MAKING USE OF ARTEFACTS IN DESIGN PRACTICE

Christoph Richter & Heidrun Allert, Christian-Albrechts-Universität zu Kiel, Germany

Introduction

The importance of shared artefacts as a means to create common understanding, to ground discourse and to pursue novel ideas has been widely acknowledged both in the fields of design (e.g. Bertelsen, 2000; Schmidt & Wagner, 2002; Vyas, Heylen, Nijholt, van der Veer, 2009) as well as the learning sciences (e.g. Bereiter, 2002; Stahl, 2006; Paavola & Hakkarainen, 2009). Despite the general interest in the role of artefacts in processes of collaborative design and learning, there is no consensus on the extent and ways artefacts actually affect respective practices. It appears obvious that artefacts such as sketches, mock-ups, scale drawings, or requirements specifications might support but also constrain certain forms of collaboration. Yet, do they actually prescribe certain practices, do they have politics (e.g. Henderson, 1998)? And how do answers to these questions affect our understanding of competent use of such artefacts?

In this paper we argue that both instrumentalist as well as socio-constructivist conceptualizations of shared artefacts fall short to account for the situated and inherently transformative nature of collaborative practice and that they are hardly able to provide for the multiplicity of functions a given artefact might fulfil in the course of a collaborative design or learning process. Adopting a practice-oriented perspective (esp. Orlikowski, 2000; Hörning, 2001, 2004) we understand artefacts and their utilization to co-evolve with the unfolding local practices. Rather than seeing the use of artefacts being primarily shaped by objective properties or social structures inscribed to the artefacts and the environment, a practice-oriented perspective builds on the proactive interpretation of the situation by the participants. Trying to overcome a techno-deterministic understanding of artefact-mediated social practice, we hope to be able to provide a clearer view on the complexities of professional practice as well as programs aimed to educate future practitioners.

Towards this end we contrast rationalist and socio-constructivist notions of artefacts with a practice-oriented perspective. To ground our position we will then follow a group of seven bachelor students trying to make productive use of a set of artefacts in order to design a web-based platform for the presentation and collective use of learning materials across four professional schools. The study was carried out as part of the KP-Lab project (2006-2011) an EC funded Integrated Project aimed at facilitating innovative knowledge practices (see www.kp-lab.org). In contrast to previous analyses of this case the focus of the subsequent discussion will be on the students' framing of the situation they find themselves in and their use of core design artefacts to achieve an agreement on the project's objectives. The paper closes with a discussion of the consequences for the analysis of collaborative practice and an outline of educational implications.

A Practice-Oriented Perspective on the Use of Artefacts

The importance of design artefacts, i.e. those objects, such as sketches, diagrams, prototypes, that are created and used in order to design something (cf. Bertelsen, 2000) has been stressed by various authors and even declared a constitutive element of the design process (e.g. Goldschmid & Porter (ed.), 2004; Visser, 2006). Yet, design artefacts and their utilization has been conceptualized quite differently. While those adopting a rationalist or functionalist perspective basically understand artefacts as objectively given means to achieve certain ends (e.g. Zigurs & Buckland, 1998), those promoting a socio-constructivist perspective emphasize that artefacts inevitably shape the relations between those involved in the design process and the group's culture, facilitating and restricting certain forms of interaction (e.g. Henderson, 1998). Our main concern with these conceptions is that both of them easily boil down into a form of techno-determinism, even though on somewhat different grounds. In a nutshell, while the rationalist or functionalist perspective implies that there is one best way to deal with a given task (incl. the artefacts to be used), the socio-constructivist perspective suggests that the designer's actions are constrained by the structures or politics built into the artefacts. In both cases the user is assumed to appropriate the capacities or structures, build in or inscribed to artefacts to make proper use of it. While proponents of both perspectives acknowledge that the actual use of artefacts often differs from the designers' intentions, this is either attributed to the "bounded rationality" of the user (cf. Simon, 1969) or limitations in the designer's capability to account for all perspectives and possible usage scenarios. Both, the idea that the utility of artefacts is a function of its objective properties as well as the idea of social structures "embodied" in the artefacts seem to block sight for the creative, transformative, and even subversive dimension of human activity. The perspective outlined in the following instead maintains that the instrumental qualities of artefacts and their use only emerge in the course of enfolding human action.

Theories of social practice form a family of theories rather than providing a unified framework (e.g. Reckwitz, 2002). The practice-oriented perspective we sketch here builds on a pragmatist notion of human action as developed by Hörning (2001, 2004) but also on the work of Orlikowski (2000) who draws on Giddens' (1984) theory of structuration. We assume a pragmatist notion of human action to be a useful starting-point as it aligns with Schön's (1982) conception of design as a practice but also shares the understanding of activity theory that artefacts mediate but do not prescribe human action (e.g. Bertelsen, 2000).

Adopting a pragmatist stance, the practice-oriented perspective departs from teleological models, that assume human actions to be guided by antecedent intentions or goals, but posits that intentions and goals are only formed in the course of action itself (cf. Hörning, 2004). Human action in this perspective is not a sequence of self-contained acts realizing preconceived plans but an on-going process in which the actor actively responds to the situations s/he finds him-/herself in. Competent action in this sense entails both an adaption of the individual to the environment s/he is acting in, giving rise to habits and routine ways of doing things, but also procedures that allow the actor to cope with situations in which established habits do not work. While habits and routines work out well in many cases, situations can also be inherently doubtful, requiring the actor to reflect and develop a new understanding to cope with them (cf. Miettinen, 2000). Social practices, from this perspective, are neither an accumulation nor abstraction of individual acts, but those patterns and styles of action that emerge from repeated interaction allowing the participants to form shared expectations on how to act in a certain situation (cf.

Hörning, 2001). Social practices hence can be understood as the conventions enacted by a certain group of people at a certain point in time. Actions and practices are recursively coupled in the sense that each action is shaped by but also constitutes to the respective patterns and styles of action (cf. Schatzki, 1996; Hörning, 2001). Yet, as emphasized by Hörning (2004), it would be too narrowly considered to focus on the stabilizing and repetitive aspects of social practice, as stabilization requires a constant environment. Changing situations and social constellations hence might make existing practices break and require their adaption or the development of entirely new ones.

Furthermore, as situations are often open to different interpretations they require an active framing of those engaged in them. Enacting a social practice therefore requires both practical knowledge, but also knowledge about the frames, the overarching schemes that allow actors to interpret and define the situation they find themselves in (cf. Hörning, 2004). The practical know-how as well as the interpretive schemes or frames can be understood as repertories the actors use to cope with the situations they are facing.

In a practice-oriented perspective activities are mediated by artefacts, i.e. the actors produce and make use of things to transform the environment and situation they are acting in. As the action itself, the utilization of artefacts is both shaped by but also constitutive for the respective practices. Blackboards are not just used in the classroom, they are also entailed in the respective practices of teaching and learning. In contrast to socio-constructive perspectives, the practice-oriented perspective holds, that even though artefacts and their use is shaped by social practice, artefacts do not prescribe their use (Hörning, 2001). Following a similar line of reasoning Orlikowski (2000) suggests to make an analytic distinction between *technology-as-artefact* and *technology-in-practice*. While the technological artefact constitutes *"the bundle of material and symbol properties packaged in some socially recognizable form, e.g., hardware, software, techniques"*, technology-in-practice refers *"to the specific structure routinely enacted as we use the specific machine, technique, appliance, device, or gadget in recurrent ways in our everyday situated activities"* (Orlikowski, 2000, p. 408). Or to put it differently, human actions are not mediated by artefacts per se, but by particular artefacts in conjunction with respective utilization schemes. The utilization schemes are not inscribed in the artefacts but co-evolve within actual use (see Béguin and Rabardel, 2000 for a similar account).

Case Study: Context, Educational Setting and Method

To ground the practice-oriented perspective, we trace the collaborative moves and actions of a project team trying to reach an agreement of the projects' objectives with an external client. The team of students, we followed over a period of 18 weeks, was enrolled in a course titled "media production project". The "media production project" is a second-year project-based course in the bachelor program "Communication and Knowledge Media" at the University of Applied Sciences Upper Austria. It is a project-based course typical for design and engineering education, in which groups of 6-8 students have to develop a concrete product (e.g. a web-application) for a client. Each group is assigned a supervisor who coaches the team. The "media production project" is accompanied by a compulsory course on project- and quality-management and students have access to several internal experts, which they can consult for project purposes. Throughout the course students have to get in touch with the client, negotiate project objectives, elicit requirements, envision, implement and deliver a

design solution and co-ordinate their activities internally as well as with the client. According to the curriculum, the pedagogical goal of the student projects is to solve an assignment by drawing on the theoretical and methodological knowledge taught in preceding courses. Furthermore, the course is aimed to develop project management skills and collaborative competencies. The students' work is supposed to cover the entire project lifecycle, including problem definition, requirements analysis, conceptual design, implementation as well as evaluation and delivery. Models for project management and engineering (cp. Mayr, 2005) as well as project management documents, such as specifications, work plans, and reports are intended to scaffold the work process.

The data collected in this case study includes video recordings and transcripts of all team meetings and meetings with the client (12 meetings in total), emails exchanged between students and the supervisor, log-files of the web-based project management tool, documents produced within the project (e.g. design documents, meeting minutes), as well as retrospective interviews with all participants. While the study was originally intended to explore social mechanism that might foster or hinder knowledge creation processes, the data has been reanalysed for this paper with a focus on the use of artefacts in the early stages of the project. The analysis covers the five weeks until the requirements for the product were fixed and approved by the client. Transcripts of the meetings together with the design documents have been analysed qualitatively in order to identify critical moves and events with regard to the analysis of the design problem and the development of requirements. Additionally, teaching-materials from the accompanying course on project and quality management have been used to benchmark student's practices.

Findings: the Students Moves and Actions

The focus of the following section is on the moves and actions the students, their supervisor and a client took to arrive at an agreement on the requirements and specifications for an online platform to support the exchange and collaborative development of learning materials across a cluster of four vocational schools in a province of Austria. In this phase, which covers 2 meetings with the client and 3 internal meetings, the students create and make use of three main design artefacts, the product requirements document, a diagrammatic representation of the structure of the online platform and static interface mock-ups.

The team commences its work on the project in a first meeting with the supervisor. Besides general housekeeping issues, the meeting is focused on the preparation for the kick-off meeting with the client to take place the coming week. The students and the supervisor discuss about the information they would like to get from the client to understand the project's objective and to devise a project plan. While some questions are directed towards the client's wishes and expectations as well as the situation that gave rise to the project, the students also raise a lot of questions on issues like server administration, system requirements, and rights management. The client is expected to provide the team with the respective information. This expectation is backed up in the summary given by the supervisor.

Supervisor :   *…in the next meeting [the kick-off meeting] we should discuss with the client that we get as soon as possible the requirement analysis from them, so that we really can start, that we can create the project plan. That we can see, whether they will provide the product requirements document and we add to it or if we will have to write it … so that we*

can define the milestones and decide upon the system and start with the implementation and conceptualization.

The *"requirements analysis"* as well as the corresponding document, the *"product requirements document"*, are introduced as crucial prerequisites to *"really start the project"*. While the students also raise questions regarding their formal relationship with the client and the way they should approach the client, there is a consensus that the project objectives have to be settled as soon as possible.

The kick-off meeting, taking place a week later, starts with a verbal presentation of the overall situation as well as the project brief by the client. The presentation is followed by a discussion between the project team and the client aimed to further elaborate on the project assignment. One of the central topics emerging from the discussion is how the online platform should be structured. Besides asking questions, the students also make proposals on how particular issues could be solved.

Student 1:   *I would like to come back to the overall structure again. I think I would not provide the learning resource in the discussion board, as a discussion board easily becomes confusing. And I believe that a discussion board should really be used to exchange experiences or something like this […]*

Student 2:   *… Otherwise to find some resources you would have to search the entire discussion board. Based on my own experience, it is very difficult as the threads become so long … it becomes very unclear.*

Client: *As said before, I am happy if you say that, because this is a subject I am not that familiar with. We had that idea and then we got in touch with Mr. S. and then we said we'll hand over this issue, explain our wishes and we think about it together.*

The client's statement in the excerpt indicates that she welcomes the project team's input but also relies on their expertise. Further comments from her side are also in support of the students' proposals regarding the structuring of the platform. At the end of the meeting the students suggest that they will prepare a proposal on how the platform could be structured. Apart from the client's presentation in the beginning, the conversation is largely driven by the students' questions who define the issues to be discussed.

After the kick-off meeting the project team has a follow-up meeting with the supervisor. Directly in the beginning one student takes up the discussion on the overall structure of the online platform but also brings forward his concerns about the procedure and the project's current understanding of the client's needs.

Student 3:   *I think that this is tricky, because so far she [the client] has little ideas, and we might exactly end up with what we are proposing now. I think we would need much more discussion, maybe also to develop the structure together with her. […]*

Together with the supervisor the students sort out their understanding of the client's needs as well as technical options and agree that the structure for the online platform is the most important issue to be addressed for the moment. The discussion at this stage is characterized by a lot of assumptions and open questions that the group apparently is not able to answer. After a general discussion the group starts changing their strategy and begins to work on a draft structure based on their current understanding. Even though there is some slight hesitance whether enough

information is available for making a first draft, the group agrees that it should be feasible to draft at least the global structure. The group spends the rest of the meeting on developing a draft structure and plans for the next steps as well the internal division of labour. With regard to the structure of the online platform, the group decides that this should be further developed into a presentation to be directly discussed with the client.

Student3:   … *We have to prepare something, which we can use to talk about with them. It must be something sketchy that can be presented easily. Because of the discussion, if she has not seen something before, otherwise it will be difficult …*

Student2:   *Except we would say, yes, there is something on the web we could show. Or you say then, this part will approximately look like as they have it here, so that they get an idea of it. Or, that we take screenshots and adapt them, for example the menu.*

Student3:   *That we can present some sketches and discuss what they [the client] are envisaging. We need something we can talk about, where you can make notes and where you can bring in your suggestions.*

The emphasis at this point is on *"something sketchy that can be presented easily"*, something that *"approximates"* how the online platform could look like. The purpose of this artefact, according to student 3, is to ground the discussion and to probe whether sketches fit the client's ideas. Discussing what else they could do before the next meeting with the client, the team decides to do some research into existing content management systems to check whether they would be suitable to realize the current ideas as well as to develop first ideas on the visual appearance of the interface. The team also collects questions to be addressed to the client.

In an internal follow up meeting, two weeks later, the students present and discuss the work done so far, including the outcomes of the research into existing technologies, the draft structure for the platform as well as different proposals for the visual appearance of the interface. The team had not gotten any new information from the client despite a mailed request. While the structure has been developed in a diagrammatic form on a sheet of paper, the proposals for the interface design are available as digital yet static mock-ups. The team decides to integrate these two artefacts into a slideshow to ease the presentation for the client (cf. figure 2).
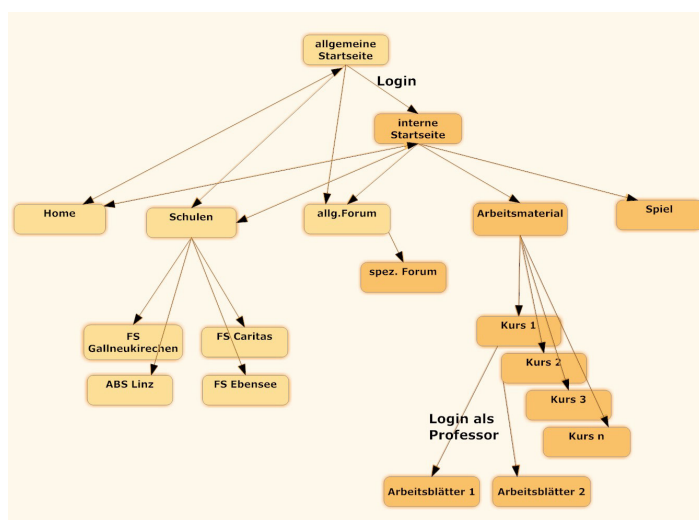
Fig. 2: A diagram representing the envisaged structure and an interface mock-up.

The second meeting with the client, three days later, starts with a presentation of the envisaged structure of the online platform and the interface mock-ups. The subsequent discussion is based on these artefacts.

Student1:   *And our question regarding the structure would be, whether those who finished the courses should have the same right as the instructors or as the students?*

Client: *[…] We don't know yet. On the one hand we would say 'yes, of course', because they are also practitioners that should have the right to access this resources and educate themselves. If this makes sense, we don't know. Yesterday a colleague brought up the question what we are going to do if someone has access to the platform who is not benevolent to the material provided.*

Student1:   *Yes, but from my perspective this is not so much of a problem, because every alumni has been a student before and therefore already has a student-login which simply could stay activated.*

Client: *Ok, if this is the case, then I don't have this problem.*

While the students raise a number of questions, the successive conversations are basically focused on whether the proposed solution would actually be suitable to satisfy user's requirements or how the existing proposal could be amended accordingly. At several occasions the students point out that as an outcome of this meeting they would like to have a formal agreement with the client on whether she accepts the proposed solution. The client, at this stage, has no principle objections to the proposal made.

In the days that follow the students complete the product requirements document in line with a template provided by the accompanying course on project- and quality management. The product requirements document provides a concise record of the project objectives, the actual and target state, interfaces, system-requirements, requirements on the implementation and use as well as non-functional requirements.

Switching Frames and Repurposing Artefacts

Looking at the artefacts produced by the students at this stage, it might appear as if they have been purposefully created in order to fulfil a specific function in the design process, namely to explicate the project's objective, in form of the product requirements document, and to reach an agreement on the conceptual design of the envisioned solution, exemplified in the diagrammatic depiction of the envisioned structure of the product as well as the digital mock-ups. As such the artefacts seem to fit nicely into the model of the design and development process as advocated in the accompanying course on project and quality management, which in turn builds on professional standards and best practices. These standards, such as the norms for project management of the German Institute for Standardization (DIN) and the recommendations of the Association of German Engineers (VDI) provide the foundation for the templates the students used when writing the product requirements document. Beyond providing a unified terminology the standards also assign specific functions to the documents. For example the role of the product requirements document is to define the requirements for the product to be developed from the customer's perspective and hence to define the scope of a project. The product requirements document is assumed to be created in the very beginning of

the project as it specifies the project objectives. The use of these kinds of documents hence is rooted in a certain understanding of design and development, also labelled as *"engineering design"* (e.g. Löwgren, 1995). This perspective is also mirrored in the supervisor's remark that the product requirements document is crucial to *"really start the project"*.

According to the above view, it seems that the students basically draw on and assimilate to the procedures and means they get introduced to in their studies, an interpretation obviously in line with the aims of the accompanying course on product and quality management. Yet, when having a closer look into the students' moves and actions, this interpretation becomes questionable. In particular, it does not account for the observation that the students worried about the fact that the client was rather unclear about the project's objectives. Furthermore, it ignores the fact that the product requirements document was only produced after the proposal for the structure and the interface of the envisioned solution had been accepted by the client.

From a practice-oriented perspective the students' moves and actions can be understood in a different way. In their first internal meeting they appear to actualize an engineering frame to make sense of the situation they find themselves in. While such a view is suggested by the supervisor's contributions it is also reflected in the students' utterances in that they assume the specification of the project objectives to be a necessary prerequisite for all other project objectives and expect the client to provide the respective information. However, after having met with the client for the first time, the students start to doubt whether the client is capable to clearly articulate what she wants. This doubt undermines the previously established framing of the situation. If the client is not able to provide them with the requirements upfront, then both the procedures and artefacts, originally foreseen to start the project, render meaningless and in worst case endangering the successful completion of the term project in time. Here, not only the project's objective, but the entire situation is uncertain, forcing the students to look for a different frame. Trying to figure out how to cope with the situation, the idea emerges *"to prepare something, which we can be used to talk about with them"*. The artefact they suggest to produce is obviously meant to ground further discussion with the client. Yet, instead of aiming to clarify the requirements directly, they now want to develop a potential solution in order to probe whether this actually meets the client's intentions. But they do not only suggest a new strategy they also redefine their expectations towards the client as well as the role of the artefacts. Instead of looking for a precise and encompassing requirements specification they are now aiming at something *"sketchy"* and *"approximate"*. While the students continue to work with this new framing, the situation becomes even more complex in the second meeting with the client. At this point, the foreseen sketches had already been refined and are now presented as a digital diagram and mock-ups. They are not the probes as they were conceived originally, but turned into a concrete design proposal to be agreed upon. The primary aim of the conversation is not to explore requirements but to check whether the proposal is acceptable for the client. Even though the students finally also produce a product requirements document this artefact never fulfilled the role it was originally assigned to have.

Conclusions

The importance of shared artefacts as mediators of collaborative activities has been acknowledged in the fields of design and learning. Nevertheless, theoretical accounts differ in their conceptualization of artefacts and the ways they shape social

interactions. Both rationalist and social-constructivist approaches tend to emphasise the guiding and stabilizing role of artefacts. The practice-oriented perspective, in contrast, takes into account the stabilizing but also the destabilizing aspects of human interactions. Situations are often doubtful and open to different interpretations the actors have to enact. Analytic accounts hence have to be sensitive not only to the socially shared routines but also to deviations, breakdowns and outliers.

With the case study we illustrated how human actors not only adopt prompted interpretations, but might actively reframe the situation they find themselves in. Additionally, artefacts, even though they might be assigned a specific role in a certain methodology, might be used in many different ways, depending on the utilization schemes actualized in local practice.

From a pedagogical point of view the practice-oriented perspective not only challenges the dualism of thinking and acting but also the understanding of competence. Given that in most situations there is neither one best way nor a single authoritative social convention, competent action requires the actors to decide on the frame, they deem most appropriate and to enact respective schemes. Competence hence is more than the ability of an individual to follow a given methodology or social convention but presupposes the availability of repertoires of frames and schemes, the actors can draw on.

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