Discursive Struggles within Cross-Disciplinary Design

Completed Research Paper

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Abstract

Cross-disciplinary work characterizes information systems (IS) research and practice, including design practice both in industry and design science research (DSR) projects. However, IS research lacks a nuanced understanding of cross-disciplinary design: of its intricacies and challenges. Moreover, IS research, particularly DSR, suffers from a limited conceptualization of design, including cross-disciplinary design. This study utilizes a discourse lens to make sense of cross-disciplinary design in a research project developing a mobile learning application. The study reveals the emergence of a variety of 'designers' who construct future users in various ways and end up in discursive struggle around their conflicting designs. Powerful disciplinary systems and associated discourses are speaking though these designers. Emergence and evolution also feature cross-disciplinary design with oscillation between multi- and interdisciplinary design. The emergent, disciplinarily bounded, evolving, and contested nature of cross-disciplinary design is emphasized in this study with implications for IS and more specifically for DSR research.

Keywords: Cross-disciplinary, multidisciplinary, interdisciplinary, design, discourse

Introduction

This study is set to explore new design issues in Information Systems (IS) research, including Design Science Research (DSR). The significance of design for the discipline and the profession has long been acknowledged. As a research method, DSR has gained momentum during the past decade, inspired by March and Smith (1995) and by decades of previous research (Cross 2001). In particular, DSR has been extensively developed and discussed in IS research (e.g. Hevner 2007, Hevner et al. 2004, Gregor & Hevner 2013, Peffers et al. 2006, Iivari 2007, Sein et al. 2011, Peffers et al. 2018). DSR in IS research connects heavily with the design science model proposed by Cross (2001), which aims to formulate a coherent, rationalized scientific method for design. Cross (2001: 53) summarizes that "design science refers to an explicitly organized, rational, and wholly systematic approach to design; not just the utilization of scientific knowledge of artifacts, but design in some sense as a scientific activity itself". DSR can be characterized by a desire to scientize design—a desire that has emerged several times and been strongly questioned in the past century (Cross 2001). Though IS research proposes diverse and varied interpretations of DSR (see e.g. Peffers et al. 2018, Rai et al. 2017), one can argue that current DSR is nearly void of discussion of the nature of design practice or an empirical understanding of its intricacies. This is surprising, as design practice is at the heart of DSR and as IS researchers have otherwise long engaged in empirical interpretive research to understand the characteristics of design practice in practice (see e.g. Levina 2006, Levina & Vaast 2005, Nandhakumar & Avison 1999, Nandhakumar & Jones 1997, Wang et al. 2016, Weedman 2008).

In this study, the focus is on cross-disciplinary design. The significance of cross-disciplinary work is prevalent in both working life and academic discourse: IS researchers and professionals alike are expected to work in teams of people representing different disciplines and professions, relying on, taking advantage

of, and combining one another's expertise (e.g. Agarwal 2016, Cummings & Kiesler 2003, Farhoomand & Drury 2001, Holland 2003, Lang 2003, Newell & Galliers 2000, Polykarpou & Barrett 2016, Schutz et al. 2009, Tarafdar & Davison 2018). IS research is, in itself, cross-disciplinary, in that it has been influenced and transformed by a number of disciplines over the course of its development (e.g. Agarwal 2016, Farhoomand & Drury 2001, Holland 2003, Hovorka 2010, Tarafdar & Davison 2018). Many complex IS topics (e.g. sustainability, health, innovation, and learning) necessitate a cross-disciplinary approach (e.g. Chu & Lee 2014, Elliot 2011, Le Rouge & De Leo 2010, Schutz et al. 2009, Tarafdar & Davison 2018) – they cannot be comprehensively addressed within a single discipline. It has also already been acknowledged that cross-disciplinary work is challenging, both in research (Cummings & Kiesler 2003, Newell & Galliers 2000) and in design practice (Bergman et al. 2007, Lang 2003, Levina 2006, Schutz et al. 2009). Though studies addressing this topic can be identified, they offer scattered accounts, without shared terminology or explicit and systematic handling of different forms of cross-disciplinary research or design. Even if plenty of research on the variety in cross-disciplinary research exists within other disciplines (e.g. Choi & Pak 2006, Kessel & Rosenfield 2008, Stock & Burton 2011), IS research remains quite ignorant of these discussions. Moreover, scant attention has been devoted to cross-disciplinary *design* in the literature. Additionally, though some prior IS studies have identified challenges of cross-disciplinary work, there is a tendency to paint overly positive pictures of cross-disciplinary endeavors. To develop the practice further, it is necessary to show the actual messy character (Newell & Galliers 2000, Khaled & Ingram 2012).

This study approaches the intricacies of cross-disciplinary design by using a Foucault inspired discourse lens. It is used to examine a cross-disciplinary research project developing a mobile learning application. Foucault inspired discourse lens has been utilized in IS studies also before (e.g. Alvarez 2002, Doolin 1999, Hekkala et al. 2014, Iivari et al. 2015, Sayer & Harvey 1997, Schuff et al. 2010, Stahl et al. 2011, Yetim 2011). Such a lens enables to examine power and politics as intimately interlinked with IS design. The lens also enables to scrutinize underlying issues and factors that are heavily shaping and driving our work, including IS design. This study critically scrutinizes the current state of affairs in cross-disciplinary design and in doing so pays particular attention to complex disciplinary power-knowledge relations. Within this lens, language, discourse, subjectivity and power are central notions. The use of such notions as an analytic lens enables to reveal that design in the case examined entailed a discursive struggle during which a number and versatility of designers emerge, each imposing a particular understanding of the world and of future users. These designers are guided by powerful disciplinary systems, driving their design work and speaking through them. Significant for the IS community, including DSR community, is to acknowledge a variety of epistemologies guiding our design work as well as that it is not necessarily the IS discipline alone who can claim design authority, but other disciplines may enter the scene and strive for such authority, too.

Theoretical framework

Conceptualizing design and cross-disciplinary design

Design can be conceptualized and viewed in different ways. Cross (2001) offers a famous discussion of scientific design, design science, the science of design, and design as a discipline. He argues for viewing design as a discipline in itself: not trying to fit it into the scientific method, but instead aiming to understand it as a rigorous culture of its own. IS research has already witnessed related discussions on the nature of design practice and its relation to the scientific method. As early as the 1980s, Hirschheim and Klein (1989) identified a variety of paradigms underlying systems development and systems development methodologies. Within the paradigm of functionalism, functionally correct and efficient systems are to be built and designers are to act as neutral experts who obtain the objective facts needed for rational decision-making, with managers outlining the development objectives. Within social relativism, on the other hand, reality is seen as socially constructed, and designers are to act as change agents or facilitators, whose cooperation and meaning making with users is necessary. Radical structuralism and neo-humanism, by contrast, are critical, contrasting the management goals of systems design with the goals of the workers and advocating for worker empowerment. In these paradigms, designers are to act as warriors, partisans, emancipators, or social therapists (Hirschheim & Klein 1989). In quite a similar vein, Löwgren (1995) identified different generations of views of design, including one closely related to that advocated by Cross (2001): the structured engineering, participatory, and creative views. Design may be viewed as a structured engineering process in which it is assumed that the problem to be solved can be fully described and known in advance and that the task is to find the solution thorough a rationalistic, objectivistic process (Gasson

2003, Löwgren 1995). Design, then, denotes a structured, rational decision-making process based on objective facts derived from reality by following the scientific method (Gasson 2003, Hirschheim & Klein 1989). On the other hand, one may also view design as a highly participatory process, in which users are to cooperate with designers as equal partners through meanings negotiations, mutual reciprocal learning, and 'design by doing.' This view of design has been particularly advocated within the participatory design tradition (Greenbaum & Kyng 1991, Löwgren 1995). However, design can also be viewed as a highly creative process necessitating invention, imagination, expertise, judgement, meanings making, reflection, and improvisation of professional designers (Löwgren 1995, Löwgren & Stolterman 1999).

In DSR, much of the diversity within design practice has yet to be acknowledged. The structured engineering view seems to dominate, while the participatory view has emerged within the works on action design research (ADR) (Sein et al. 20119), and particularly in participatory ADR (Bilandzic & Venable 2011; Haj-Bolouri et al. 2016). Creative views seem almost absent, if one does not consider the discussion of emergence in action design research to be a seed (see Sein et al. 2011). Iivari and Kuutti (2017) have pointed out that some of the diversity not yet acknowledged in DSR can be nicely illustrated by a framework introduced by Deetz (1996) that includes the distinctions between local/emergent versus elite/a priori and consensus versus dissensus. The distinction between local/emergent and elite/a priori highlight the origins of research ideas; for example, are DSR ideas, requirements and evaluation assumed to emerge locally or are they defined by researchers a priori (Iivari & Kuutti 2017, interpreting Deetz 1996)? The distinction between consensus and dissensus can be interpreted to concern the relation between research, including DSR, and the existing social order: That is, research may rely on 'a dominant set of structurings of knowledge' within organizations, a research community, or society (consensus), or 'work to disrupt these structurings' (dissensus), in which case the researcher aims to challenge the maintenance of order and the domination of people (Iivari & Kuutti 2017, interpreting Deetz 1996: 195). Iivari and Kuutti (2017) point out that DSR tends to represent the elite/a priori and consensus dimension, while ADR and, particularly, participatory ADR can be seen to represent the local/emergent and consensus dimensions. Current DSR, however, is almost void of the critical research tradition: the dissensus dimension remains neglected.

Equipped with these varying views on the design process, which differ in terms of their ontological, epistemological, and ethical assumptions, the present study examines cross-disciplinary design.

In IS research, some studies have already scrutinized cross-disciplinary design. Some explicitly study it and show, for example, that, in cross-disciplinary research, there may be great variety in ways of work and in the ontological, epistemological, and methodological assumptions held by the researchers representing different disciplines (Cummings & Kiesler 2003, Newell & Galliers 2000, Weedman 2008). With respect to cross-disciplinary design, much discussion, sharing, negotiation, and learning may be needed within design teams involving designers representing different disciplines, as there may be mismatches in team members' goals, language, assumptions, practices, and understandings (Bergman et al. 2007, Lang 2003, Levina 2006, Levina & Vaast 2005, Schutz et al. 2009, Weedman 2008). In addition to the few studies explicitly addressing cross-disciplinary design, many studies have examined collaborations among several disciplines without mentioning cross-disciplinary design. These studies, nevertheless, indicate the enduring popularity of cross-disciplinary design as a topic within the discipline. For decades, IS research has highlighted that design is a political and social process involving multiple stakeholders and areas of expertise. Of the parties to be involved in the design process, the importance of users and their participation has been particularly emphasized (see e.g. Cavaye 1995, Markus & Mao 2004). On the other hand, in recent years, it has also been acknowledged that systems design involves not just designers and users, but also numerous other expert groups. Design participants may represent multiple organizations, professions, nationalities, areas of expertise, and disciplines (e.g. Bergman et al. 2007, Gasson 2012, Hekkala & Urquhardt 2013, Levina 2006, Levina & Vaast 2005, Rosenkranz et al. 2014). These studies show, for example, that design may involve marketing, strategy, graphic design, technical and business stakeholders from different organizations (Levina 2006, Levina & Vaast 2005). In these studies, communicating, collaborating, and arriving at shared understandings have appeared challenging (Levina 2006). The concept of boundary objects has been popular in studies scrutinizing design practice involving disciplinary boundaries (e.g. Bergman et al. 2007, Gal et al. 2005, Gasson 2012, Levina & Vaast 2005, Panourgias et al. 2009, Rosenkranz et al. 2014). Although very relevant research, this stream focuses on boundary objects' role in alleviating challenges of cross-disciplinary design, whereas the challenges of cross-disciplinary design practice still deserve a deeper look in IS research. Instead of painting an overly positive picture of such design work or focusing on how challenges can be alleviated with boundary objects, the present paper reveals its messy character.

This paper maintains that there is a blind spot in IS research on cross-disciplinary design: Though studies have addressed it over the years, systematic and fine-grained studies on the intricacies and complexities of cross-disciplinary design are limited. Such studies are specifically needed now, as it has been acknowledged that cooperation across numerous disciplines is required to address the complex challenges facing the IS community today in both research and practice (e.g. on sustainability, health, innovation, and learning) and to create high-value real-world impact (Nunamaker et al. 2017). Detailed examinations of design work are also needed. In IS research, there is a naïve assumption that adopting a designer role and acting as a designer is self-evident and straightforward; however, the present study shows that design work may include extensive positioning and negotiation as well as the emergence of designers representing very different disciplines, all assuming authority in the design process.

Introducing the discourse lens

This study relies the Foucault inspired discourse lens within which language, subjectivity and power are central notions. Language is in a critical position: it is assumed that language does not represent reality but actively produces it. All our prevailing definitions are constructed in language and different languages and different discourses using the same language produce different kinds of definitions and realities. (Hall 1997, Weedon 1987, 2004) Discourses define how we can meaningfully talk about a topic (Hall 1997). They produce the meanings attached to our social reality. They try to disseminate preferred understandings of the world. It is important to acknowledge that meanings are constructed in language to serve particular interests. (Foucault 1972, Weedon 1987) Foucault maintained that discourses need to be seen as assets – 'limited, desirable, useful assets that pose the question of power': 'discourses need to be seen as objects of political struggle' (Foucault 1972: 120). In the analysis of discourses one should always ask: who is speaking, who has the authority to use this language, who is qualified? Who has the right to speak, the ability to understand, access to the statements and the capacity to invest the discourse in decisions, institutions and practices? These rights are limited. (Foucault 1972, 1980)

Subjectivity is another central concept. It refers to the 'individual's sense of herself and her ways of understanding her relation to the world'; it refers to the positions with which we 'structure our sense of ourselves' (Weedon 1987: 32, 33). Humanism assumes that people are 'sovereign, conscious, knowing, intentional individuals'; people are assumed to be 'knowing subjects' who are led by free will, reason, knowledge and experience, and who use language to express meanings (Weedon 2004: 8); hence, subjectivity is assumed to be unified and rational; it is assumed that there is a unique, fixed, coherent essence making people 'what they are.' However, poststructuralism assumes subjectivity to be fragile, contradictory and constantly constructed in discourses. Forms of subjectivity are historically produced and there are always competing forms available. (Hall 1997, Weedon 1987, 2004)

Discourses offer individuals forms of subjectivity through subject positions that must be occupied while participating in discourses (Foucault 1972, 1980, 19, Weedon 1987). Overall, discourses 'make sense the most,' 'become meaningful' and 'have effects' through these subject positions. We become subjects of discourses by 'subjecting ourselves to the discourses.' (Hall 1997: 56) People are continuously persuaded to become subjects in discourses that constitute individuals as 'subjects of certain kind.' Therefore, individuals are both the site and subjects of discursive struggle for their identity (Weedon 1987: 97). However, the persuasion of individuals as subjects is never final, but continuous and open to challenge. People do not only adopt discourses and the subject positions offered in them, but discourses can also be questioned and challenged. Prevailing notions may be contested as well as reproduced. (Weedon 1987, 2004) The subject positions offered may also be resisted, negotiated or even opposed (Hall 1980). However, some discourses are more readily available and more influential than others, while access to some discourses might also be limited to only certain individuals (Foucault 1982, 1980, Weedon 1987, 2004).

This study analyzes the formation of particular kinds of subject positions for users and designers within design discourses. This is done by examining an IT artefact 'in the making'. The analysis concentrates on texts produced during the process, from which subject positions offered for users and designers are identified. The power of the designer in creating these texts is emphasized. Designers engage in as well as produce and reproduce certain kinds design discourses, along with which, particular kinds of subject positions both for designer and users become produced, reproduced, adopted but also potentially negotiated and challenged. (Foucault 1972, Hall 1980, Hall 1997, Weedon 1987) In the case of cross-

disciplinary design, also the design authority may become questioned and discursive struggle emerge. This will be illustrated in the upcoming empirical analysis.

Research design

In the examination of cross-disciplinary design this paper relies on data generated through an interpretive case study (cf. Denzin & Lincoln 2000, Klein & Myers 1999) on a research project developing a mobile learning application designed to serve the learning needs of individual users, learner communities, and classroom practice. The project under scrutiny offers an exciting setting to study cross-disciplinary design: It involves several disciplines and participants from different countries and organizations, including IT companies and research institutions with expertise in IT, human computer interaction (HCI), and educational sciences. In the project, IT, HCI, and educational science specialists all ended up acting as 'designers,' albeit designers of very different kinds. Users were involved, too, though they were not allowed to act as 'designers.' The author of this paper was involved in the project during its preparation and supervised more junior researchers working on the project. Hence, she acted as an 'involved researcher' and, as such, had a direct personal stake in the outcomes and interpretations, while simultaneously getting a direct sense of the field from the inside (cf. Walsham 1995).

As the project is a multinational and cross-disciplinary endeavor, it has relied very heavily on computer support. The project happenings have been extensively captured in documentation produced and distributed. The present study relies on the reading of these texts addressing the development of the IT artifact in question. The empirical analysis concentrates on the design phase of the project. The project participants collaboratively produced the research material that, in this case, comprises the technology development texts created in the project. The material were gathered over the course of a year and a half, including some preparatory time before the project officially started and one year and one month of official project work. The research material includes all the documentation produced in the project during this time. The number of individual files during the initial screening was nearly 2,000. For the purposes of this analysis, the data were restricted to those documents that actually addressed requirements or design, reducing the number of individual files to by analyzed to around 500. These data include official project plans, formal project deliverables (settling the requirements and design), different kinds of memos and informal documents (e.g. sketches, drawings), and email discussions among the project partners addressing requirements and design. The material is particularly suitable for examining cross-disciplinary design, as the documentation has extensively captured the collaborative design work in this project. Whereas each party in this cross-disciplinary and multinational project did complete some independent design work locally, the cross-disciplinary work is captured in the examined texts.

The data analysis proceeded the following way. First, a chronological outline of the project happenings was developed based on the reading of all the texts. As the particular focus was on the construction of subject positions for users and designers, this step identified the main texts related to this topic. Important to note is that, in this project, as usually happens in any technology development project, there was no explicit discussion on the subject positions created for the users and designers; rather, these positions were revealed through the data analysis after the fact. All relevant texts were saved into a single lengthy document (approximately 150 pages with around 200 snippers of text), from which they were placed into separate tables, each relating to one particular influential party taking part in the design process (e.g. HCI specialists, educational science specialists, IT specialists). As these texts were read and categorized during several rounds in a data-driven manner by considering who said what, how, when, where, and why. Early on, the technique of member checking was also utilized: A case study write-up was delivered to the project participants for comments, corrections were made based on their feedback, and some direct citations were removed following the request of a participant.

Afterwards, the discourse lens was utilized to make sense of the data. During the iterative reading of the texts, an understanding of divergent design discourses started to emerge. It became obvious that the participants were engaging in distinct design discourses. For the analysis of these emerging and evolving discourses, the texts were carefully examined from the viewpoint of the ways of speaking about 'users' in relation to each influential party. With regard to these ways of 'speaking about the user,' it was also noted 'what kind of a designer' the speaker was made to be. In this way, the subject positions for the designers were identified from the texts. Each snippet of text was characterized from this perspective, and the discourses started to emerge. The disciplined nature of each discourse also became foregrounded, as did

the negotiation and challenging of the design discourses, which were competing for the power to define the subject positions. Overall, this analysis considered how and what kinds of subject positions were created, but also how these were refined, questioned, and negotiated among and between the parties and how this process evolved. The process was ultimately characterized as a discursive struggle in which designers and disciplines of different kinds were engaged. The analysis also concentrated on disciplinary interactions in more depth. The existing literature on cross-disciplinary research and design was utilized as a sensitizing device, and the dataset was examined again. Traces of both multi- and inter-disciplinary design were located in the evolving process. Occasionally, the different disciplined designers and discourses were contributing in parallel or sequentially to the creation of the subject positions for users, while, at other times, they were addressing this as a shared problem and integrating their contributions (Choi & Pak 2006, Stock & Burton 2011). By examining the process over time, this analysis made visible how heavily disciplinarily bounded the designers' discourses were, but also how evolution and change pictured in their interactions.

Disciplinarily bounded design discourses in cross-disciplinary design

In the following, a set of disciplined design discourses evident within cross-disciplinary design is identified (Table 1). These disciplined discourses shaped and framed the creation and negotiation of subject positions for both future users and designers. Table 1 introduces three design discourses and their associated subject positions created for future users and designers: that is, the discourses configuring and positioning both the speakers and the listeners (i.e. the designers and the users) as 'people of a specific kind.'

Table 1. Three design discourses constituting designers and users in particular ways

Discourse	Designer	User
Educational science discourse: theory driven, constructing the learner	Educational science specialist: authoritative, theory driven producer of the learner – Creating, negotiating, and refining subject positions for future users – Integrating, negotiating, challenging, and ignoring the HCI specialists' contributions	Playful, creative, social, simplicity deserving learner
HCI discourse: empirical user data driven, constructing the user	HCI specialist: authority seeking, user data driven producer of the user; advocate for the user – Creating, negotiating, and refining subject positions for future users – Integrating, negotiating, challenging, and ignoring the educational science specialists' contributions	Familiarity and understandability deserving, clumsy and vulnerable user; an inspiring design participant
IT discourse: technology driven, constructing the user	IT specialist: obedient implementer – Negotiating subject positions for future users – Obediently implementing subject positions created by the HCI specialists	Technology savvy or accustomed user

Table 1. Three design discourses constituting designers and users in particular ways

Next, each identified design discourse in discussed in more depth.

Educational science specialists constructing a multifaceted learner

The educational science specialists were a very influential group in the project: They ideated the entire project and had a major role in defining the requirements for the learning application. When the project started, they took an authoritative position and straightforwardly articulated requirements for the learning application, even if they also extensively invited other parties to comment on the requirements (see Table 2. E1-3). They collaboratively created educational requirements and educational design documents. Their requirements specification and design documents were heavily involved in the theory-driven design of the learning application – this was pointed out by the HCI specialists early on, when they spotted the first signs of potential struggles with design authority between them and the educational science specialists (Table 3.

H1-2). At this point, the educational science specialists admitted their inexperience in IT design and called for help from an HCI specialist (Table 2. E4), who acknowledged the challenges and stepped in to help (Table 3. H3). Nevertheless, the educational science specialists assumed authority to create the theory-based educational design for the learning application: to define what the application would do and how it would behave in relation to the user (Table 2. E5-14).

Overall, the subject positions offered for the learner in the design documentation created by the educational science specialists positioned the learner as playful, creative, and social, but also deserving of guidance and simplicity. In the documentation, play was postulated as an important element to entice users to use the application (Table 2. E5-7). In these texts, back-up was derived from no less than Piaget. Play was also seen as supporting creativity, which the educational scientists saw as another important objective of the application (Table 2. E7-8). Therefore, users were positioned as playful and creative learners who were to be supported in being such and enticed to use the application through connections with these characteristics. Another concern was users' need for support and guidance (Table 2. E9-11). The educational science specialists considered simplicity important and a simple user interface necessary. Users were to be guided through the use of the application and through their learning process. Altogether, the application was to serve simplicity- and guidance-deserving learners in multiple ways. Again, the educational science specialists relied strongly on their theoretical knowledge. They justified their proposed features with scientific references, starting with Vygotsky. Finally, they postulated that collaboration was highly important (Table 2. E12-14). Collaboration was connected to learning and creativity and assumed to contribute to simplicity. Again, scientific references were used to support the choices made. Overall, one can say that in the educational requirements and educational design documents, the educational science specialists forcefully articulated their theory-inspired design discourse on 'design for the learner,' which, along the way, constructed a particular picture of both the learner and designer.

Table 2. Characterizing the educational science specialists' design discourse

	Empirical illustrations
Educational science specialist creating, negotiating and refining subject positions for users	"Attached is a UI design as a PowerPoint show, made by [an educational science specialist] … There are the things pretty much crystallized. […] Maybe these help to clarify the picture of the requirements set for the software." (E1) "Ideas for the functionality of the technology and social contexts are presentable. Now we need the technological boundary conditions" (E2) "Please find the following documents: … Let's discuss these ideas in a meeting. [HCI specialists and educational science specialists], please let us know whether the date & time proposed is OK." (E3) "The project plan was mostly constructed by non-software focused people, who created the entire research idea. We only had some tiny little background experience on developing the [earlier version of the] application. We were not familiar enough what a project like this could bring in front of our eyes." (E4)
Educational science specialist constituting playful, creative, social, simplicity deserving learner	"The general structure of UI should be as simple as possible, in a form of play." (E5) "The games aim at … an enjoyable and playful activity." (E6) "[The application] aims at fostering creativity and expression through play." (E7) "[The application] includes creativity [and] improvisation." (E8) "Text menus are avoided, and iconic menus are used instead." (E9) "Hierarchical decision-making is to be avoided… Every action should be a goal in itself and lead to the next goal in the decision-making chain. More complexity is introduced by gradually extending the previous simple procedures." (E10) "Scaffolding aims to increase the difference between what a learner can do independently and what the same learner can do when tutored (Vygotsky, 1978). (…) The following characteristics of effective tutoring are required …" (E11) "[The application] aims to encourage collaboration of users through cooperative play" (E12) "Collaboration allows users to share cognitive load." (E13)

	"Users will find open workshops, and create new workshops. In the online community, users also learn to share and discuss and help each other at the help desk. There should be discussion, self- and peer-assessment in community" (E14)

Table 2. Characterizing the educational science specialists' design discourse

HCI specialists constructing a multifaceted user and an inspiring design partner

The goal of the HCI specialists' work was to ensure the application's 'user centeredness' and 'usability.' The HCI specialists initially did not assume much authority in the project. They started mainly by commenting on the work done by the educational science specialists (see Table 2. E3). Main source for their comments was their fieldwork with users that they initiated early on (Table 3. H4). Along their fieldwork with users, the HCI specialists also started to construct their user-centered design discourse, which argued for taking users more seriously into account and started challenging some of the educational science specialists designs (Table 3. H5-8). The HCI specialists also collaboratively created two design related deliverables: the usability requirements and usability design documents. In these deliverables, the HCI specialists articulated in authoritative voice how the application should be for users (Table 3. H5, H8). They eventually also quite explicitly questioned the educational science specialists' design authority (Table 3. H1-3, H9).

With regard to the design discourses, one can say that the HCI specialists, less forcefully than the educational science specialists, but nevertheless explicitly, articulated a discourse on 'design for the user' through their texts. This discourse derived its legitimacy not from scientific sources, but from empirical user data generated by the HCI specialists. Although figures like Nielsen, Norman, Shneiderman, and Dourish pictured in the texts crafted by the HCI specialists, their main arguments relied on user data. The subject positions offered for users in these texts positioned users as familiarity- and understandability-deserving, but vulnerable and somewhat clumsy people to be viewed as highly inspiring design partners. Understandability and familiarity were positioned in the HCI specialists' texts as essential, and issues familiar and understandable to users were to be included in the application (Table 3. H10). Users were also positioned as a little bit clumsy and in need of well-designed user interfaces and devices to prevent errors (Table 3. H11). The HCI specialists' arguments were not only based on user data, but also design guidelines emphasizing these issues. Evaluations relying on these foundations were also carried out, and problems reported. Norman (1988) played a role in this discourse (Table 3. H12), as the guidelines were mostly adopted from his work; however, in relation to the full amount of text or emphasis in the documentation, Norman (1988) clearly plays a less prominent role than the famous scholars cited in the educational science specialists' texts. With regard to the vulnerability of users, the HCI specialists also pointed out that users do not necessarily possess sufficient knowledge concerning security or privacy; therefore, special concerns relating to these issues were needed (Table 3. H13). Overall, in these texts, users were positioned as vulnerable and in need of protection and guidance. Here, Dourish, Bellotti, and Fogg, among others, were used to justify the work and the choices made. Then again, the HCI specialists also developed another way of approaching users, portraying them as highly inspiring and creative participants in the design process, working with whom was postulated as a great time (Table 3. H7, H14-15). With this user-centered design discourse, the HCI specialists tried to make the other parties take the users' voices into account.

Table 3. Characterizing the HCI specialists' design discourse

	Empirical illustrations
HCI specialist creating and negotiating subject positions for users	"[Requirements] produce information on what will be implemented, but you do not need to design the user interface… we will produce the user interface design" (H1) "Although well written and certainly worthwhile, the document … is not entirely what I would envisage a software requirements document to be. (…) As the document progresses … the document starts to confuse design solutions with software requirements – many of the requirements are in fact design solutions." (H2) "Hindsight is a wonderful thing, and with hindsight we should not have expected this document to be entirely created by non-SE people." (H3) "I can confirm that we will 1. Be evaluating the old version next week. 2. Be evaluating the device. 3. Be evaluating the scenarios with users to gather their ideas." (H4)

	"Please be informed that we tested [a feature] already with users. It seems like that they do not need that/they are not interested in/they thought they did some mistakes. It was just too confusing thing. That's our opinion." (H5) "When prototyping users didn't quite understand the idea of [a function]." (H6) "I just remind of the attractive users we have "as a team-workers" in the background …" (H7) "Based on our work and testing during the spring house/home was an important and central element … and it should be kept in the main menu." (H8) "We are wondering here together with [a HCI specialist] that why the user interfaces have been made again, and our findings … have been neglected? The project gathered feedback and generated new ideas based on the scenarios produced [by the educational science specialists]. Now it seems that our feedback has been neglected but the work seems to continue from the own scenarios. I would say that we should prefer designs that already have been evaluated with users." (H9)
HCI specialist constituting familiarity and understand-ability deserving, a bit clumsy user and an inspiring design partner	"Use of icons needs special care – they must be understandable to the users, using familiar and recognizable icons wherever possible" (H10) "Users' manner of holding the device could often result in them unintentionally touching the screen, and hence causing errors. This was more noticeable where there is only a small gap between the screen and the edge of the device." (H11) "Ensure a high degree of visibility (allow the user to know what is going on and what he/she can do next). Provide feedback (give continuous clear information about the results of actions). Provide a good conceptual model (allow the user to build up a picture of how the system holds together)…" (H12) "[Users] need to be aware of the potential complex security aspects associated with the device … [Users] need to know what data on the device is special to them and what is being globally held." (H13) "When [users] created their own [application], first by drawing and then by building the prototypes, users were very creative. All had some unique features." (H14) "Thanks to the whole group for today's workshop! We have a well-functioning group! The workshop succeeded very well and users enjoyed (in addition to us)."(H15)

Table 3. Characterizing the HCI specialists' design discourse

IT specialists constructing a technology savvy user

With regard to the creation of subject positions for users, the IT specialists contributed little. They initially mainly commented the proposals of the educational science specialists and identified technological possibilities for the forthcoming application (see Table 2. E2-3, Table 4. D1-2). Based on these possibilities, they proposed some new features for the application and engaged in a technology-savvy discourse on the most recent technological advancements. During the analyzed time period, the IT specialists also created some prototypes for which they considered the work done by the HCI specialists as a very beneficial basis (Table 4. D3-4). They also invited other project partners to comment on these prototypes. (Table 4. D1, 2, 5) Regarding the subject positions for users, the IT specialists only introduced a few design conventions to be considered in the learning application. Their suggestions implied that they viewed users as quite technology-savvy and accustomed to existing solutions and conventions (Table 4. D6-7).

Table 4. Characterizing the IT specialists' design discourse

	Empirical illustrations
IT specialist negotiating subject positions for users	"I have been thinking about this multi touch (or actually multipoint). … I tried this out and I think it works pretty well! …. There is a demo program. (…) Try it out!" (D1) "About effects of (…) icons: [a link]. I just made this video of current implemented situation. Elements (…) are moving all the time. When element is dragged (…) it transforms (slowly and nicely) its original shape and then stops all effects." (D2)

	"[Project MEMO (…) In the meeting the contributions of [Architecture work package] partners was discussed: (…) UI group requirements will be sent later (remark: [a HCI specialist] sent within [Software requirements] writing process), extremely helpful for getting use cases" (D3) "[A HCI specialist's] students have sketched quite detailed design for [the application]. It is based on your scenarios and has been usability tested (paper prototyping). The student group has made magnificent work! … (Just to remind to make sure that you are not doing overlapping work)" (D4) "Hi all. I just uploaded three new videos of [the application]. I would like to hear any comments [a link]" (D5)
IT specialist constituting technology savvy or accustomed user	"It depends whether you expect users to use the device for something else than playing with [the application] only. If they have experience with other applications also, they are familiar with the general user interface style of the device. In that case they do know that the back arrow is on the top-right corner, and will also expect that from [the application]" (D6) "From the left side one opens the menu where one can switch from one program to another, and from the right top corner one can always go back This makes me think that should home symbol be moved to the top right corner? Then it would follow the same principle than other programs of the device." (D7)

Table 4. Characterizing the HCI specialists' design discourse

Cross-disciplinary design: emergent, contested, and evolving

This section discusses the variety and evolution in the ways in which design was performed. A struggle emerged between the disciplined designers and their designs. As the different design discourses and their productions of subject positions for users indicate, various kinds of designers emerged and competed for the authority to define the subject positions for the users, which were constructed to be very different. The experts engaged in negotiations and struggles, resulting in a process that constructed the experts themselves as designers of different kinds. The educational science specialists were the most powerful group of designers, imposing requirements and designs for learning and learners inspired by educational science theories (Table 2. E1-3); however, through their empirical work with users, the HCI specialists started to claim authority to settle the design solution (Table 3. H4-8). The IT specialists remained quite silent throughout the design process. Hence, the negotiation and opposition emerged primarily between the educational science specialists and the HCI specialists (Table 3. H5-9). In this project, the experts representing different disciplines did not have a shared understanding of what was to be included in the requirements and design. The IT and HCI specialists had a shared IT background that gave them a common understanding of these issues (Table 3. H1, 3, Table 4. D3-4), while the educational science specialists had a firm understanding of what the learning application should contain and do, for the integration of which the HCI and IT specialists remained poorly prepared. As for the user interface and interaction design, two partners separately assumed authority to accomplish design and created their design documentation. The HCI specialists and IT specialists noticed that there is a potential risk of this (Table 3. H1-3, H9, Table 4. D4), but they did not to address this risk in due time. These disciplined groups of designers had to negotiate their designs after the fact (Table 3. H5-8).

It was also clear that no clear-cut boundaries could be drawn between different forms of cross-disciplinary design in the project. Many phases can be labeled as parallel or sequential multidisciplinary design, with difficulties in integrating the contributions; however, during some specific phases, interdisciplinary design was identifiable, with different disciplines solving shared problems and integrating their knowledge. The trajectory of the project involved an oscillation between these two forms. The requirements generation phase at the beginning of the project can be characterized by an open attitude towards the ideas and requirements of different parties (Table 2. E2-3), which were addressed in the evolving requirements discussions, even if the educational science specialists were the most active party and provided their contributions in an authoritative tone. However, the more formal requirements specification and design work ended up being a highly disciplined endeavor. From this case, one can identify that the design of the learning application was bounded by powerful disciplinary systems, most notably those of educational

sciences and HCI, with some involvement from software engineering. During the design process, the representatives of these disciplines took responsibility purely for their own design documentation, which was only delivered for others to view near the end. The educational science theories and learning focus on one hand, and the strong emphasis on user studies and usability in HCI on the other hand, led the designers representing these disciplines to create two overlapping and conflicting designs for the learning application. Both designs described the user interface and user interaction with the system but were driven by different epistemologies; the designers clearly had divergent views on what constituted a good basis for design: theory or data. Neither party considered integrating their work with the other party during the process; instead, integration was only considered when finalizing the deliverable. Both parties seemingly assumed that they had the authority to settle the design and, therefore, did not consider it necessary to collaborate. Furthermore, the designs were scheduled to be delivered at the same time, which hindered their integration even further. Software requirements specification formed an exception to this trajectory – it was expected to be produced by the educational science specialists, but it appeared that all parties needed to contribute to this work and eventually, this led to a highly collaborative process involving contributions from different disciplines, most notably from HCI (Table 2. E4, Table 3. H2-3).

Discussion

Based on the empirical results and the discourse lens, the article proposes a novel conceptualization of (cross-disciplinary) design, highlighting its emergent, evolving, contested and disciplinarily bounded nature (see also Figure 1). Implications of the conceptualization are discussed for IS research and practice.

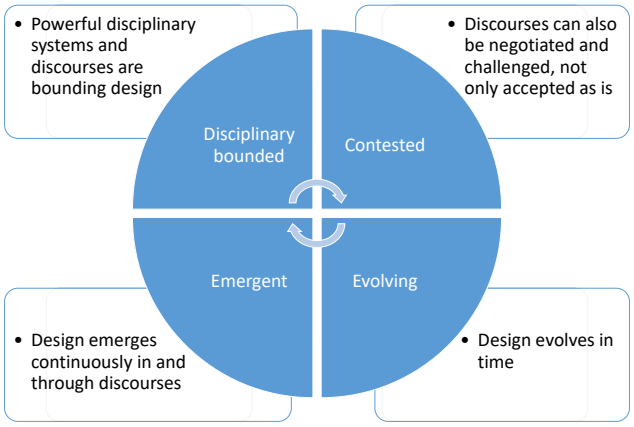

Figure 1. Conceptualizing (Cross-Disciplinary) Design

Emergent: The discourse lens emphasizes that discourses are continuously produced and reproduced in an emergent design process. Subject positions both for users and designers emerge along the way. The discourses position, regulate, and transform both the designers and the future users. Also in DSR and ADR, design and designer identities should be seen as emergent; that is, they are not static, fixed categories in the world, but are instead produced and reproduced during design. Even if the emergent nature of design has already been stressed in ADR (e.g. Sein et al. 2011), the emergence of discourses and designer and user positions remains unaddressed. This study showed the emergence of various kinds of discourses shaping design as well as considerable variety in how designers and users were positioned along the way. The educational science specialists produced the learner as a very multi-faceted one: playful, creative, and social, but also deserving simplicity. The application supported learning activities with such qualities. The HCI specialists also constructed the user as multi-dimensional one: as an inspiring participant in the design process as well as an understandability and familiarity deserving, a bit clumsy and vulnerable person. The

IT specialists also constructed the user, positioning users as technology-savvy through their emphasis on the design conventions and cutting-edge technological innovations. At the same time, the discourse lens also emphasizes that designers are given, adopt, produce, and reproduce particular kinds of subject positions during the design process and this study showed the adoption of various kinds of designer subject positions, be they authoritative and theory-driven, authority-seeking and user data-driven, or neutral if not even obedient implementers without no passion to define the user. Such discourses and designer positions significantly shape how both design and evaluation ended up in being executed. This emergence of variety of discourses and designer positions is DSR, also in ADR, remains yet to be addressed.

Disciplinarily bounded: Various kinds of discourses may circulate around and speak through designers, and the design may be shaped by powerful disciplinary systems. The concept of disciplinary bounding (cf. Larsson & Wisselgren 2006) is used in the design context to refer to certain disciplines adopting design as a legitimate area of expertise to which particular ontological, epistemological, methodological, and ethical assumptions are attached (cf. Choi & Pak 2006, Cummings & Kiesler 2003, Newell & Galliers 2000, Stock & Burton 2011, Iivari 1991). Such disciplines define the nature of design and determine what is to be considered valid knowledge and, possibly, what are to be considered acceptable goals. This study emphasized the role of three disciplinary systems in shaping and speaking through the designers. Both HCI and educational science emerged as highly influential disciplines, while software engineering also had some legitimacy. The HCI specialists contributed with their empirical user data, while the educational science specialists relied on their theoretical knowledge about learning and development. Overall, it is emphasized that design cannot be seen as discipline-free or unrestricted; rather, it is heavily shaped by history and tradition. So far, this issue has remained unexplored in IS research, including DSR and ADR. IS research should now both acknowledge the significance of this and explicate the ways in which design in IS is disciplinarily bounded: IS education as well as DSR and ADR researchers should critically reflect on the disciplined nature of design in IS and try to characterize and compare it with other design disciplines.

Contested: The discourse lens also emphasizes the contested nature of design: Discourses are not only adopted and reproduced, but continuously produced, negotiated, and challenged—and, as a consequence, divergent subject positions for users and designers are created, adopted, negotiated, and challenged. In IS research generally, the conflictual, power-laden nature of the design process has been acknowledged for decades; however, this perspective has yet to be explored in DSR. Even if ADR emphasizes emergence and the roles of both users and designers shaping design (e.g. Sein et al. 2011), the contested nature of design and the variety of designers struggling for design authority remains unaddressed. In this study, both the educational science specialists and the HCI specialists positioned themselves as the ones who knew what was 'good for the human being'—the user/learner—and claimed authority to settle subject positions in the IT artefact. The main battle was between the disciplines of educational science and HCI and between theory and user data. One can say that similarly to the medical discourse in Foucault's accounts, the HCI and educational science discourses were attributing status to certain people in the project (for HCI and educational science specialists similarly to doctors in Foucault's work). Hence, certain individuals became privileged and exclusive enunciators of the discourses, having authority over the associated knowledge as a form of power, these discourses resulting in the definition of subject positions for users to adopt in the forthcoming application (cf. Foucault 1972, 1980, Hall 1997). Unlike in Foucault's case, however, this case involved no one authoritative discourse; instead, a discursive struggle emerged. Interestingly, as there was no predefined, unquestioned authority allowed for one particular discourse or discipline, the experts had to negotiate it, showing that discourses can indeed be questioned and challenged, not only accepted as is (Weedon 1987, 2004). The HCI specialists' strategy was to rely upon their users. They referred frequently to their empirical findings to give legitimacy to their design decisions. One could say that they needed their users to need them (cf. Finken 2005): That is, they used their users to legitimate their design decisions, along with figures such as Nielsen, Norman, Shneiderman, and Dourish. In a sense, these figures were thrown into a battle with scholars such as Piaget and Vygotsky, who were used by the educational science specialists to support their design decisions. The main battle, however, was not between these scholars, but between educational science theory and user data.

Evolving: The study also highlights that design is an evolving phenomenon. In time there may emerge different kinds of design discourses and they may change. In IS research, evolvement of IS design over time is yet to be acknowledged. It should be realized that IS design is not a static or fixed phenomenon; rather, its trajectories need to be appreciated and followed in time. Again, ADR stresses the evolving nature of design (Sein et al. 2011), while the focus is rather on evolving IT artifact than on evolving design process

and designer positions. In this study, the evolution of the design process in time became most clearly visible when examining the nature of cross-disciplinary design, as there was constant oscillation between multi- and inter-disciplinary design.

This analysis corroborates existing findings on the complex, conflictual nature of cross-disciplinary work (Bergman et al. 2007, Cummings & Kiesler 2003, Lang 2003, Levina & Vaast 2005, Newell & Galliers 2000, Schutz et al. 2009), while also introducing new insights. This study shows to the IS community that it is not necessarily obvious who gets to act as a designer and how design is accomplished in cross-disciplinary design. There may be several experts striving for the position and multiple powerful disciplinary systems at play, speaking through the designers and imposing particular understandings of the world. For IS research, it is important to acknowledge these power dynamics. Through the Foucauldian lens, IS researchers are invited to critically consider what kinds of disciplines and discourses are involved, accepted, and according status to certain positions in cross-disciplinary design; who are allowed to act as enunciators of these discourses; and who are allowed authority to invest the discourses in decisions and practices (cf. Foucault 1972, 1980, Hall 1997). Then again, it is equally important to acknowledge that discourses can also be questioned and challenged (Weedon 1987, 2004), keeping still in mind that some discourses are more readily available and influential than others and that access to some discourses might be limited to only few individuals (Foucault 1982, 1980, Weedon 1987, 2004). Any design process may entail complicated power dynamics, but these are especially likely to appear in cross-disciplinary cases.

IS research should become more aware of the different forms of cross-disciplinary design. Though there is a body of knowledge addressing the differences and challenges of multi-, inter-, and transdisciplinary work produced within other disciplines (e.g. Choi & Pak 2006, Kessel & Rosenfield 2008, Stock & Burton 2011), IS research seems quite ignorant of these issues. Awareness is needed to make informed choices on which form to pursue; whether simple parallel or sequential multidisciplinary work is enough; whether reciprocity, shared problem solving, and integration of knowledge are required; or whether the ambitious aim should be to transcend disciplinary boundaries and transform the involved disciplines. Then again, this study also wishes to warn that whatever choice is made, the outcome might be something different, as the boundaries between different forms of cross-disciplinary design are not fixed, but evolve in time. Due to various circumstances, developments, and drawbacks, design work may switch from multidisciplinary to interdisciplinary or vice versa. Disciplinary bounding and the evolution of design work are likely to take place in any cross-disciplinary design endeavor. Thus, the goal should not be to eliminate these phenomena, but to understand and possibly explicate them and their consequences early in the design process. Disciplinary bounding is potentially even beneficial for multi-, inter-, and transdisciplinary design; the involved disciplines should simply be better prepared to coordinate their work and appreciate one another's input. Organizing and facilitating such design work may well be interpreted as the task and duty of IS researchers and designers, as they have been positioned as facilitators in the design process overall, arranging conditions for meaningful participation of others (e.g. Markus & Mao 2003). Based on the results of this study, IS researchers are also encouraged to critically reflect on the disciplinary backgrounds and positionings shaping IS design, as this will form a valuable reflective starting point for IS researchers examining, engaging in, or facilitating cross-disciplinary design and research.

This study shows that it is not necessarily obvious who gets to cater for users' needs in design – the extensive IS literature on user participation seems unaware of this challenge (e.g. Markus & Mao 2003). This study shows designers representing different disciplines assumed the authority to cater for users' needs. All tried to serve the learner-user the way they saw best, guided by their disciplines. It was interesting that it was not the IT specialists with whom the HCI and educational science specialists fought to cater for users' needs, but the representatives of the 'soft side' ended up fighting against each other. The educational science specialists' discourse was strong and expected to overrule any other concerns: In their view, the project was to support learning in a playful, creative, simple, and social way, and certain use concerns were ignored to ensure learning with such qualities. On the other side, the HCI specialists were unaware that there was such an authoritative designer group ready to define the user; instead, they assumed they had this authority.

This study makes visible the variety of ontological and epistemological assumptions that may be involved both in design of innovative IT artifacts and in their evaluation, including in DSR and ADR. Interestingly, in this case, the educational science specialists came closest to traditional DSR in the sense of being strongly guided and inspired by educational science theory in their design, while also acknowledging evaluation with practitioners, i.e. learners (cf. Hevner et al. 2004). They relied on the elite/a priori design orientation (Iivari

& Kuutti 2017), assuming theories are to a priori guide design, but evaluation afterwards is also required to see how well the artifact performs (e.g. Hevner et al. 2004). The HCI specialists, then again, were strongly committed to the local/emergent design orientation (Iivari & Kuutti 2017) and the participatory view of design, which prioritizes users' participation and influence in design and evaluation (cf. Löwgren 1995, Löwgren & Stolterman 1999; Greenbaum & Kyng 1991, acknowledged also to an extent in ADR, see Sein et al. 2011, particularly in participatory ADR, see Bilandzic & Venable 2011, Haj-Bolouri et al. 2016). Hence, they assumed design ideas and feedback emerge and evolve in an iterative, collaborative process with users. adhering to the principles of reciprocal shaping, guided emergence, mutually influential roles and authentic and concurrent evaluation (Sein et al. 2011). Overall, this study indicates alternatives to the existing genres in DSR (Peffers et al. 2018). Even if this case was missing the creative view of design (Löwgren 1995, Löwgren & Stolterman 1999), also it could open interesting avenues to develop the DSR or ADR design practice further: The creative view celebrates the artistic nature of design instead of trying to 'scientize' it (Cross 2001). Then, the goals could emphasize, e.g., aesthetics (cf. Baskerville et al. 2018). The DSR or ADR design practice could also be developed to pursue dissensus, challenging of the status quo, and the liberation of the oppressed (Iivari & Kuutti 2017, based on Deetz 1996, see also Greenbaum & Kyng 1991, Hirschheim & Klein 1989). Again, no such orientation was found in this empirical case. From the perspective of participatory design, one can criticize even the HCI specialists' discourse as not truly aiming to empower users, as users were never invited to participate in the design process with power of decision concerning design. Instead, they were only allowed to act as providers of information and evaluators of design solutions. This could be strongly criticized by the Scandinavia-originated participatory design tradition (Greenbaum & Kyng 1991). DSR and ADR along the lines of the critical tradition is warmly welcomed.

The study suggests that IS designers as well as DSR and ADR practitioners should critically reflect on what kinds of subjects they make users to be as well as on what kinds of subjects they themselves end up being during the design process. It should be useful to approach design from this novel angle and to reflect on the discourses, practices, and values that shape the design process. IS designers as well as DSR and ADR practitioners should acknowledge that they are not making their design decisions based purely on neutral and objective goals and facts, or even on their personal values and interests; rather, they may be channeling powerful disciplinary systems and discourses. In addition, they could reflect on their own design practice and on the contestation and evolution therein. Project management explicitly acknowledging this nature of design practice and corresponding reflections could also be very beneficial. Management practices definitely can shape the discourses and the emergence and evolution around them, while important is also to note that project managers can never settle or fix the discourses. However, they can start explicitly addressing them and their implications. Especially in a cross-disciplinary design teams, early reflection on disciplinary backgrounds and positionings and associated discourses would be highly valuable. IS education could also more explicitly address the challenges involved in cross-disciplinary design and start educating future designers to be prepared to collaborate with a multitude of disciplines in design work—and potentially to even be prepared to organize and facilitate such design work, not only with users, but also with a number of different kinds of experts with differing disciplinary (and other) backgrounds.

Conclusions

This study examined cross-disciplinary design through a discourse lens. The study contributes by offering a novel conceptualization of (cross-disciplinary) design through and by revealing variety and power related challenges involved within cross-disciplinary design. The study showed an emergence of a variety of 'designers' who constructed future users in various ways and ended up in discursive struggles around their conflicting designs and around design authority. Powerful disciplinary systems and associated discourses were speaking though these designers, positioning also them in various ways. Emergence and evolution also featured this cross-disciplinary design case, with oscillation between multi- and interdisciplinary design. In some situations, design was highly disciplinarily bounded and executed in silos with little attempt to integrate with others' contributions, while in others, the designers gathered together for a task to which they all contributed, building on one another's expertise. These findings provide valuable insights for DSR and ADR on the variety and complexities involved in (cross-disciplinary) design.

As for the limitations of this study, important is to note that the project in question is specific in many respects and hence the results cannot be generalized to all cross-disciplinary projects in the world. In projects with different disciplines involved, with differing personalities, preferences and experiences among

designers or with alternative types of technology under development, for example, different results likely appear: divergent discourses and subject positions emerge and become adopted, differing kinds of struggles are ended up with, diverse design trajectories evolve. However, very likely the emergent, evolving, contested and disciplinarily bounded nature of the design process prevails. Particularly the disciplinary bounding and divergent design discourses are relevant to focus upon in all cross-disciplinary design cases. Future research is needed for scrutinizing other cross-disciplinary design projects for deepening our understanding of their nature and challenges. In this case, the discursive struggles centered around design authority and authority to cater for users' needs. In other cross-disciplinary projects, other topics likely appear.

The results presented in this article are based on the project's first year of functioning. More data should be gathered from the project to see what subject positions eventually end up being realized and distributed to the world. It would also be interesting to examine how users see and interpret them. Users may interpret and appropriate IT artifacts in ways not intended by designers, even if the natural and obvious subject positions available are quite powerful. Then again, users' encounters with artifacts also involve new productions of meanings – people are able to negotiate or oppose the subject positions, not only to adopt them (Weedon 1987). Examining the dynamics involved in adopting, negotiating, and opposing the subject positions embedded in this learning application would be very interesting.

This study, like others, emphasizes the significance of cross-disciplinary research and design practice for the future. As has been acknowledged, many complex IS topics necessitate cross-disciplinary approach. While the relevance of such approaches has been acknowledged, our understanding of the intricacies and challenges involved is still limited. This study makes visible many potential challenges, showing that interdisciplinary and, especially, transdisciplinary design are difficult to achieve in practice. When aiming to work in an integrative manner, with reciprocal actions among different disciplines, or even to transcend disciplinary boundaries and transforming the involved disciplines (Choi & Pak 2006, Stock & Burton 2011), problems can be expected. This study opened the path for future studies in this area. Future work may develop specific means and tools for avoiding or mitigating the challenges, such as encouraging more explicit discussion and reflection on the basic assumptions of the different disciplines involved in design.

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