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A VISUAL VOICE, SKETCHNOTING FOR ENGINEERS

Verena PAEPCKE-HJELTNESS, Lara HETHERTON and Haley GROTE
Iowa State University

ABSTRACT
This pilot study is part of an ongoing investigation, which explores how low fidelity visualisation such as Sketchnoting, can support learning habits, as well as foster sketch and creative confidence. Sketchnoting is situated at the lower end of the visualisation fidelity spectrum, which ranges from napkin style sketches to photo-realistic renderings or high fidelity info-graphics. It is a methodology that uses simple shapes, frames, and connectors to visualise complex information, concepts, and physical objects, thus it has a low barrier entry for skilled and non-skilled drawers, as well as for designers or non-designers alike.
The main focus of this study is to investigate if supplemental materials such as visual templates or specifically developed note-books with visual guides, plus frequent Sketchnote learning and practicing sessions will significantly enhance and positively influence the implementation of Sketchnoting in the day-to-day lecture note-taking and study practices of the students. For this exploration two 3rd year electrical engineering students were introduced to the methodology in a series of one-on-one sessions learning the basics of Sketchnoting over the course of several weeks. In collaboration with the students visual materials were investigated and developed to support their lecture note taking and study material development. The students were followed throughout the process lasting over a period of 16 weeks. This paper discusses the process of the pilot study as well as its outcomes and future implications for a large-scale investigation with a sizeable group of students and possible curriculum implementation.

Keywords: Sketchnoting, Low Fidelity Visualization, Sketchnoting for Engineers, Creative Confidence

1 INTRODUCTION

As part of a multi-faceted approach this research team has been successfully introducing Sketchnoting across campus to students, staff, and faculty from various disciplines, ranging from veterinary medicine, to food nutrition and sciences, to mathematics, engineering and beyond. Sketchnoting is positioned at the lower end of the visualisation spectrum, which ranges from simple stick-figure drawings to high-end photo-realistic renderings. Due to its simplistic nature it has lower barriers to begin and to practice sketching compared to e.g. perspective drawing. The simplicity is based on the framework to communicate visually through basic shapes, breaking down complexity using combinations of dots, lines, squares, triangles, and circles [1]. Sketchnoting fosters breaking out of linear note-taking habits by leveraging the space of the page as an open canvas. The previous introductions to Sketchnoting were conducted with groups ranging from 10-240 people. Sessions lasted from 45 minutes to three hours, and a few were extended over up to three meets, which allowed for more in depth practicing. However, follow up has been limited and participant feedback was gathered mostly through questionnaires or in the case of industrial design students, in form of Sketchnotes used for idea generation [2]. These previous investigations uncovered potential research areas through Sketchnoting [3]. One approach suggested the development of visual materials specifically for electrical engineering faculty to be introduced as part of the lectures [4]. The latter investigation is still in progress and inspired this particular pilot study, which set out to gather qualitative data. This highly student-centred investigation is based on two participants with the goal to co-develop visual material as well as making the use of Sketchnoting in the day-to-day practices as seamless as possible. The research group was purposely kept to this minimal size of two participants to allow for true one-on-one interactions, flexibility through immediate responses, and a focus on regular and consistent in-person follow up. The long-term goal is to lower the barriers to Sketchnoting for design and non-design disciplines by developing a consistent methodology for implementation.

2 CONTEXT

Traditionally engineering classes are fact and information based with instructors lecturing on specific topics and concepts. High volumes of information and examples are being covered and often followed by heavy homework loads and weekly laboratory sessions.

In an effort to inform engineering education and to better match students' learning styles with faculty teaching styles in 1988 Felder and Silverman investigated learning styles that were significant in engineering education. They inquired which of those were preferred by most students, as compared to the professors, in addition to what could be done for the students whose learning styles were not addressed by traditional methods of engineering education. They concluded that a significant number of engineering students are "visual, sensing, inductive, and active, and some of the most creative students are global" as opposed to "most engineering education is auditory, abstract (intuitive), deductive, passive, and sequential". Thus, there is a major disconnect between how students learn and how instructors teach [5]. In 2002 Felder prefaced this study with two new insights; he excluded the inductive/deductive dimension as well as changed visual/auditory to visual/verbal [ibid]. However, one major point omitted at the time and discussed later by also Felder as well as Samavedham, among others, is the increased need for engineering students to become critical as well as creative thinkers in addition to having an entrepreneurial understanding in order to fit the changed industry requirements of the 21st Century [6][7][8].

In response to this existing body of knowledge, the goal of this paper is not to discuss general learning strategies or hiring requirements for engineering students, the goal is to further nurture the students' inherent creativity through Sketchnoting, by exploring ways to truly make it accessible for the students allowing them to seamlessly integrate it in their day-to-day practices. The driving hypothesis is that Sketchnoting fosters sketch and creative confidence by breaking out of linear thinking patterns. In addition, due to its dual coding nature [9] of combining words with visuals it also promotes practicing to move freely between divergent and convergent thinking, meaning moving between deductive/inductive (based on, or deriving from facts) and abductive logics (asking 'what if') as they pertain to design thinking [3][10][11].

One of the overarching intentions is to provide stakeholders of various development processes with an easy to learn, common visual voice to be able to communicate together on paper [2]. Based on class observations it has shown that in collaborations across disciplines the person with superior visualisation skills has a stronger visual voice. Especially in educational environments this can lead to biased decision making due to the convincing visualisation of embellished realistic looking renderings, or simply due to the ability to communicate on paper with imbued confidence. In addition, it has been observed that there is often a block across disciplines to transfer knowledge easily on paper. This pilot study explores the process of co-developing visual materials with and for the students, the barriers of integrating Sketchnoting in the day-to-day and new ways to fuse the students' study practices with Sketchnoting ability. The findings of this paper highlight considerations for a large-scale implementation of this methodology.

3 METHODOLOGY

This paper addresses three key research questions:

1. How can electrical engineering students integrate Sketchnoting in their day-to day practices?
2. What are key influences that contribute to the acceptance of Sketchnoting?
3. How does Sketchnoting influence electrical engineering students' educational experience?

To answer these questions an empirical study was conducted in two phases, which was based on one-on-one interactions with two 3rd year engineering students. As discussed above, the size of this study was purposefully kept small to allow for highly qualitative interaction that was driven by the idea of co-creating meaningful and truly useful visual materials and effective implementation. The goal of this pilot study was to identify if there is merit of integrating Sketchnoting in electrical engineering students' practices in addition to co-develop visual materials for a large-scale study, ultimately to nurture creative thinking across disciplines.

3.1 Phase 1

During the first phase students were tasked to complete a visual template to set a base line concerning their visualisation ability as well as their confidence of putting pen on paper. Students were then introduced to the basics of Sketchnoting in a 45-minute session and provided a sketch journal.

Table 1. Phase 1

Phase 1 (n=2)			
Aim	Research Technique	Duration	Collected Data
Setting a sketch base line, understanding attitude towards it.	Visual template	30 minutes	Visualizations of basic artifacts and perception thereof.
Introducing Sketchnoting	Hands on instructions and practice of visuals.	45 minutes	Participant feedback and reflections
Getting acquainted with Sketchnoting. Fostering acceptance of it.	Sketch journal with sketch prompts and examples	Flexible over course of 2 weeks.	First round of visuals by participants

3.2 Phase 2

The second phase was composed of one-on-one sessions with the engineering students, one faculty member, and one student research assistant over the course of six weeks, plus additional informal reflection meetings following their progress.

Table 2. Phase 2

Phase 2 (n=2)			
Aim	Research Technique	Duration	Collected Data
Understanding students' acceptance and integration of Sketchnoting in their day-to-day practices	Interviews	6x20 minutes	Personal reflections on weekly Sketchnote experiences
Exploring the students change in sketch confidence	Observations	4x20 minutes	Sketchnotes of different stages in the process
Developing useful and meaningful visuals	Co-creation	4x20 minutes	Participants' input regarding use of visuals and meaningfulness.
Understanding change in sketch ability and attitude towards it.	Visual template	30 minutes	Comparison to first exercise of research project.

4 OBSERVATIONS AND FINDINGS

4.1 Phase 1 // Process & Initial Feedback

Both, the initial benchmark template and the introduction to basics of Sketchnoting (Figure 1) were focused on actual visuals such as figures and artifacts.

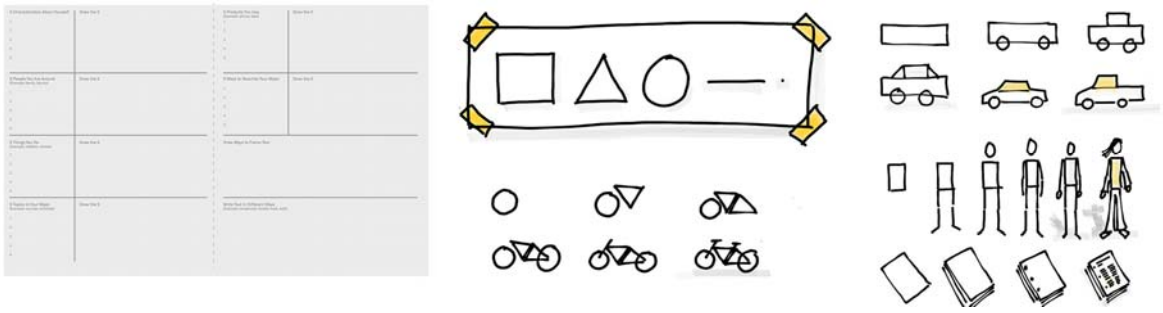

Figure 1. Left: Benchmark Visualization Template. Middle/Right: Visual Examples

The session was modeled after a conference workshop conducted by Eva-Lotta Lamm at the International Forum of Visual Practitioners in Berlin 2014 [12], influenced by material from Mike Rohde [13], and the Kommunikationslotsen [14] and has been the foundation in all previously conducted introductions to Sketchnoting on this campus. The feedback indicated that the immediate focus on visual artifacts is not very conducive and applicable to the context of engineering in general. Moreover, according to the students it was not as easy to keep pace with sketching the different elements, while following the introductions of visuals. After the introductory session the students were

provided a sketch journal with visual prompts and a set of pens (Figure 2). They were encouraged to practice Sketchnoting over the course of two weeks following the sketch journal prompts. The students embraced the provided materials and practiced some of the visuals. However, the prompts did not include step-by-step instructions and were kept very broad and conceptual. Requiring to solve a problem while trying to figure out how to sketch at the same time posed a barrier to just putting pen to paper.

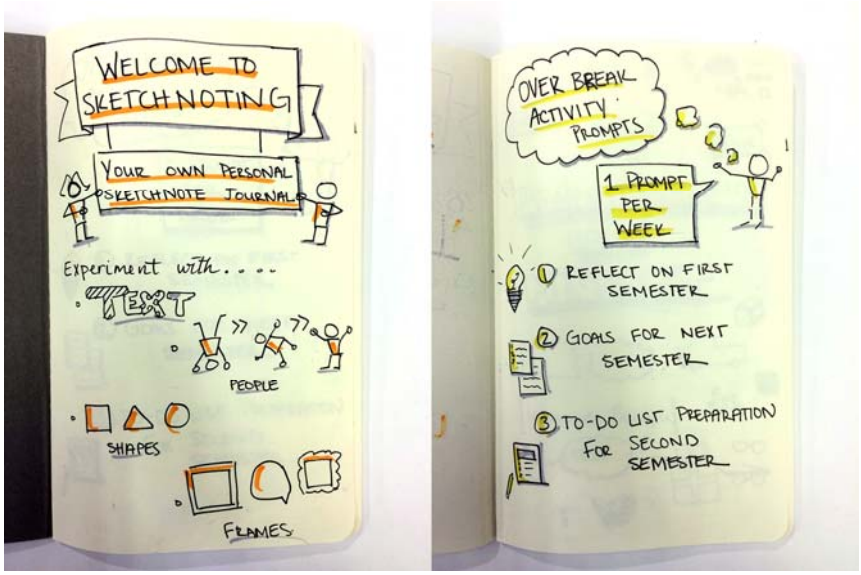

Figure 2. Sketchbook with Visual Prompts

4.2 Phase 2 // Process & Initial Feedback

The weekly feedback and practice sessions allowed for in depth discussion of the previous week's Sketchnotes and reviewing of the class and study notes. Working together as a team the entire group would refine copies of lecture notes to explore different variations and to discuss how to assign visuals to certain content features such as book chapters, input/output, equations, properties, questions, etc. (Figure 3). These sessions revealed the students' different study approaches. One student frequently turned readings into study Sketchnotes using plain white paper as well as sketch noted on the computer. The other student used the standard ruled paper journals for lecture notes. Both voiced difficulty of live Sketchnoting during the actual lectures due to the fast pace and complex content and the concern of possibly missing important information for exams.

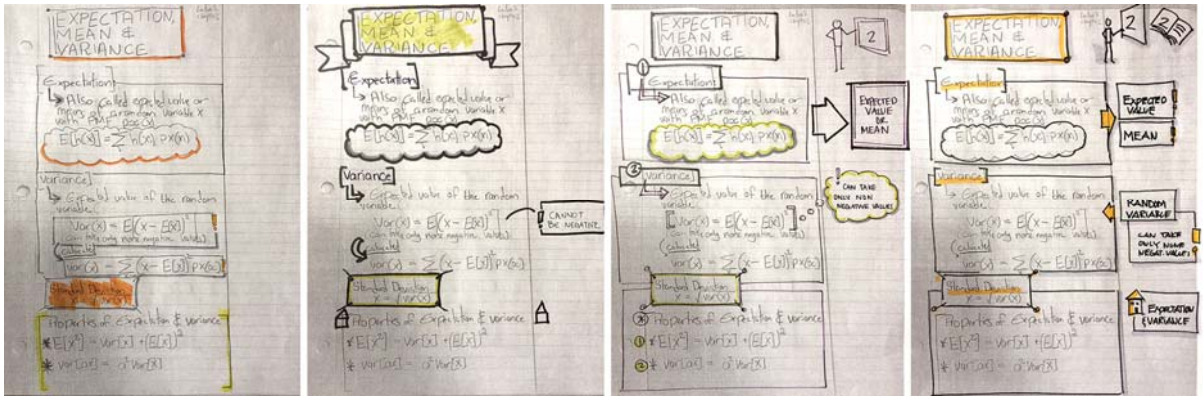

Figure 3. From left to right variations of the same base Sketchnote

During the sessions different visual approaches were identified, tested, and ideas for alternative visuals were developed. Thus, the participants were frequently provided with sets of visuals that were specifically developed to fit their particular style of note taking and content of lectures and study materials (Figure 4).

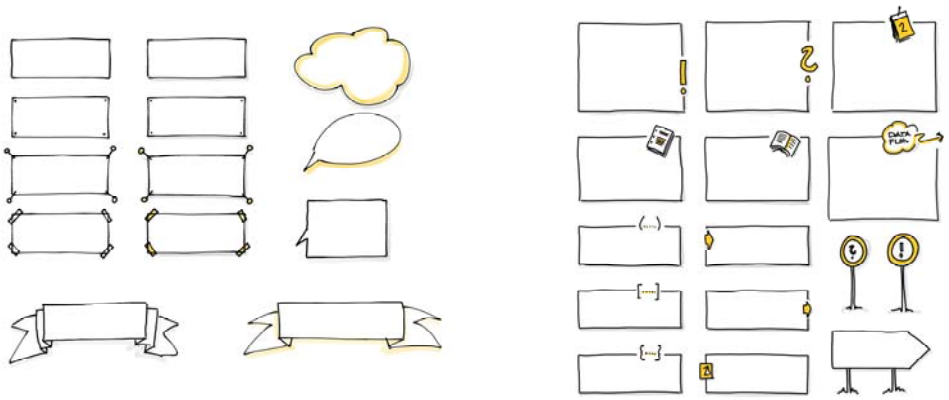

Figure 4. Left side traditional containers, right side adapted with focus on engineering notes

4.3 Addressing research questions and steps for implementation

4.3.1 Integration of Sketchnoting in electrical engineering students' day-to day practices

Conducting lectures with Sketchnoting in mind could significantly lower the pressure of being able to keep up with the fast pace and capturing of the content. Many faculties are already providing PPT files of their lectures; in addition it would be valuable to develop visual material pertaining specifically to the topic. These visuals could be integrated in the lectures and handouts. Introducing Sketchnoting at the beginning of their programme of study, such as during freshmen year, would allow students to develop visual note taking habits without having to change their routine later on. Thus, providing an additional platform to nurture their creative mindset early on. An auxiliary benefit of turning fast paced lecture notes into revised study notes is to further the comprehension of the subject matter.

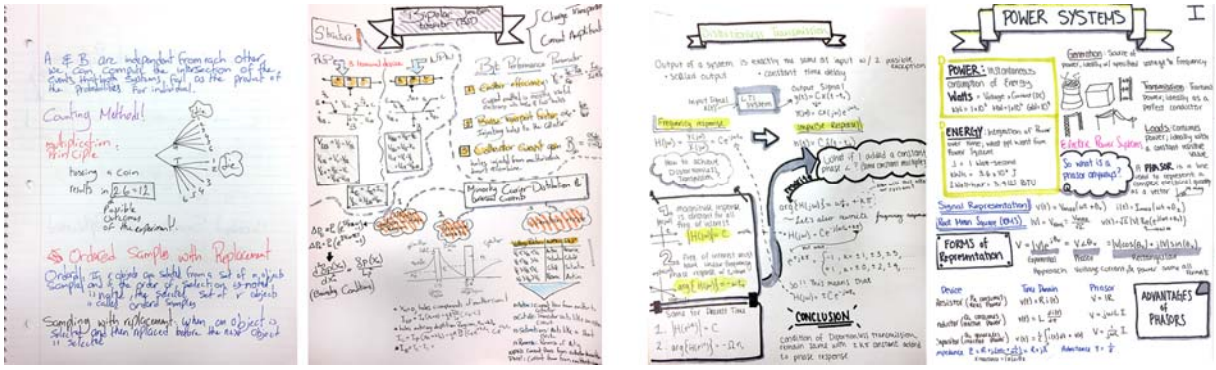

Figure 5. Left to right: Original note, after 16 weeks, first Sketchnote, after 9 weeks

4.3.2 Key influences that contributed to the acceptance of Sketchnoting

It was very beneficial to work in the small team, which allowed the students to develop their own visual voice in a safe space without any pressure or expectations on the outcomes. Changing the sequence of the introductory session by avoiding an immediate focus on actual visual artifacts was the first major insight. When visual material is provided it should pertain to the topic and be in form of step-by-step guides to avoid additional barriers. Developing visuals with the students imparts a joint investment in the process and encourages further exploration, which can also increase the level of sophistication. As hypothesised, all lines were sketched with more confidence and colour was used with purpose. The notes became more fluent and detail oriented, specific visuals were assigned to topics within the notes. The subject matter was clearly depicted and subsequently synthesised (Figure 5).

It is encouraged to always use ink pens over pencil, because erasing writing and sketches sowed distrust in the students' own ability and fostered second-guessing. It is important to have the right tools, such as a light grey and one colour marker. This can make or break Sketchnoting for novices. A slight shade and a touch of colour makes all the difference in helping to create visual hierarchy on the

page and drawing attention to what is important, therefore creating an immediate sense of satisfaction and success, which promotes and encourages continued practice.

4.3.3 Sketchnoting influence on engineering students' educational experience

This methodology does not require a strict formula, as the students stated, which was a welcome change from the hard facts they have to learn. The students confirmed that it encouraged them to think in a non-linear way, by breaking out of their traditional note-taking mould. Sketchnoting allowed them to approach their learning in a new way at their own pace. Most importantly, it fostered a deeper understanding of the subject matter. According to the students the reading, thinking, and visualisation sequence pushed them to not just think about why something is important, but also how to represent it. This representation made for more in depth and lasting learning experiences. The focus switched from memorising examples, to understanding the underlying concept. Thus providing a deeper understanding and mastery of the subject matter, which the students considered the greatest benefit.

5 CONCLUSION

Overall this pilot study revealed many useful insights that will be adapted for a large-scale research investigation. The visual guiding materials specifically developed with and for the students were crucial in gaining trust and buy-in to the usefulness of Sketchnoting. For a large-scale study this needs to be considered, providing students input opportunities to help shape the process. Nevertheless, a basic visual library with step-by-step instructions should be part of the introductory session. Frequent check ins and revisiting of notes and jointly developing variations in courses over 40 students could be implement through e.g. Team Based Learning strategies [15] fostering team consensus and joint development. Providing different entry points for learning and incorporation of Sketchnoting is very important. This would address the varying comfort levels to changing ones study and work habits. In closing, it will be paramount in a large-scale study to provide an open dialogue and to keep an open mind toward varying learning and studying styles.

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