with GDS. The feedback from 22 higher education students indicates how UCD helped them to keep the focus on the important things, and how the detailed structure of GDS process guided them fast forward. In the fast-paced Design Sprint, students need dedicated time for reflection. The contributions of this work include the course structure for teaching a User-Centred Design Sprint process, student feedback on the new process, and recommendations for teaching such a course.

Keywords: Interaction design · User-centred design · Design sprint · Higher education · Course development.

1 Introduction

Human-Computer Interaction (HCI) education has been criticised for the lack of support for a creative design approach [6]. Since the centre of User-Centred Design (UCD) is on user needs, the actual craft of design receives too little attention [3]. When planning an intensive Interaction Design course, we wanted to combine the hallmark HCI method of UCD with a creative design method, aiming at a more balanced role between the user and the designer in the interaction design process [2].

At the time of developing the course, a design method called Google Design Sprint (GDS) [12] started to get more attention among interaction designers.

GDS is an expedited design process for ideating, prototyping, and testing a design idea just in one week. This specific form of a design sprint was developed by Knapp while at Google, therefore it is also colloquially known as the Google Design Sprint [10]. GDS does not include UCD activities such as user interviews or observations to find out user needs in the early stages of the design sprint. This may be because in industry, knowledge on user needs accumulates over the years and today, many projects build on the previous knowledge of the users. But GDS includes user evaluations, which can be grouped as one of the core UCD methods, as the last activity of the design sprint. When designing for user groups and contexts that the designers are not familiar with, the User-Centred Design activities of interviewing and observing users are elementary to understand the contexts of use and user needs, and to verify that the users can adopt the new design as part of their practices [11].

In our previous work, we have tested teaching GDS and UCD on an intensive 2-week interaction design course. The first week was devoted to teaching the GDS process and the second week for UCD. This structure resulted in positive feedback from students but also revealed issues to be improved [15]. The students liked the fast pace of GDS and the structure that it provides to design work, but they missed clarifying the users' needs before starting the GDS process. The first edition of the course structure was not optimal.

Based on the above, there is need for research on integrating user-centred methods to creative design methods. There is also a need to study how to teach this integrated approach for students. Therefore, we defined two research questions to be answered in the present study.

RQ1: How can User-Centred Design and Design Sprint processes be integrated into a coherent structure in an intensive course?

RQ2: What should teachers pay special attention to in teaching User-Centred Design Sprint?

In this paper, we report the development of a structured design process that combines User-Centred Design (UCD) and Google Design Sprint (GDS) processes into a coherent User-Centred Design Sprint (UCD Sprint). The new design process was developed for and tested in the context of an intensive two-week course on interaction design in higher education. On this course, the basics of interaction design were taught through project-based learning.

The UCD Sprint has been developed along two editions of the course. After the first version of the course in 2018, we saw that it was important to improve the course structure so that students would do GDS after having conducted user research and thus gained understanding of user needs. We used the 2019 course as a case study to test a modified structure, where UCD process was combined with the GDS process in a more integrated way. We taught the new UCD Sprint for students with different backgrounds and gathered the student feedback on the course. The students acted as users of the new process, and their evaluation of the new course structure and content forms the main data set reported in this paper.

2 Related Research

In this section, we present the pieces of research that are closest to ours. We start by reporting studies around teaching UCD, then around teaching design sprints, and finally the works combining the two design approaches.

2.1 User-Centred Design and Design Sprints Education

The research literature on HCI includes an extensive number of references that present the rationale behind UCD or techniques that are relevant in a UCD process. Contrary to this, the literature on teaching of UCD is very limited, even though the number of developers skilled in UCD is critically important for the employment of UCD in software development organizations. One of the few exceptions focuses on the skills needed for UCD practitioners, arguing that UCD is a process that should yield a high level of utility and usability by developing good task flows and user interfaces. Therefore, UCD practitioners should have the knowledge and skills needed for considering and involving users [7].

There are also more specific descriptions of UCD courses. Greenberg [8] presents a complete course design. It is a general HCI course for university students, but it has a part on design with users. The main focus in this part is on evaluation, but the last element in this part is on involving users in the design process. There is not an overall method to guide the process and the application of the UCD techniques. Seffah and Andreevskaja [18] present the content of a course specifically on user-centred design for university students. In addition, they describe the approach behind the course through a list with 17 skills on design and evaluation that should be developed in a UCD course. Unfortunately, they neither outline the contents of the specific course nor any experiences from teaching it.

The literature mentioned above is mostly characterised by guidance on ways of teaching UCD, however, there is almost no evaluation of these teaching efforts. An early exception to this is a report from training workshops where the UCD process and related techniques were presented. The participants indicated that after a workshop, they felt more empowered to evaluate and design new systems [21]. An evaluation of teaching of UCD on elementary and secondary school level concluded that there was a clear lack of opportunities for pupils to experience user-centred approaches when undertaking tasks in classes on this topic [17]. The evaluation of a course for experienced practitioners provided experiences of different part of the contents of the course, but they are still on an overall level [13].

Culén [6] wanted to bring innovation and creativity to HCI education and used Design Thinking [5] for this purpose. She notes that while the overall Design Thinking process is similar to UCD, the role of research, requirements specification, questioning assumptions, the consideration of organizational issues, and the systematic exploration of design alternatives make the difference. Culén [6] reports an Interaction Design course within an HCI curriculum, which showed

Design Thinking to foster innovation and creativity. This work is close to our attempt to combine UCD and GDS, since GDS is often seen as an implementation of Design Thinking in practice. However, while Culen aimed at bringing creativity to HCI education of non-designers, our aim was to develop a design process integrating UCD and design sprint to the education of interaction designers.

We have only found a few scholars investigating the topic of design sprints in education. [20] discuss design sprints in education and conclude that through the sprints, students can learn practical skills of avoiding fixation to the first idea of the solution, understanding the problem deeply because of its ambiguity, and collaborating with team members. They also list many values that design sprint can bring to design education. Encouraged by these works, our paper focuses on an unexplored topic of students' experiences of design sprint as a learning method, and especially of User-Centred Design Sprint.

2.2 Integrating UCD in Design Methods

Integration of UCD and design methods has been discussed to some extent. One of the first was [19] who discussed how UCD and software engineering could be integrated. They review a number of software life-cycle methods that involve a user-centred approach. There are other suggestions for integrating user-centred design into software development, but they are typically integrating UCD in established software engineering process models, e.g. [16].

A major stream of work has focused on the integration of UCD with agile software development approaches. Brhel et al. [1] provides an overview of this issue. Additionally, Cockton et al. [4] provide good insights into the challenges of integrating UCD in agile and conclude that both agile and UCD can learn from each other and from other approaches from design, engineering and business. Besides this focused area, there is very little literature on integration of UCD and design methods. The closest work, although not involving an interaction design method per se, is by Zhang and Joines [22] who integrate UCD and theory of innovation for problem solving.

In summary, the review of literature on teaching UCD and design sprints shows that both are used in education separately, but few publications disclose the course structure. The Design Sprint process is often described in detail elsewhere, e.g., GDS in Knapp [12]. We also studied existing works on integration of UCD activities with any kind of design method. We found publications that focused on the software development processes, but we were unable to find publications targeting the phase before the software development starts.

3 Course Development

To respond to the calls for teaching UCD with a creative design method [6] and for balancing the roles of the user and the designer in the interaction design process [3], we have developed an intensive Interaction Design course combining UCD with a design sprint. The design of the course was inspired by constructivist

learning theories. They are often utilised in teaching interaction design in higher education where teams of students work on a design project and learn by doing [23]. Such project-based courses have shown to support students' deep learning, in contrast to surface learning of memorizing given pieces of information [1]. The course development is reported below.

3.1 Background of the Course

Over three years, we have developed a two-week summer course on interaction design for university-level students. We gave the course for the first time in 2017 at Tallinn University with 18 participants from four countries [14]. Since this edition did not include a design sprint, we do not discuss it in this paper. Based on the evaluation from the first edition, we redesigned the course to include GDS process, and provided it to a new group of 19 international students at Reykjavik University in 2018 [15]. This paper reports the third and last edition of the course, which was further developed based on the student feedback and held at Aalto University to a group of 24 international students in year 2019. The first two editions of the course were planned and delivered by four partner universities: Aalborg University, Aalto University, Reykjavik University and Tallinn University. Uppsala University joined the third edition of the course. Each year, five students from each country were chosen to participate.

In 2019, connected health was chosen as an interdisciplinary field, and we made an effort to recruit students from the related fields of design, engineering, computer science and medicine to the multidisciplinary teams. A total of 24 international students worked in five groups of four or five members on designing and evaluating an application prototype.

3.2 Course Structure

In teaching the course on interaction design, we wanted to find a structure where the UCD and GDS activities would form a coherent and balanced design process for a 2-week intensive course. Before describing our solution for the course structure, we briefly describe the process of UCD and GDS. The two processes are documented in detail in [11] and [12].

The standard process of UCD [11] starts by planning the design process, understanding and specifying the context of use, specifying the user requirements, producing design solutions, and evaluating the design. The UCD process is iterative, repeating the activities until the evaluation results satisfy the main goal of UCD, meeting the user requirements.

The goal of the GDS process is to solve big problems and test new ideas in just five days [12]. Before the sprint starts, an important challenge is defined, and small teams with diverse skills are recruited to join the one-week sprint. On Monday, a map of the problem is made by defining key questions, a long-term goal, and a target, thus building a foundation for the sprint week. On Tuesday, individuals follow a four-step process (i.e., notes, ideas, crazy 8, and solution sketch) to sketch out their own detailed, opinionated, and competing solutions.

On Wednesday, the strongest solutions are selected using a structured five-step “Sticky Decision” method and fleshed out into a storyboard. On Thursday, between one and three realistic-looking prototypes of the solutions proposed in the storyboard are built, using tools like Keynote to create the facade for apps and websites, a 3D printer to quickly prototype hardware, or just build marketing materials. Finally on Friday, the prototype is tested with five target customers in one on one interviews or think-aloud sessions. While only some of the resulting solutions will work, going through such sprints provides clarity on what to do next to tackle the big important challenge.

On our course, the students used the first three days of the course for UCD activities with introductory sessions on the course theme (e-health), developing a design brief, collecting needs from potential users, analysing user data, and setting UX goals. On the first day, the students got an introduction to the challenges in digitization in healthcare digitalization. Students were asked to find an idea individually for a health-related software solution. After presenting the individual ideas to the team members, the teams decided on one idea to work further on during the course. The GDS process ran for 5 course days, from Thursday the first week to Wednesday the second week. The course concluded with UCD activities and wrap up during the last three days of the course. The course schedule is illustrated in Figure 1.

	Monday	Tuesday	Wednesday	Thursday	Friday
Week 1	UCD - Vision Introductions Visions	UCD - Research User groups Interviews Results	UCD - Define UX goals Usability requirements	GDS - Map Set the stage Mapping Ask the experts	GDS - Sketch Lightning demos Sketching
Week 2	GDS - Decide Design voting Speed critique Storyboarding	GDS - Prototype High-fidelity prototyping	GDS/UCD - Test User testing Results	UCD - Iterate 2nd prototype evaluation	Wrap up Presentations Reflection Celebration

Fig. 1. Illustration of the course schedule.

The course schedule focused on combining UCD with the “by the book” GDS process during the two weeks. For the first three days, the focus was on UCD, so the students got an understanding of the problem they wanted to design for, the user needs, high-level usability requirements, user experience (UX) goals, documented in a design brief. The next two days were scheduled according to the first two days of GDS, by making a map, reflecting on the map by asking the experts and sketching the first ideas of the interaction design. During the second week, the first three days were according to the last 3 days of the GDS process: making a design solution, a storyboard, a hi-fi prototype and conducting user testing. The last Thursday focused on final evaluation and iterating the proto-

type. On Friday, the students presented their design process and final outcomes, gave feedback, and celebrated the completion of the intensive course.

The changes in the course schedule in 2019 were triggered by student feedback from the 2018 edition of the course, where students expressed a need to be introduced to the context in which they would be designing, rather than immediately jumping into a Design Sprint. After extensive discussions within the teaching team, an understanding was reached that Design Sprints provide a very well-structured framework for quickly coming up with design solutions. However, if the idea for the solution, that will be the target of the design sprint, is brand new as in the course setting, the participants need to understand the users' needs prior to starting to design the software. Driven by the desire to combine the main concepts of UCD while also being able to “get something hands-on done” during a design sprint, we adjusted the course schedule from 2018 to 2019. An illustration of the course structure in 2018 and 2019 is shown in Figure 2.

	Week 1					Week 2				
2018	GDS Map	GDS Sketch	GDS Decide	GDS Prototype	GDS/UCD Test	UCD Define	UCD Research	UCD Iterate	UCD Iterate	Wrap up
2019	UCD Vision	UCD Research	UCD Define	GDS Map	GDS Sketch	GDS Decide	GDS Prototype	GDS/UCD Test	UCD Iterate	Wrap up

Fig. 2. Comparison of the course schedule in 2018 and 2019.

Another trigger for this change was the fatigue that we observed in the 2018 edition of the course, when after running a week-long design sprint and coming back after a weekend, there was a loss of energy and motivation within the student group to run the user-centred design methods after the design sprint, because they felt like that was not the right timing for those activities.

4 Methods

We used two data collection methods: a weekly Retrospective Hand technique and a final feedback questionnaire. For analysing the open-ended responses, we used Conventional Content Analysis method, and Mann-Whitney U test for comparing numeric ratings between the two editions of the course.

4.1 Data collection

The data set was collected from students. Out of the 24 students, 12 were from computer science or similar technical fields, 4 from design, 1 from HCI, 4 from well-being or medical field, and 2 had experience in both medical and technical fields. Two students had to leave early on the last Friday, so we only had feedback from 22 students in the second week. All feedback was collected on paper, and

the students returned the paper in a box to keep anonymity. The data collection methods will be explained in the following.

Retrospective Hand Technique The students were given a blank A4 sheet of paper and asked to draw their right hand on the paper. In the space for the thumb, they were asked to write what was good on the course (hence the like finger), in the space for the index finger, they were asked to write anything they would like to point out, which could be either positive or negative. In the space for the middle finger, they were asked to write anything they think was not so good in the course, in the space for the ring finger they were asked to write what they take home from the course, and finally in the space for the pinkie, they were asked what they would like more of in the course. It took the students around 10 minutes to write the feedback they wanted.

Feedback Questionnaire The Feedback Questionnaire consisted of three sections, of which this paper focuses on the questions regarding course structure and content. Section 1 contained evaluation on the following aspects of the course: 1. Course content, 2. Teaching methods, 3. Course structure, 4. Soft skills, 5. Learning environment, 6. Learning support, 7. Course administration, 8. Staff quality, 9. People, 10. Experience (overall course experience), 11. Feedback collection. Each aspect was explained with one sentence, for example Item 3, Course structure, was explained as: Structure and scheduling of the activities, days and the whole course. The students were asked to rate these aspects from 1 being “very bad” to 7 being “Very good” and 4 being “Neutral”. The students were given the space to comment on each aspect. At the end of this section the students were asked to answer 6 questions about the questionnaire itself, results of which we do not report in this paper.

Section 2 contained two background questions on their expertise and if they planned to use these kinds of methods prior to the course. Section 2 also contained questions on 14 methods used in the course. The students were asked to rate if the method was thought provoking, was useful for the course and if they thought it would be useful in the future. The scale was 1 to 7, 1 = “Not at all”, and 7 = “Extremely so”. The students also answered two overall questions on the Google Design process as a whole and the user-centred design process as a whole.

Section 3 contained a evaluation of the pros and cons of the GDS process and the UCD activities. The students were asked to write three qualities with the two processes that they found good and three qualities that they found not so good. At the end of this section the students were asked particularly on the schedule of the UCD activities, i.e., if they found the 3 days of UCD activities in the beginning of the course to be short, about right, or too long. The same question was also asked about the 2 days of UCD activities at the end of the course.

4.2 Data Analysis

The qualitative data analysis covered student feedback from the Retrospective hand and sections 1 and 3 of the feedback questionnaire. The analysis followed the Conventional Content Analysis by Hsieh & Shannon [10], although the student feedback was more lightweight and focused than typical data in content analysis. After converting the hand-written feedback to a digital table format, the section-specific analysis started by reading the responses of students for each feedback theme. When several topics were covered in one response, they were extracted as individual comments. Also, if the same student gave the same comment in multiple responses, they were combined into one. In this paper, we report the comments regarding the course content, structure, and teamwork. We leave out the comments regarding the course practicalities or teachers, due to the scope of this paper, the limited space, and the low value of case-specific details. The conventional content analysis started by open coding, i.e., one of the authors assigned initial codes for each individual comment. Another author used the initial codes to independently code the data. The two authors discussed the differing codes to gain a consensus and agreed on the final set of 24 unique codes for the Retrospective Hand data and 16 for the good and not so good aspects of UCD and GDS process. The most frequent and interesting codes from sections 1 and 3 of the questionnaire were further analysed, and they formed the three main categories of Focus, Structure, and Reflection. Finally, all student comments were re-checked to see if they contained new perspectives to the topics of the main categories.

The quantitative data from Section 2 in the questionnaire was analysed by calculating the means of the students' rating of each method. Since the data was ordinal and the sets of data were unrelated, we used the Mann-Whitney U test for the statistical comparisons of the means from 2018 and 2019. We compared the ratings of individual methods that were used in both course editions and the ratings of the UCD and the GDS processes as a whole. We use p less than 0.05 and p less than 0.01 as values for stating evidences of statistical differences in our findings.

5 Results

In this chapter, we shortly report the results from the different data collection methods. After the results from the Retrospective Hand, we report separately the quantitative and qualitative results of the feedback questionnaire.

5.1 Weekly Feedback on the Course

The Retrospective Hand technique was used to collect student feedback on the course as free-form comments. It was the only data collection method used twice, on both Fridays, which helped us to improve the course on the way and to receive feedback on the first week activities when it was still fresh in students'

minds. The first week, 23 students, and the second week, 22 students returned their responses. Altogether 45 comments on week 1 and 43 on week 2 about the course content, structure, and teamwork were extracted for the conventional content analysis. The results of the analysis are depicted in Table 1.

Table 1. Coding of student comments about good and not so good aspects of the User-Centred Design Sprint.

	Good		Not so good	
Week 1	Fast process	10	Challenges in brainstorming	6
	Structured process	7	More real-life examples	4
	Time before GDS	3	Duration of lectures	4
	Lectures & Practice	2	Unclear structure	4
			Roles did not work	2
			Limited time	2
			Too much time	1
			Reflection	1
		Good in week 1, total	22	Not so good in week 1, total
Week 2	Prototyping	10	Limited time	7
	GDS process	6	Too much time	2
	User tests	6	More real-life examples	5
	Fast process	3	More lectures	2
			Roles did not work	2
		Good in week 2, total	25	Not so good in week 2, total

Both weeks, following the structured, fast-pace process attracted the highest number of positive comments (1st week: 17, 2nd week: 9). Most of these comments stated simply "GDS" or "the GDS process" without a reason for liking. Six students, one of whom was among those who spontaneously appreciated the fast pace of GDS, wanted more time for the interviews, brainstorming, data analysis, lectures, or to catch up. In contrast, there were 3 comments about too much time.

The comments regarding the UCD activities highlighted the user tests in the second week, which 6 students specifically mentioned as useful. In the first week, two students spontaneously commented that the activities before starting the sprint were good, and that "[we] are learning, so it's good to adapt first". However, the additional time for specifying the design brief before starting the GDS process was still not enough based on the comments of five students. One of them criticised: "We had to brainstorm on ideas before knowing the problem". Apparently, some teams worked more smoothly towards a joint idea, since a student reported idle time as a negative aspect in the first week: "Time allocated for the activities (some was too much)".

5.2 Feedback on the Methods Used

Data was gathered from students on the usage of 14 methods and the GDS and UCD process during the course in 2019. One student left this part of the questionnaire blank, so the results in this section are based on 21 students' ratings. The students were asked to rate three stages of the usage: a) if the method was thought provoking, (meaning that when getting introduced to the method it resulted them in getting new thoughts), b) if the methods was useful during the course and c) if they think it would be useful in their future job or studies. The students rated the methods on a scale from 1 to 7, where 1 was "not at all", and 7 was "extremely so". The same was done in 2018 for the methods used then, in total 13 methods [15]. Note that some methods were used only in 2018 and others only in 2019.

We acknowledge the difficulty in comparing two editions of a course, but to see if the new structure and order of using the methods made a difference for students, we compared the students' average ratings on the methods in 2018 and 2019 (Table 2). The ratings were compared with Mann-Whitney U test to check if there was evidence for significant differences. We mark the results with a statistical difference with asterisks, one for $p < 0.05$ and two asterisks for $p < 0.01$.

Table 2. The average rating of students of the UCD and GDS methods in 2018 and 2019 on scale from 1 to 7, with the highest ratings marked as bold.

	The Method was Thought Provoking		The Method was Useful for the Course		The Method will be Useful for Future Job or Studies	
	2018	2019	2018	2019	2018	2019
Making a map	5.94	4.71	6.06	6.38	6.00	6.00
Ask the experts	4.81	5.00	4.44	6.33**	5.63	6.19
Lighting demos	5.31	4.76	5.00	6.10*	5.00	5.95*
Sketching (incl. the crazy 8)	6.38	5.43	6.63	6.29	6.25	5.62
Voting on design solutions	5.00	5.33	6.13	6.33	5.56	6.14
Speed critique of the designs	5.63	5.10	6.00	6.19	5.44	5.81
Storyboard making	6.00	4.60*	6.31	6.05	6.38	5.80
Hi-fi prototyping	5.50	5.29	6.25	6.81	6.50	6.05
User evaluations of prototype	6.38	5.38	6.56	6.76	6.63	6.19
Stating usability goals	-	4.71	-	5.86	-	5.86
Stating UX goals	4.56	4.86	4.31	5.95**	5.00	5.90*
Storyboard evaluation	-	4.43	-	5.48	-	5.29
UX goals in storyboard evaluation	-	4.33	-	5.52	-	5.05
Evaluating against UX goals	4.63	-	4.50	-	5.13	-
Prototyping for the last evaluation	4.81	-	5.50	-	5.31	-
Summative evaluations in the end	5.19	5.00	5.06	6.24**	5.25	6.10*
Google Design sprint as a whole	6.69	5.48	6.75	6.76	6.63	6.24
User-centred design as a whole	5.06	5.29	5.13	6.62	5.40	6.43

The analysis shows that the students gave the Storyboard making method a significantly lower rating for thought-provokingness in 2019 than in 2018 ($p = 0.023$). The analysis shows evidence of statistical differences also in the ratings of how useful the methods were in the course for four methods: Asking the experts ($p = 0.0012$), Lightning demos ($p = 0.012$), Stating UX goals ($p = 0.00024$) and Summative evaluations in the end ($p = 0.0034$). The ratings were higher for all these four methods in 2019 than in 2018. The method of stating UX goals was used earlier in course in 2019 than 2018. This seems to be more natural and more useful for the students. The other three methods were used later, after having used UCD methods earlier in the course and this seems to give the students more confidence or willingness to use them. The statistical significance between years was found also when rating the method's usefulness in the future for Lightning demos ($p = 0.029$), Stating UX goals ($p = 0.024$) and Summative evaluations in the end ($p = 0.047$).

When the ratings from students on the whole GDS process from 2018 and 2019 are compared with a Mann-Whitney U tests we found no evidence of statistical differences between the 2018 and 2019 ratings. We also compared the ratings from students on the whole UCD process. There is no evidence of statistical difference in how thought provoking the UCD process is in 2018 and 2019.

On the contrary, there is strong evidence of statistical difference ($p = 0.00022$) that the students think the UCD process was more useful in the course in 2019 than in 2018. Additionally, there is evidence ($P=0.011$) that the students rate the usefulness of the UCD process for future jobs and studies higher in 2019 than in 2018. This indicates that the changes made on the course structure between 2019 and 2018 were appreciated by the students.

5.3 Feedback on the Processes as a Whole

In the last part of the questionnaire, the students were asked to list three good and three not so good aspects of both GDS and UCD. A total of 21 students contributed with a total of 181 comments. For unclear comments, the two authors returned back to individual responses to understand the context of the comment, so only 6 comments were ignored due to their unclear message, e.g., "Excellent" or "Research". Additionally, 10 comments were ignored since they were not about GDS or UCD, but about teaching e.g. "well taught" or "I'd like to have a bit more lectures", so the total number of comments included in this paper was 163. After the coding process described in 4.2, 16 codes emerged from the data, as shown in Table 3.

The left side of Table 3 lists the codes and the number of comments under each code, which emerged from the students' responses of 3 Good aspects of GDS or UCD, respectively. The codes and the number of comments on Not so good aspects of GDS and UCD are on the right. Some topics divided opinions, such as the Fast process on the good side and Limited time on the Not so good side, and Teamwork on both sides. GDS attracted almost a third more comments than UCD, 96 vs. 63.

Table 3. Coding of student comments about the good and not so good aspects of GDS and UCD.

	Good		Not so good	
GDS	Fast process	19	Limited time	15
	Structured process	12	Skills needed	7
	Facilitate design decisions	8	Teamwork	6
	Interesting/innovative	6	Slow process	5
	Prototyping	4	Detached from practice	3
	Teamwork	3	Activities/Products not useful	3
	User focus	3	Difficult activities	2
	User feedback	2	Design decisions	1
	Good in GDS, total	54	Not so good in GDS, total	42
UCD	Facilitate design decisions	14	Difficult activities	6
	User focus	12	Activities/Products not useful	5
	Testing/Evaluation	5	Slow process	4
	User feedback	4	Skills needed	3
	Interesting/innovative	3	Limited time	2
	Structured process	1	Design decisions	2
			Detached from practice	1
			Teamwork	1
	Good in UCD, total	39	Not so good in UCD, total	24

6 Discussion and Conclusions

This paper reports development of an intensive two-week interaction design course where UCD was combined with Google Design Sprint [12]. In this paper, we focus on the course structure and report feedback from the students, who also are the users of the new User-Centered Design Sprint process. The main contributions of this paper include 1) the course structure to teach User-Centred Design Sprint (Figure 1), 2) the evaluation results of the new process (Tables 2-3), and 3) recommendations for teaching this kind of a course. Next, we will answer our two research questions by analysing the meaning of the results for the integrated UCD and GDS, and by sharing important remarks about teaching this kind of a course.

6.1 An Integrated UCD and GDS Process

We have tested two process structures of integrated UCD and GDS during the two editions of this Interaction Design course (Figure 2). The change between 2018 and 2019 editions resulted in several statistically significant differences in students' ratings of the design methods. First, our results provide very strong evidence ($p = 0,00022$) on the new UCD process being more useful than the one used in 2018 both in the course and in the future ($p=0.011$). This is very positive feedback on the changes we made to the design process. It is evident that the students found using the UCD process before and after using the GDS process more useful than doing all the UCD activities after the GDS activities

like in 2018. The positive results could also be due to the similar structure of the UCD activities in the same way as the GDS activities, i.e., we kept the fast pace and the guided structure for the UCD activities similar to the GDS activities in 2019. This was not done to the same degree in the 2018 edition of the course.

The students rated Stating UX goals method on the third day in the course in 2019 much higher than stating those on the sixth day in 2018. There was a significant difference in the ratings for the method being useful in the course and in the future. Additionally, the students found the summative evaluation of the prototype in the end more useful in 2019 than in 2018. When conducting the method, the students gather quantitative data on the usability and the UX of their prototype. The method was used during the ninth day in both years. In 2019, the students had not done as many evaluations of their prototype before the summative evaluation as in 2018, which may be a reason for the difference. There is evidence that three GDS methods got higher ratings in 2019 than in 2018: storyboard making for being thought provoking, asking the experts for being useful in the course and lightning demos for being useful in the course and in the future. This may be because all these methods were used later in the course in 2019 than in 2018, so the students were more prepared to use those methods in a useful way.

The qualitative feedback supports and justifies the quantitative ratings about the new structure above. The content analysis of student comments show that the UCD activities in the beginning of the 2019 course were appreciated: “Time before sprint” and “Activities to prepare for the GDS” were mentioned by students in the What was good section of the first week feedback. Defining the target user group and conducting user interviews set the scene for the whole project: “[UCD] data are the roots of design”. After the 3 days of UCD in the beginning, the students were ready to start the GDS process: “User interviews helped to set the tone for the GDS”. For teachers, the new structure allowed to keep the same format and pace both for the UCD process and the GDS process throughout the course in 2019, focusing on one method at a time for a specific time slot. This shows in student feedback as a fluent overall design process: “Nice workflow” and “Flow of sprint”.

The Retrospective Hand feedback (Table 1) provides us information on the process on weekly basis. The feedback on the integrated process shows that the integrated process worked well on both weeks. First week, 10 out of 22 positive comments were about the fast process, such as “tempo” or “speeds up the design process”. The students were impressed how much they achieved during just one week: “achieve a lot in a short period”. At the end of the second week, the students were not so happy with the results, since they did not have enough time to finalise the prototypes. While the goal of design sprints like GDS is to test an idea, not produce a high fidelity prototype, the students would have enjoyed spending more time on prototyping. This shows as the highest number of the positive comments on the second week being about prototyping (10), but the limited time did not allow it (7 negative comments).

Compared to GDS, UCD Sprint provides one additional day for prototyping and summative evaluation, i.e., another iteration round. The students seemed to appreciate this day, as the Summative evaluations method got high ratings for usefulness, and the qualitative feedback supports the rating, e.g., "summative evaluations were helpful". In the previous edition of the course, the weight was more on the iterative prototyping and evaluation. Back then, the first prototype was developed on the 5th day, two days earlier than in the new structure, and there were three iterations of prototype tests. The students thought the last summative evaluation was too much. On this class, we shifted the weight from prototyping towards UCD in the beginning of the course. The initial user studies eliminated the problem of a team working for one week on an idea that did not fly when users evaluated the prototype. Higher user relevance is an important benefit of allocating more time on UCD and less on prototyping.

Regarding the qualitative feedback on both GDS and UCD process (Table 3), the highest number of comments were coded under "Facilitating design decisions". This includes 22 positive comments about how both processes helped making decisions in the team. Seven of these comments mentioned the goals set for design, e.g., UCD "gives guiding stars (goals)" through user research based user experience and usability goals. GDS provided specific methods to facilitate decision making, of which students mentioned voting (3 comments, e.g., "democratic way of choosing ideas to develop further"), roles ("the use of decider and facilitator made most of the tasks easy") and storyboards ("creating storyboards was helpful to create common understanding between team members"). Also, some of the positive comments coded under "Fast process" were related to the need to decide and go on, from a timing perspective: "forced to move on and make decisions", "clocking the time", "pressure". The user research in the beginning and user feedback later in the process provide data to support decision making, so UCD provided a "good way to keep focus on important things". **Focus** is the first high-level theme we want to highlight. It was visible both in the guided structure that steered students to focus on one activity at a time, and in the above methods that provided focus to the fuzzy front-end phase of a design process. In conclusion, a clear focus expedites decision making and focus is what both user studies and GDS methods provide.

The new structure, where UCD activities took place before and after GDS, received significantly higher ratings from students than the structure in the first edition of the course, which started directly with GDS and UCD activities followed on the second week only. The structured process of GDS induced only positive comments, including "organized progression of ideation", "super nice to structure the process of finding out what to prototype", and "easy to follow". The comments under "Unclear structure" in the Retrospective Hand feedback were not about GDS but about teaching and will be discussed in the next section. Although there were more positive comments on the fast process than on the structured process, the teachers saw that it was the structure that enabled the fast process. Therefore, rather than the fast pace in itself, our second theme to highlight in teaching User-Centred Design Sprint is **structure**. There is a

specific, granular structure in GDS, and we introduced a specific structure of UCD as well, as explained above. We conclude that when teaching GDS, emphasize the structure of the process rather than the speed. The strict timing can be relaxed, but the structure should stay the same. The teacher needs to find ways to handle the different pace of different teams, and this we will discuss in the next section.

As an answer to our first research question, how can UCD and Design Sprint methods be integrated into a coherent structure in an intensive course, we recommend reserving ample time for team building and user research before starting a Design Sprint, and an additional round of prototyping after it. During the fuzzy front-end of the design process, which User-Centred Design Sprint is targeting, activities that help to focus are important for efficient decision making. Examples of such activities include user interviews, voting, decider role, storyboards, and user evaluations. A predefined, detailed structure is the other important feature of User-Centred Design Sprint, which should not only cover GDS but also the UCD activities.

6.2 Recommendations for Teaching User-Centred Design Sprint

Teaching User-Centred Design Sprint is not only about optimizing the design process practised on the course. The two editions of the course have shown that teachers also need to handle a number of important challenges that may occur despite the smooth and fast overall process.

One such challenge was facilitation of teamwork. The Design Sprint process guidance is targeted for a single team, but a teacher needs to facilitate the work of several teams of students. This is a challenge both from the facilities perspective, as well as from the perspective of understanding how the teams are doing. Some teams seemed to work well, as 3 comments were positive to the teamwork: “allows professionals of different specialities to contribute” and “working with a team on ideation”. Other students were more critical about the teamwork (7 comments): “depending too much on team dynamics”, “needs disciplined team”, and the most critical was “discussions were not fun, too many ideas and too many ego”. To manage team dynamics, GDS provides the roles of decider and facilitator, but the Retrospective Hand feedback included 2 comments each week on the GDS roles not working. According to one comment, this was because the roles were decided before the students knew each other. Another reason was that students are not experienced to act as a facilitator or decider: “Because the roles holders did not manage to fulfil their roles the group did not manage to finish tasks on time”. Thus, teaching User-Centred Design Sprint requires assistance on handling teamwork and team dynamics. We recommend doing this by paying special attention to the decider and facilitator roles.

There were mixed opinions about the pace of the design process that is enforced especially with GDS. Many students liked its fast pace, as emphasised above. Some students would have enjoyed even faster pace, and they commented that using five days for gaining the given outcome was too slow (9 comments altogether): “takes a long time”, “could be done quicker”. One student related

the slow speed to teamwork by stating “without team support nothing moves ahead”. On the other hand, the limited time was also emphasised as the main drawback, with 15 comments about difficulties due to the limited time for activities, e.g., “too fast”, “stressful process”, “time for prototyping is too short”. In conclusion, even though some students seem impatient and want to move on, the teachers should be prepared to manage the different pace of the teams and individual students. Teachers should also consider relaxing the strict timing of activities with GDS if the students seem exhausted.

The fast pace of the intensive course leads us to our main finding on teaching, **reflection** activities. Two student comments at the end of the first week on what they would like more of, “Retrospect, what went well, where could do better” and “Not enough feedback/reflection on exercises” reminded us about the importance of reflection as part of the learning process. If the course simply follows the strict structure and timing of GDS, there is no time for reflection: “I sometimes need to reflect [for] a while, now it was not possible”. Based on this feedback, we added a reflection discussion at the end of each day in the second week. The feedback collection in the end, the results of which we report now, was another important part of reflection. In conclusion, we recommend the teachers to arrange dedicated activities for proper reflection on what was learned.

Looking at the Retrospective Hand feedback, the students raised several challenges related to teaching, especially related to the lecture contents. Four students requested more real-life examples in week 1 and five are requesting that in week 2. Some students wanted more lectures, but longer lectures were criticised by some others. In an intensive course, there is little time to study additional materials, but one student suggested sharing materials (e.g., for prototyping) before the course.

In a class of students with different backgrounds, the teachers need to pay attention to the pedagogical aspects during the scheduled process: ensure all students learn, and the teams who finish quicker have something meaningful to do while waiting for others to finish. On the other hand, it seems difficult to reach a moment when all teams would agree that the idea chosen by the team is the right one to be developed. Since the objective of this intensive course is to learn to test ideas quickly in a user-centred way, the chosen idea for the exercise is not the main success criterion.

Two students in both weeks commented that the GDS roles did not work in their team. The reasons included 1) too early assignment of decider and facilitator, as the team members did not know each other to agree the most suitable one for the role, 2) rotating the roles on the 2nd week was “messy”, 3) a Mediator role was missing, and 4) unclarity on the roles. These challenges may be alleviated by clarifying the roles, checking how the teamwork and the roles are working in each team, and reminding about the duties if the roles are rotated.

In line with the previous versions of this course, two students appreciated the balance between theory and practice. However, there was a contradiction in comments about too long lectures (on the 1st Wednesday, 2 students) and too few lectures (2 students). An important comment from the first week, although

the only one at this point, was about the lack of retrospection after each phase, which we paid attention to during the 2nd week. Although there were only a few spontaneous comments about reflection in the feedback, pedagogically this was an important reminder about allocating ample time for reflection on a fast-paced course.

Finally, four students stated after week 1 that the structure of activities was unclear: "Hard to know where we are in the sprint", "Clarify the aim of the process". During the second week, we paid special attention to reminding where we are in the process, which seemed to help, as there were no such comments on week 2. Anyway, our recommendation for teachers is to be crystal clear about the phase of the process, e.g., having a slide of the whole process, or the day's structure, available when moving from one phase to the next.

To summarize the answer to our second research question, what should teachers pay special attention to in teaching User-Centred Design Sprint, we conclude that these specific points include facilitation of the teamwork, finding a pace for the sprint that serves all students, balancing theory and practice, providing examples outside the course work, reminding students about the structure and phase of the sprint frequently, and, last but not least, facilitating reflection on learning.

7 Limitations and Future Work

Our study shares the same general strengths and weaknesses as any case study in an educational context [9]. In our case, the quantitative data analysis compares two versions of the same course, between which there were many differences in the course structure, teaching facilities, students, some teachers, details of taught content, etc. We were most interested in student feedback on the course structure and content, which we could study by collecting feedback partly with the same methods.

The sample size of 21-23 students in the 2019 data collection can be considered small. However, we see it an adequate number of respondents in constructive education research that develops course content and leans on versatile qualitative data. The quantitative analysis confirmed several statistically significant differences between the two editions of the course. The total number of comments included in the qualitative data analysis was 251 (Retrospective Hand: 88; Key aspects of GDS and UCD: 163), which gave further evidence and reasoning behind the numerical results. However, since the qualitative feedback contains a small number of comments on one topic, we chose not to draw conclusions on the qualitative data between the two course editions.

Naturally, courses should be continuously improved regarding the course structure, content, and practical arrangements. Although some of the negative comments on our course criticise aspects that we cannot easily improve, such as the method characteristics or teamwork dynamics, the feedback collected point at many opportunities to address in the future work. For future research, it would be especially intriguing to study even more integrated UCD and a Design

Sprint, where the Design Sprint would not be a separate module. Since the clear structure of GDS was appreciated by all students, defining a granular, guided and timed structure for the UCD activities would be worth further investigation.

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