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Abstract. The literature on design research emphasizes working in iterative cycles that investigate and explore many ideas and alternative designs. However, these cycles are seldom applied or documented in educational research papers. In this paper, we illustrate the development process of a video sketching model, where we explore the relation between the educational research design team, their sketching and video sketching activities. The results show how sketching can be done in different modes and how it supports thinking, communication, reflection and distributed cognition in design teams when developing educational theories.

Key words: sketching, reflection, design, distributed cognition, education

1 Introduction

Design methods have increasingly found their way into educational research, especially with the emergence of design-based research [1, 2], which has seen a steady rise in popularity over the last few decades [3]. Although there are many articles that provide an overview of the approach [3], as well as articles discussing its merits as a scientific methodology [4, 5], articles focusing on the early stages of design-based research remain scarce [6]. A recent analysis of the 47 most cited articles from 2002 to 2012 shows that early iterative methods, such as sketching and prototyping, are hardly mentioned in the literature. When they are, they seem to be understood as longer, often annual, cycles of analysis rather than short alternative design trials, as for instance using rough disposable sketching techniques [7, 8]. It is not clear whether these processes take place and are simply not reported on or they are not implemented at all.

In this paper, we therefore seek to open the black box regarding sketching processes. Our point of departure is a network of information technology (IT) and learning design researchers at Aalborg University who for the last year have implemented different sketching techniques in various settings for knowledge sharing and learning. The preliminary culmination of this work is the development of the video sketching framework shown in Fig. 1. This model is inspired by the work of several researchers in the field, most notable Olofsson and Sjölén [18]. Herein, we explore how the video sketching model came about and ask: What are the steps that lead from any number of ideas to a single model finding its place as an academic contribution? In what ways do video sketching techniques contribute to the development of educational theory? We start by presenting our theoretical framework, elaborating on how sketching can be perceived and what purposes it fulfils. We then analyse different steps in our process

as an educational research (ER) design team in an investigation and discussion of the research questions raised above.
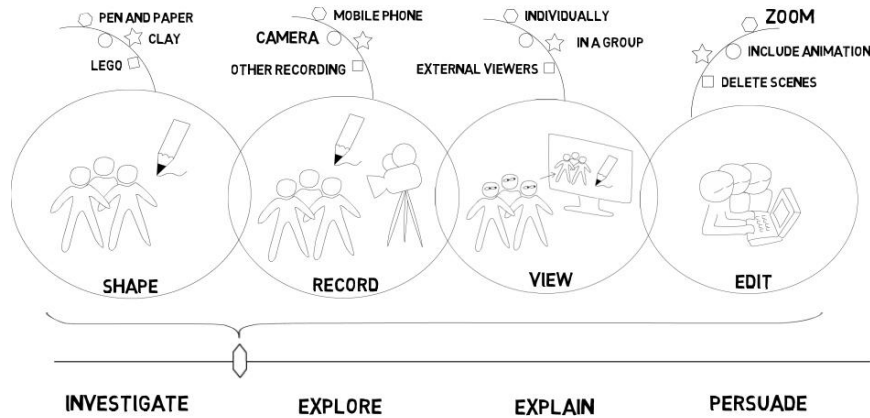

Fig 1. Video sketching framework. To learn more about this framework, see [9]

2 Theoretical Framework

2.1 Moving beyond Words

Here, we present our point of departure by considering the question of why researchers in education, or any discipline, should concern themselves with alternative thinking tools besides their minds and words. Western culture, not least within academia, has consistently privileged the spoken and written word as the highest form of intellectual practice, relegating visual representations to second-rate status as illustrations of ideas [10]. In 'Unflattening', Sousanis [11] makes a compelling argument for words not being the only vehicle for communicating thought. While referring to the written word, he states that linear sequences of rows have their strengths but that they are not the only option. When conveying meaning, the relationship between components, such as words and pictures, matters in terms of size, shape, placement, etc. For Sousanis, cartoons are a means to capture and convey thoughts with more complexity than do written words. Drawing becomes a way to tap into our imaginative system and extend our thinking, engaging both conception and perception simultaneously. As we elaborate below: 'Drawing is not to transcribe ideas from our heads but to generate them in search of greater understanding'[11, p. 79].

Further, the visuals and the process of making and discussing these in collaboration, supports knowledge creation beyond the individual. Hutchins framed the distributed cognition concept in the 1990s, and he elaborated on it from a human–computer interface (HCI) perspective with Hollan and Kirsch in 2000 [12]. A vital perspective, in view of our research, is that distributed cognition rests not only in the materials but also in the interplay between the participants and the material. Thus, cognition may be distributed among group members, across time and space, and be part of physical, digital and mental representations.

2.2 Sketching Theory

In a review of sketching in design processes in the literature from the mid-1960s until the beginning of this decade, Vistisen [13] identified two perspectives on sketching: visual thinking and visual communication. The dominant perspective, sketching as visual thinking, focuses on the ability of sketching to mediate the sense-making process between the designer and the design problem. Sketching enables the designer to have a conversation with the drawing, also referred to by Goldschmidt [14] as 'the backtalk of self-generated sketches'. On the other hand, Buxton [15] places sketches as shared points of reference against which we can compare other ideas or re-interpretations of the existing designs. In support of this view, Hutchins [16] regards sketches as artefacts that may act as a form of distributed cognition – a way of putting ideas 'out there' for debate, critique, and most importantly new interpretations [13].

Oxman [17] contributes with an important distinction between the medium of sketching and the series of actions carried out by the designer which result in transformations of the representations. With this differentiation, it is possible to look at vastly different sketching media (not only pen and paper) and the different purposes tied to the actions of a designer working with these processes separately.

Olofsson & Sjölén [18] argue for four different purposes of sketching: investigative, exploratory, explanatory and persuasive. Investigative sketches work on the problem identification level. The purpose of explorative sketches focuses on possible solutions to identified problems. In explanatory sketches, the aim is to communicate a clear message to others outside the design group in a neutral, straightforward manner to get feedback from users, clients and external experts. Persuasive sketches have the function of trying to 'sell' a proposed design concept to influential stakeholders and are therefore often artistically impressive. Consequently, there is a big difference between the numerous, rough, pencil drawn and disposable explorative sketches and the highly detailed 3D-rendered persuasive sketches.

Apart from categorising sketching according to purpose, it can be categorised according to medium and subject. Traditional media counts pencil, pastel, airbrush, etc., but new research in the field proposes an expansion of this category to include temporal media, for example, in Vistisen's [19] approach to sketching with animation, where he, in the model of expressive capacity, sums up different media use (Fig. 2).
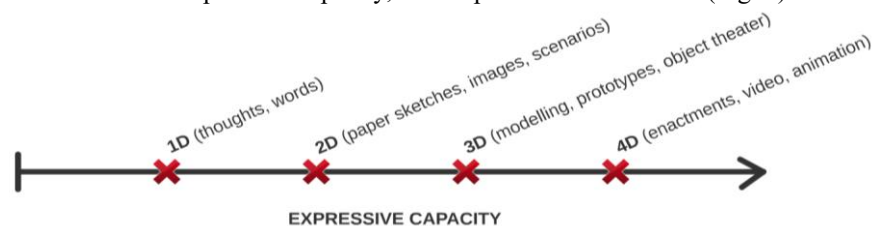
Fig. 2. Scale of expressive capacities in sketching (Fig. 11 in [19], p. 32)

In our video sketching framework, we add yet another layer. All sketching processes with their different purposes and expressive capacities can be recorded through different setups. Our argument is that this creates an interesting hybrid of visual thinking and visual communication. The thinking processes of a design group while sketching suddenly become (more) transparent and editable when recorded, and a visual

communicative sketch gains temporality, creating opportunities for the designers to re-enter the design situation with different purposes as new ideas emerge while watching the session (see Fig. 1).

The question is, what kind of sketch is a video sketch? On one side, recorded investigative pen and paper and digital sketch sessions gain an additional sketch layer through which the designers are able to re-view and retain otherwise elusive thought processes. On the other side, a recording of an explanatory sketch in the making can change its purpose completely as new understandings arise in the editing phase.

3 Our Process

We now turn our attention to the process of developing the video sketch framework and unravelling the applied sketching techniques. We start with an early paper sketch, where the ER design team is investigating the problem space. Next, we look at early solution proposals, closing with an implementation of video sketching techniques.

3.1 Early Sketchwork

The early sketch in Fig. 4 investigates a pivotal aspect of our understanding of how sketching and video interact. At the sketch's upper edge, the team investigate the functionalities of the involved media. Initially, it seems simple to conclude that the camera provides a means of retaining the sketching process. Recording sketching sessions enables re-viewing and re-analysing thought processes materialised through either ink on paper or recorded words. However, in the lower right corner, an interesting figure emerges. Here the ER design team collaboratively discuss and imagine the multiple decisions made over the course of a sketching session. What if we had taken a different route? What ideas were discarded without sufficient investigation? Is it possible for a group of designers to restart a discussion from a given point in the video?
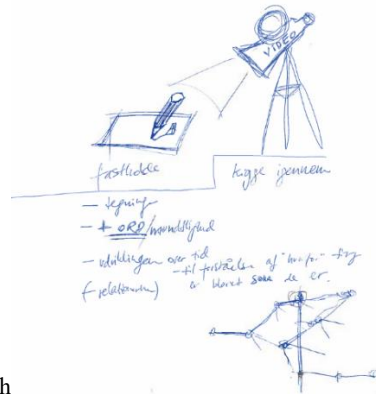

Fig. 4. Early sketch

3.2 From Sketch to Model

In the early sketches (above), we primarily focused on the investigative sketching mode, i.e. we strived to identify the problem. In the following sketches, we primarily sketched in an explorative mode, exploring possible solutions to the problem we had identified. In this explorative phase, we produced multiple sketches and multiple sketching materials' using pen and paper and a blackboard, which gave more space for drawing and a better overview. The following sketches are examples from this process.

In the sketch in Fig. 5, we explore various approaches to how we can identify, understand and visualise different phases in video sketching and how these phases can loop into each other. For example, one loop could be: A person records him or herself and views the recording (symbolised by the eye). After viewing, the person decides to redo the act/recording and view again, or perhaps the person decides to move on and edit the recording. After editing, the person decides to go back to recording with new insights from the process just completed. At the bottom of the sketch, a wavy line both visualises time going from A to B and visualises how the process from A to B can take place in different types of sketching modes (investigative, explorative, etc.) symbolised by the crosses on the wavy line. In this sketch, we also debated and strived to clarify the understanding of sketching modes in relation to video sketching. Are the phases supposed to be understood as purposes (focusing on the outcome) or as approaches (focusing on maintaining a specific mind-set throughout the process)?
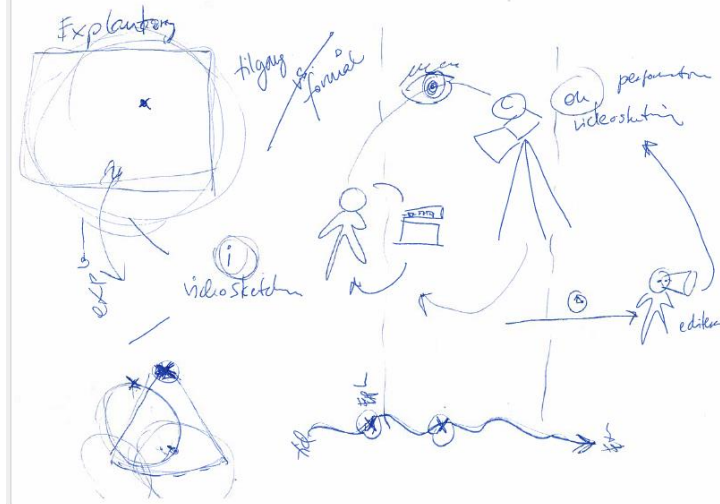
Fig. 5. From early sketch to draft model

The sketch in Fig. 6 is a clarification of the sketch in Fig. 5. One can argue this sketch enters the purpose of explanatory sketch and we move from visual thinking into the area of visual communication. We explicitly sketch the phases: shaping, recording, viewing and editing and the possible loops between the phases (shown by the curved arrows). At the same time, we continue exploring the possible visualisations of the various parameters (shown by the 'arm'/line with a circle, triangle and square).

Fig. 6. From draft model to model

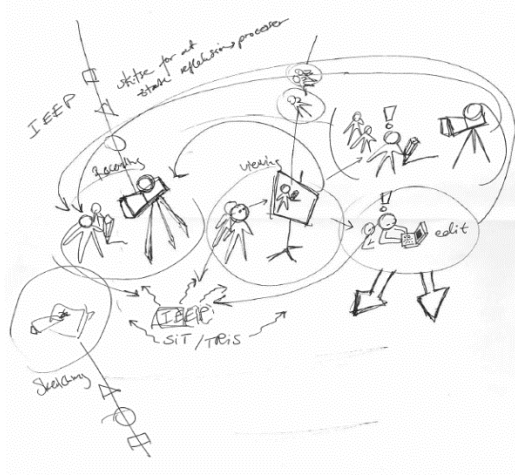In the sketch in Fig. 6, we did not explore the relation between the sketching phases (shape, record, view, edit) and the sketching modes (investigative, explorative, etc.). We had briefly touched on this relation with the waved line and crosses earlier (see Fig. 5), and we returned to this issue in the sketch below, in Fig. 7, where a 'slider' emerged under the phases, shown as four intertwined circles. We strived through the slider to visually express that each sketching phase (shaping, recording, viewing, editing) can be combined with various sketching modes (investigate, explore, explain, persuade). For example, an editing phase can be done in either an investigative, explorative, explanatory or persuasive mode. Similarly, in a recording phase, it is also possible to be in either an investigative, explanatory or persuasive mode.
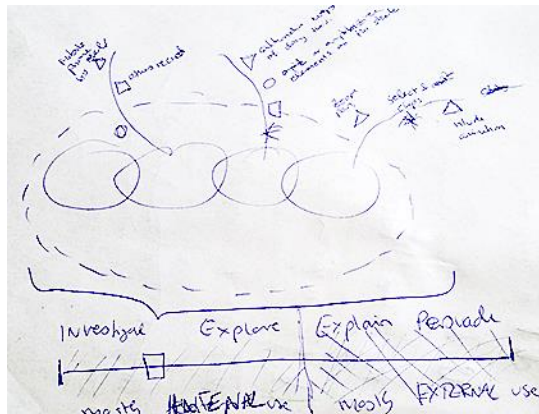

Fig. 7. Refining the model and its interrelations

After working our way through the different sketches with pen and paper, we closed in on the final model presented in the introduction (Fig. 1). In the sketching and production of this final model in the software VideoScribe (http://www.sparkol.com/),

we focused on explaining the model. We strived to clarify and communicate the content/the model in the video editing phase. Even though the primary purpose of this phase was explanatory/persuasive, the switch in material from pen on paper to video software initiated a new round of exploration. At first, we made a very rough version, using existing template icons. We then moved on to our own digital drawings. To ensure clear communication of the different elements of our video sketching model, the ER design team viewed and discussed the draft versions in VideoScribe. We also experimented with the graphics and temporal details in the video, making it more convincing. Thus, we argue that the video also has the purpose of persuading the viewers through seductive and corporate-type graphics.

3.3 The Meta Layers and Process Over Time

When exploring the process, we revisited not only our sketches but also the photos taken on the days of collaboration. Here, it became clear how the situational factors (sitting around a table, drawing on the same paper from different angles) and time (the layering of papers on top of each other) constitute important relational factors that co-construct our meaning [12]. We also experienced this as supporting our historical recall and reasoning when revisiting and choosing the significant examples later on, as the timely progression shown in Fig. 8 illustrates.

Fig. 8. Progression over time in the work with the model

3.4 From Model to Video Sketch and to Model-in-Use

The empirical research behind the model, i.e. the case studies related to its development, was presented at the Association for Visual Pedagogies Conference in 2017 [9]. The ER design team made an explanatory video which was presented virtually and discussed. In the video, we used an informal panel discussion (see Fig. 9). We first sketched (pen and paper) ideas for the content and form, and the video was then

recorded in one shot with two cameras. Later, in the edit mode, the VideoScribe movie was superimposed to the screen, camera angle was chosen, etc. This presentation video supported a process of thinking about how to utilize video sketching in the explanatory form. After submitting the video to the conference, we reviewed it and found that our recorded and edited panel-like discussion, while sketching on top of our model (Fig. 1), gave insight into three different ways of utilising the model-in-use in future scenarios.

Fig. 9. Screendump from the conference video

4 Discussing the Learning Potentials in Video Sketching

In the introduction to this paper, we asked two questions: whether we could identify steps in the process of formulating academic contributions, and in what way video sketching techniques contribute to the development of educational theory. In the previous paragraphs, we have zoomed in on our sketching processes and the steps involved, and we have showed how it influenced our development of the video sketching framework. To further understand the reflective processes that occur when working with the development of the video sketching model, we draw upon the work of Donald Schön [20]. Schön focuses on reflective practices among practitioners and notes that it is vital to combine the ability to operate in uncertain and unique contexts in the field of design. According to Schön, a design situation is unique because there is not just a single way to solve the problems that may occur. This places a demand on the designer to reflect in terms of reflection in action and reflection over action [20]. In the ER design team, we switched fluently between reflection modes, using different expression formats, e.g. drawings, dialogues, and videos.

We argue that the use of video sketching potentially supports and enlarges reflective processes through the possibilities of: 1) re-viewing and re-entering thought processes via the recorded video sessions, thereby triggering memories [21] about the intention of the sketch which can open a new round of collaborative exploration and re-analysis; 2) providing a collaborative log of drawings and video sketches which is easily accessible, supports coherence through fragmented processes and scattered meetings and supports knowledge sharing and distributed learning over time; and 3) making the research process transparent to fellow researchers or project stakeholders.

In relation to the first point, we acknowledge the potential weakness of not having sufficient time in a given research project to make numerous iterative recordings and holding re-viewing and reflecting sessions, although we stress that doing so among research peers strengthens not only the theory under discussion but also the professional development of the participants. Regarding point two, the notion of having a collective log of materials relates to portfolio thinking – and having a common portfolio may not be for all researchers. Some find working with academic matters a more solitary matter and do not feel comfortable sharing knowledge with peers, especially in the early stages of a given project. Future investigation into the research on (e)Portfolio, could provide knowledge that can be explored with regard to video sketching as well, for example in relation to the (e)Portfolio concepts of ownership, the meaning of volunteering and mandatory participation for the result, etc. [22,23]. On a positive note, we found the materialisation of early ideas and, not least, the discussions along the way to be pivotal in our understanding of the framework we were generating, and we have retained several ideas for future research topics that would have been discarded.

Thinking and communicating with sketches and video sketches has in our case been a pivotal part of educational research and has impacted theoretical development.

5 Conclusion

In this paper we have outlined our sketching processes in order to make our development of the video sketching model transparent. Our purpose is to contribute a detailed description of these processes, which is typically omitted in papers in the field of design-based research. Based on design literature, we argue that these processes are pivotal in order to grasp learning potentials, and we find our process underlines how sketches in many forms, with many purposes and with various expressive capacities, play a significant role in academia, especially when it is desirable to prioritise short iterations on ideas and alternative designs, such as when developing educational theory.

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