

# DESIGNERLY WAYS OF TEACHING AND LEARNING: A COURSE STRUCTURE FOR INTERACTION DESIGN

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## ABSTRACT

*Society's use of increasingly complex information technology is, in a long-term perspective, shaped by the way we train our future designers and developers of information systems. By preparing students for practice on the field, in complex use-contexts, we aim to help student's bridge theory and practice, thereby helping them incorporate procedural knowledge and reflective practice in their skill repertoire. This paper presents a new course structure founded on active, contextual, and peer-based formative learning. Based on student and teacher reflections from two implementations of a course in Interaction Design, we find that our approach enhances the students' understanding, and assimilation, of the reflective aspect of interaction design practice.*

## INTRODUCTION

As Information Systems (IS) – driven by mobile, web, and other technologies – are becoming increasingly integrated in everyday life for many people around the world, the question of how IS academic research and practice can contribute to an emerging digitally interactive society arises. One response to this question is to consider that design, and use, of information technology in society starts in the educational settings where IS design and development are taught. Arguably, this is where the long-term trajectory of future societal IS design and development is set in motion. It is clear that design-related education tend to lack structured ways to help students embrace the core nature of design (Marrin, 2005; Schön, 1984). Design-oriented education needs to resonate with not only declarative academic requirements, but also the procedural craftsmanship and reflective qualities of design practice (Sas, 2006; Wroblewski, 1991).

The question guiding the work presented in this paper is thus: How can we design an effective curriculum suited for teaching and learning information systems design? The contribution is a course framework based on active, contextual, and peer-based formative learning that adheres to designerly ways of thinking (Stolterman, 2008). The framework consists of new structure and content for the course Interaction Design (7.5 credits) given three times per year at undergraduate level. We have given this course according to the new curriculum twice, and continuously performed qualitative evaluations based on written student and teacher reflection essays. We present our initial findings, and discuss their effects on learning and teaching experiences reported in the reflection essays.

The paper is structured as follows: In Section 2 we briefly outline the characteristics of design knowledge and designerly ways of think and act; and the requirements imposed on any education-

al setting claiming to teach it. We also introduce a theoretical reference frame that enables us to investigate our empirical data and answering our research question. In Section 3 the framework is described, and key differences from the previous course structure are highlighted. In Section 4 we present the empirical study and analysis. We conclude with a discussion of the findings in Section 5.

## DESIGN KNOWLEDGE AND LEARNING

Design research has provided the community with several methods and academic ways of framing design problems. Even though teaching and research in IS has been reported as being in a coherent and healthy state (Avison et al., 2001), several scholars (e.g. Stolterman, 2008; Wang, 2010) have recently noted a lack in design-oriented education. Specifically, institutions face a challenge of introducing students to *designerly* ways of knowing, and teaching the craftsmanship aspect of the discipline based in a practice in complex contexts.

There are several ways and nuances to characterizing “design knowledge” (Cross, 2001; Schön, 1984), and the epistemological debate on what underlies design research, practice, and education is far from closed. Indeed, in a larger sense, various design disciplines struggle with how to articulate what design knowledge really is, and exactly how it can contribute. This is, however, not a design theoretical paper. Rather, our contribution lies in aiding IS students to bridge theory and practice, and thereby helping students improve interaction design practice.

The purpose of this section is to emphasize two important qualities of interaction design that we have seen students struggle with previously, and frame our approach in relation to learning perspectives and educational challenges facing instructors teaching Interaction Design.

### Complexity and Context-of-Use

Increasingly, the interaction patterns and touch point integration of IS use over several media and contexts grow more complex (as can be seen in the recent trend towards responsive design, and deployment of services and system versions on versatile platforms). For members of society to

be able to utilize the massive opportunities of digital interactions seamlessly over various platforms, in a myriad of contexts, they need well-designed systems that embrace complexity, but in a non-complicated way. The ability to handle complex design situations is part of a *designerly way* of thinking (Cross, 2001; Buxton 2007; Stolterman, 2008), and lies at the core of being a design practitioner.

As has been argued by Stolterman (2008), traditional HCI design research has relied on science rhetoric when developing new design methods and tools, sometimes at the expense of being guided by the core nature of design practice. And since research and education are intertwined in the university setting it is only natural the academic perspective becomes the focal point in the design education. Interaction design of IS is about creating a desired, and specific, outcome – and is always aiming at a specific context-of-use. A core task for educators in Interaction Design is thus to create and provide learning environments where students can begin to understand how design complexity and context-of-use relate to each other; which leads to the notion of design as practice.

### Practice

Interaction and User Experience Designers are expected to work in the field, carrying out contextual observation and perform interviews as part of task analysis, user goal detection, etc. Even though the practical nature of design has long been acknowledged (e.g. Cross, 1982; 2001; Buxton, 2007; Stolterman, 2008), efficient and effective teaching methods for teaching contextual design practice have not been widely adopted in university curricula. Furthermore, criticisms have been raised against a too abstract and theoretical focus on the interaction design methods developed in academia (Stolterman, 2008; Rogers, 2004). Students struggle with the task of bridging HCI theory with design practice. A typical way for educational institutions to deal with the theory-practice bridging is to let students carry out “practical projects” during courses, expecting them to put theory into practice on their own, with theoretical support from (the comfort of) the university lecture halls. However, in traditional HCI-based academia we as teachers sometimes forget (or perhaps do not even realize) that it is not enough to *talk about*

field work in class. For example, the notion of *praxis chock* (Nilsson, 2008) has been considered in educational ventures of other fields, such as various medical professions, but is rare in the field of IS design and development. The typical way of learning the practice is through design projects, where the work is mostly carried out outside of class, with limited contextual guidance from instructors (Sas, 2006).

In summary: Just as a designer is expected to work “in the wild”, it is reasonable to think that the education itself should take place in the complex use-contexts students are expected to design for.

### Related Theoretical Learning Perspectives

The process of learning has through history been researched and theorized from a wide range of perspectives (James, 1893; Ryle, 1949, Vygotsky, 1978; Leinhardt, McCarthy Young & Merriam, 1995) and can for instance be found in literature for interaction design (Sharp, Rogers & Preece, 2011) or in literature for teaching in higher education (Biggs, 2003). While it is possible to approach the complex learning situation at hand from several theoretical angles, our contribution is based upon three theoretical frameworks on learning and teaching. The theoretical frameworks were chosen based on their suitability to be an appropriate tool to advance the understanding and resolution of our research question. They are:

1. *Declarative and Procedural knowledge.* This division allows us characterize the difference between two basic knowledge types required for craftsmanship as well as academic and scientific work in design.
2. *Zone of proximal development* (Vygotsky, 1978), which allows us to reason about progressing through a developmental trajectory.
3. *Reflection-on-action* allows us to relate to the theory about the possibility to reflect upon recent and occurring problem situations.

### Declarative and Procedural Knowledge

Ryle (1949) points out a distinct difference between the knowledge of “how” and knowing “that” – where “how” is the knowledge learned by practice, rather than by plain theory (“that”). *Procedural* knowledge is often described as “learned by practice” (Leinhardt et al. (1995); Anderson & Lebiere, 1998; Biggs, 2003; Sas, 2006). The knowledge of “that” – or factual knowledge (Anderson & Lebiere, 1998) – is described as *declarative* knowledge (Leinhardt et al., 1995; Biggs, 2003; Sas, 2006). Leinhardt et al. (1995) also characterize declarative knowledge as the professional knowledge acquired in academia. Furthermore, the authors discuss how “*university educators and researchers have tended to ignore or devalue the uncodified knowledge of practice*” (Leinhardt et al., 1995, p 403).

A design-oriented education should acknowledge that the core of the discipline lies in developing both declarative and procedural knowledge (Wang, 2010; Sas 2006). Therefore, we find this distinction useful to frame and examine the learning effects, and teaching aspects, of any design-oriented course.

### Zone of Proximal Developments

The zone of proximal development (ZPD) is defined as “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers” (Vygotsky, 1978, p 86).

The motivation to turn to ZPD is based on previous experience with students that have struggled with crossing the hurdles of performing interviews and contextual observation in practice; even though they can articulate the benefits from a declarative perspective. Our hypothesis is that (the procedural aspects of) this activity lies outside most students’ ZPD, and that they can benefit from appropriate assistance and guiding (“scaffolding”) in order to be able to learn the task.

### Reflection-on-Action

Brockbank and McGill (2007) discuss reflective practice based on Schön’s work (Schön, 1984),

but in a student context. The authors point out the importance of the students' capability to individually reflect upon their actions in a specific situation. Cowan (1998) talks about reflection in a student context and introduces the term "reflection-on-action". This is defined as the reflection students make based on past learning experiences, which they analyze, summarize and make general conclusions about. This can then be used in future situations. While reflection-on-action indeed is crucial in most learning situations, the reflective aspect of design lies in the very core of the discipline (Schön, 1984). Transferring, and maintaining, reflective capacity beyond the educational setting into a design profession is therefore imperative.

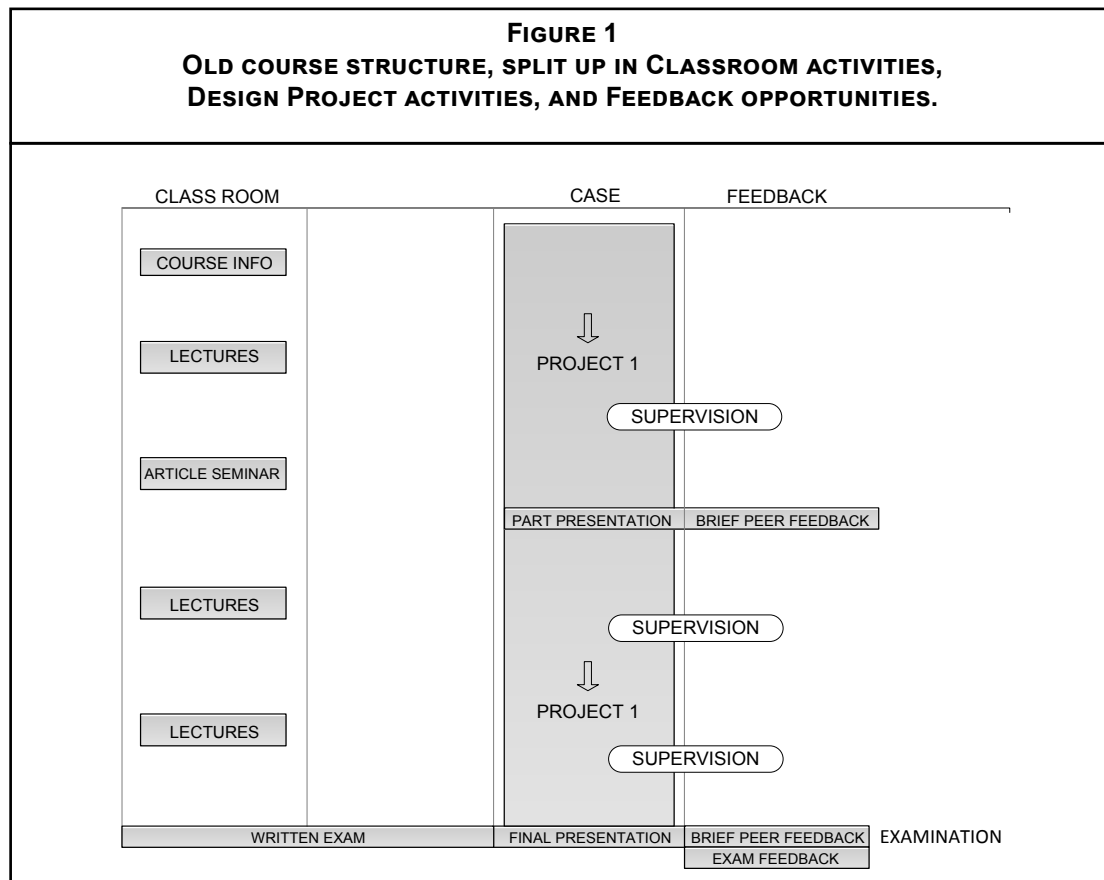
### A FRAMEWORK FOR TEACHING INTERACTION DESIGN

This section covers our main contribution: a course framework for teaching interaction design as both an academic discipline, as well as a craft, preparing students for a design profession.

For reference, we start with a brief outline of the previous structure and content (3.1), before moving on to the key differences in the new course with regards to both structure and content (3.2-3.9).

### Background: The Previous Course Structure

Figure 1 shows the previous course structure. It consisted of traditional classroom lectures, a seminar, one written exam and a design project performed in groups. The group projects were carried out in rather isolated manners. Student groups chose their own systems to evaluate and re-design, with little or no between-group interaction. In the middle of the course, students presented their "half-way status" and had the opportunity to receive teacher as well as peer feedback. The course examination at the end of the course consisted of a written exam and a project presentation and report where teachers and students had the opportunity to provide feedback.



### The New Course Structure at a Glance

Chronologically, the new course structure is segmented into three parts, as shown in Figure 2. These parts correspond to the design phases that students work through in their practical design project. Even though previous version of the course also included a practical design project, the structure, theme, interactions in and between, and implementation of, the projects have been modified significantly. First, the project is actually divided into three sub-projects, with clear deliverables that correspond to the generic design process phases of Research and insight; Conceptualizing and prototyping; and Evaluation and improvement suggestions. Second, common theme ties all the design projects together and makes it possible to share collected research data between projects, and allows for field activities where instructor and students work together in a use context that is relevant for all project groups.

Instead of one exam at the end of the course (Figure 1), we have split the written exam into three parts (Figure 2). These smaller chunks of exam assessment provide three opportunities for fo-

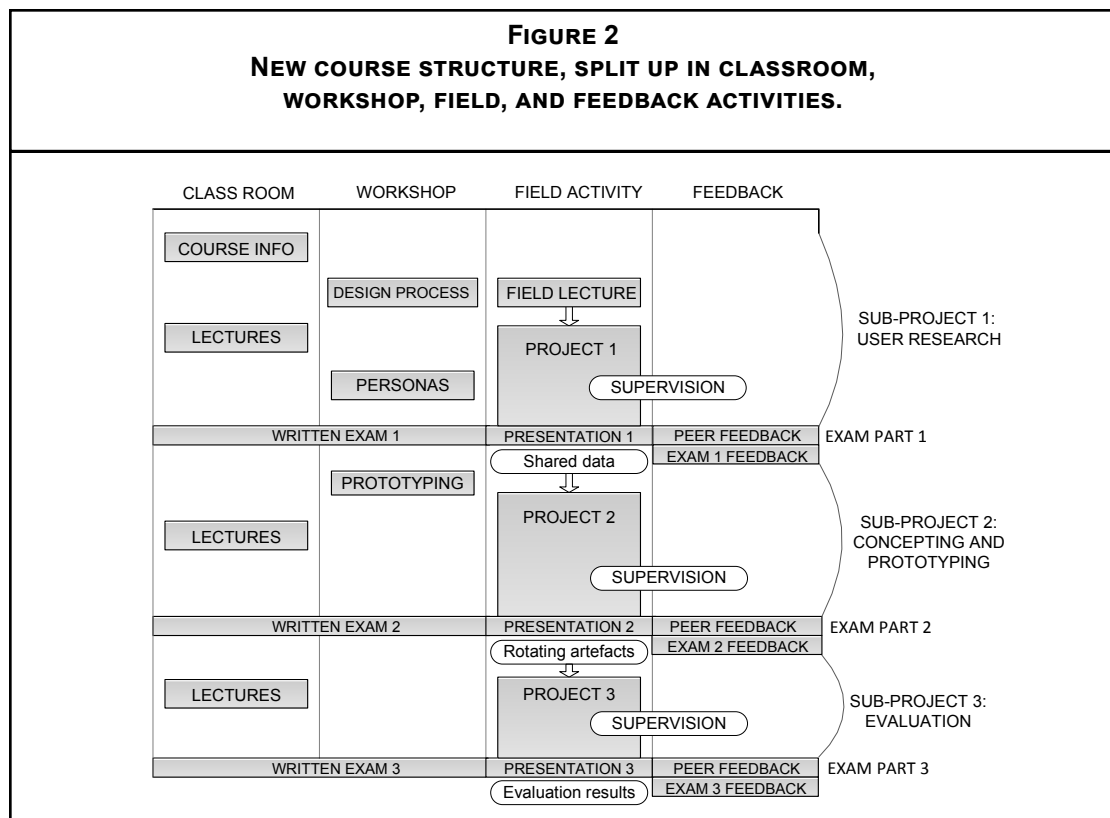
cusd teacher feedback to the students spread out over the course, instead of once (after the course has finished, and covering all aspects of the course in one sitting) as in most traditional course setups. Some topics previously covered in lectures (with an active teacher, and passive students) have transformed into workshops, where the students are active and the teachers re-active.

In the following, we present a more detailed account of the revised course components.

### Theme: Providing a Common Course Context

All design efforts in the course target a context that is common to all projects, and some lectures. The course is currently thematically focused on the public City Library. This means that all student projects are investigating and designing for user experiences connected to the same environment. The theme is introduced in the course introduction, and reinforced by a “field lecture”, given on-site at the library.

The purpose of this field lecture is to guide students in the art of observation. An experienced



instructor helps students identify systems and interactions while touring the library localities. By relating observation techniques to the course literature, and showing students how to actually do it, the students get a gentler introduction to “observation in the wild”, and can ask situated questions that most likely would not pop up if they were to hear about it in a classroom.

Since the library is a public space, we divide the class into groups of less than eight students at a time in order to not disturb. Due to this arrangement we can move smoothly through the library. It does, however, require several sessions in sequence if the course consists of many students.

This is student-driven, active shaping of the learning environment, since students influence what services and artifacts to look at during the tour. Sometimes the interest is centered around a very specific interaction, such as the loaning kiosk screen, or the search interface on the public computers; and sometimes a more holistic question is pondered, such as how do people actually get inspired to find new books while browsing the library, or what accessibility support exists for blind visitors, etc.

## Workshops

The original lecture on the design process is replaced by a workshop where students spend two hours moving through a complete design process. The workshop starts with students taking turns interviewing each other about a given design topic: designing a digital support for travel and vacation. Based on the findings in the interviews, students then rapidly sketching several design directions (at least five design concepts) individually, before presenting and getting feedback from peer. The second half of the workshop consists of reflecting on the feedback, choosing a concept to flesh out, prototyping it on paper, and evaluating the prototype with the peer (mimicking end-user testing). This concept has successfully been used at Stanford’s Design School (Stanford, 2010).

We also provide one workshop on persona generation, where the students spend the time slot building personas based on interviews they carry out with each other. Throughout, students are guided when needed by the instructor in a walking-around fashion.

Finally, the third workshop is about prototyping in different media using various techniques. Students bring empirical data from sub-project 1, personas from Workshop 2, and their initial design ideas. Together with a lecturer design solutions are created in different ways based on different prototype techniques. The lecturer acts more as a design tutor than a lecturer in this workshop – showing, helping and creating together with students.

## Aligning Subprojects to Design Process

As the students have gone through a complete micro design process in the first Workshop (see Section 3.4, and Figure 1), they have received a practically grounded overview of the steps usually found in a design project. These steps are mapped to the three sub-projects, whose deliverables span (1) actionable research insights, (2) interactive prototypes of services or products, and (3) evaluation protocols and suggestions for design refinements.

Sub-project 1 is focused on user research, where students return to the same context introduced by the instructor in the beginning of the course. In our case, the context is the City Library (see Section 3.3). Armed with the experience of being guided through that environment, and having discussed observation techniques with a senior designer, as well as the peer interview sessions in workshops 1 and 2, students carry out observations and interviews in “the wild”, in a real and relevant environment that feeds directly into their projects.

Sub-project 2 is a generative process focused on designing solutions based on the problems that have been identified in sub-project 1. All groups design interactive prototypes based on the empirical data that has been collected.

Sub-project 3 concerns evaluation of the prototypes created in sub-project 3. Typically, this consists of user testing, and standard usability inspection methods such as heuristic evaluation.

## Collectively Owned Research Data

The outcomes of sub-projects 1 and 2 have to fulfill the requirement of “external use”. That is, it has to be in a state that could be useful for

another team. After presenting sub project 1 the ownership of all groups' research data and findings are posted on the course website for all other project groups to use.

We did this for two main reasons: first, it requires the groups to package and present the material in an explicit and actionable manner. Second, it provides the teams with the possibility to enrich their research with additional material from their peers, thereby enhancing the design decision base. By having all projects centered on a common theme, a project groups' data and findings have a high likelihood of being useful to other project groups.

### Presentation Volume

Instead of a halfway status report, we make a point of delivering at three clearly defined points in time (see Figure 2). Design and research findings are the topic of the first presentation. Here, the students' task is to present their findings in a manner that can be utilized directly in the design process of all other teams, should they be so inclined (Section 3.6). The second focus is on presenting a finished prototype based on the research data. This requires another type of presentation technique compared to a research finding presentation. Third, the prototypes resulting from sub project 2 are rotated, so that teams evaluate the usability and user experience of another team's prototype. Presenting evaluation results and giving suggestions for improvements is the topic of the third presentation slot.

This approach gives students training in presenting three different kinds of contributions; it also allows students to follow the other teams' progress closely, and relate to their own throughout the course.

### Tightening the Exam Feedback Loops

By splitting examination and project into three parts, students gain feedback through three stages instead of one as in latter versions of the course. By having examination and project presentations in three parts, students can check and reconcile their knowledge in relation to the course. The advantage is that they can relate to the feedback and use it *in* the course rather than getting feedback, knowledge assessment and awareness *after* the course ends.

This approach allows teachers to use the exam grading process as an in-course learning device more efficiently.

## STUDY

This section presents a summary of student and teacher reflection essays collected after each course regarding the effects of the new interaction design course curriculum on learning and teaching aspects.

### Method

According to Myers (1997) the researcher's impression and reaction are one of many data sources in qualitative research. The method used in this case is based on students' and instructors' written reflections at the end of the course. The study's empirical data currently consists of 9 student reflection essays, and 3 instructor reflections. The student data comprises 8,472 words, with an average of 942 words per essay (median 936 words per essay). Instructor data consists of 3,581 words (average 1,193; median 1,196).

Students were asked to submit personal reflections after all course activities were completed (save for the third examination feedback step; we wanted the students to have the course as fresh in memory as possible and not burden the students with extra assignments when the next period's courses had started). The essays were then analyzed using the affinity diagram technique, where quotes were coded and related to the new structure and content (corresponding to the material in sections 3.3-3.8). This approach allows us to pinpoint assessments of the learning and teaching experiences of the new course features.

### Results

We specifically examined the material for statements regarding the new course framework. That is, positive and negative comments about content and structure changes covered in sections 3.3-3.8. The results are shown in Table 1.

Overall, both student and instructor essays contains positive sentiments on the examined aspects. Only two negative aspects stand out, and they both concern self-reported teacher workload.

<b>TABLE 1.</b>		
<b>TEACHING AND LEARNING ASPECTS RELATED TO THE PRESENTED COURSE FRAMEWORK.</b>		
<b>Framework aspect</b>	<b>Main effects</b>	<b>Sample quote</b>
Common theme & field lecture (3.3)	+ Deepened understanding of the importance and increased insight derived from contextual research. + Low rate of reported praxis chock + Facilitates reflection-on-action. - Long day at the library for the instructor due to having to limit the group size on-site.	“Fieldwork experience at the library was very valuable. Now I understand what the book says about fieldwork.”
Workshops (3.4)	+ Procedural knowledge increase. + Holistic perspective on the complete design process.	“If this stuff would have been covered in a regular lecture, I wouldn’t have learned half as much as I did at the library visits.”
Alignment of sub projects (3.5)	+ Increased understanding of the design process due to workshop and project phases reinforcing each other.	“I felt I was in control of the design process since I had experienced it in workshop. It helped us plan the design project.”
Collective ownership (3.6)	+ Increased understanding of the importance of communicating empirical findings efficiently. + Practice in basing design on research carried out by others.	“It’s easy to forget why we present course work. Now that peers would use it, it made so much sense!”
Presentation volume (3.7)	+ Understanding the value of being able to present research data effectively. + Understanding the value of integrating several research data sources in the design.	“We could follow the other teams’ progress and be inspired by them. We also got continuous feedback on our own projects”
Exam feedback loops (3.8)	+ Less stress and more control; allowing for continuous reflective actions. - Increased teacher effort in grading due to increased number of exams	“Having three exams worked extremely good. It made it easier to focus, and less stressful (even though I ended up reading just as much, if not more)”
<p>Notes:            Plus signs (+) annotate positive effects.            Minus signs (-) annotate negative effects.            Section references explaining the framework aspects are in parenthesis.</p>		

It seems reasonable to infer that the field lecture helped students increase their zone of proximal development, evident in sentiments such as: “Approaching and interviewing strangers is hard. But having the introduction at the library and getting practical tips from the instructor how to do it made

*this easier*”. At the same time, statements related to decreased praxis chock seem to follow with increased ZPD. The theoretical frameworks help identify interesting dynamics of ZPD, procedural knowledge, and praxis chock. There are several examples of reflection-on-action afterwards based



on different situations, that give such insights: “I don’t think there was someone in the group who had considered that we would actually have to talk to strangers. When it was time to conduct the interviews, I think we all experienced a mild panic at first as it was not easy to find on spontaneous follow-up questions that could give us more information about what the respondents liked with our idea. [...] [interviewing] turned out to run smoother later.”

On a different note, we experienced that some students never had visited the city library before. Therefore, we feel that introducing our students to this environment is an added bonus in itself, which chimes in with our overarching mission to provide learning environments for future educated IS designers.

### CONCLUSIONS

Our study shows that students explicitly reflect about design practice. It is encouraging and a sign of success to find several accounts of “a-ha moments”, and eye-openers in the data. The reflection statements have given us indications that contextualized “lectures” have lessened the experience of *praxis chock*, and at the same time allow students to increase their ZPD. The relationship between *praxis chock* and ZPD is an interesting direction for future research, and we find that qualitative analysis of self-reports displaying reflection-on-action is a suitable method for investigating this. Procedural knowledge has balanced the previous focus on declarative knowledge thanks to the workshops. We also found that classroom interactivity and student motivation has increased for each presentation opportunity, and that students feel more secure in their understanding of the required readings due to the tighter examination feedback loops. Furthermore, students display insightful reflections on the importance on packaging and presenting research data. It is not enough to “know” the outcomes of field research—it is just as important to be able to explicitly use data to be able to trace design decisions in the process, and to effectively present research data to other teams (and future clients).

Course restructuring is a never-ending work, so refinements of this approach will be carried out continuously. We also plan to incorporate the successful aspects of this venture into other (de-

sign-oriented) courses at our department. From a knowledge-theoretical stand-point, we believe this work could be developed towards a contribution in answering the question of how design education can evolve and be established more firmly within—and positively affect—the university educational model in general.

Returning to the research question, we have clear indications from both a student and teacher perspective that the suggested course framework seems to result in an effective way to teach interaction design that chimes in with the notion of the reflective practitioner and designerly way of thinking. We feel our approach helps students build a designer identity and purpose. As one student put it: “We actually solve real problems for real people—and not fabricated classroom exercises!”

Immediate next steps include devising and introducing course components focused on ethics and sustainability from a design perspective. With those in place, we believe our future interaction designers are prepared to truly shape our digital and interactive society for the better.

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