

Sketchnoting: A new approach to developing visual communication ability, improving critical thinking and creative confidence for engineering and design students

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Abstract: In this study we provide our methodology and implementation strategy of Sketchnoting in Freshman Engineering and Technological Literacy classes. The objective is to improve students' learning, visualization, and communication proficiencies, as well as to foster advancement in knowledge retention, and critical thinking. This study provides the motivation, supporting research background, design, and the first set of results of this new approach implemented in engineering and design curricula.

Keywords— *Sketchnoting; visual thinking; creative confidence; critical thinking, nonlinear note taking*

I. INTRODUCTION

Recently, this research team has been introducing Sketchnoting as a visual listening tool in design and engineering classes as an alternative approach to traditional note taking. At its core, Sketchnoting applies dual coding theory [1] by combining both words and images. Sketchnoting, if seen as a methodology, provides a framework that is based on low fidelity and low complex visual outputs - everything can be depicted through combinations of dots, lines, circles, squares, and triangles. It was originally derived from the desire to take notes that are more meaningful and engaging. Rohde defines sketchnotes as “visual maps combining written words and images while providing structure through variations of frames, dividers, bullets, icons, and connectors such as arrows and lines.” [2] As such, Sketchnoting might have the ability to enable students at any level to engage and develop their own visual voice for documentation and idea exploration. Preliminary research conducted by one of this paper's authors, explored the possibility of this approach in lowering the threshold to sketching in particular and visualization in general for industrial design students. The motivation for this paper stemmed from these preliminary observations, which showed the potential that this methodology could be an effective approach in lowering the barriers to thinking on paper and

fostering creative confidence while employing the theory of dual coding for better cognitive processing. In the broadest sense, Sketchnoting engages two levels of agile synthesis, visual listening and visual idea generation. When utilized, this process of low fidelity visualization activates divergent, holistic thinking as well as convergent, analytic thinking. The combination of visual and verbal formats improves retention and more effective studying on the one hand, and allows for the integration and visual output of one's thoughts, knowledge, and creativity on the other. This paper elaborates how this methodology could be integrated in engineering classes to foster creative confidence and critical thinking. Our initial research and implementation in Electrical Engineering Freshman and Technological Literacy courses will be introduced and explored. In support of our thesis, the results will discuss the validity and efficacy of this method for improving students' engagement, advancement of visual thinking and communication, and the development of refined critical and creative thinking.

II. FROM TRADITIONAL NOTETAKING TO SKETCHNOTING

A. Learning and Retention

Learners from the beginning of their scholar career are taught to practice note taking during lectures. The recording of information has frequently been linked to enhancing student's ability to learn and retain information [3]. Therefore, note taking is believed to have positive impact on a learner's ability to follow what is being taught and to remember the information being presented. While some might have been introduced to note taking in a certain manner, others developed their own methods of recording information intuitively. However, learner's note taking is often characterized by styles and methods that have been developed over time throughout their educational career [4]. To this effect, through their college years, learners have already adopted a personal style that facilitates their specific note taking process.

It is believed that students who take notes during lectures perform better on their tests than those who do not take notes. As such, a large body of research accustomed the primary functions for taking notes as a way for learners to record information and create a learning reference for later use. Di Vesta and Gray [3] observed the effect of note taking on enhancing student's learning and retention through different settings and concluded that student's performance through note taking could be effectively manipulated through different strategies. They identified that by means of encoding the learner is able to link the material to his existing cognitive structure, developing meaningful connections to the class material. Peper and Mayer [5] supported this argument by stating that note taking stimulates a generative process allowing note takers to connect content with their prior knowledge.

B. Methods of Note Taking

Learners generally take notes using different methods such as verbatim, paraphrasing, outlining, dotting, color coding, main points, using lines to divide points, generating headings with body outlines, marking or drawing arrows to indicate connections and others [3]. The object of how information is recorded stems from the different courses that learners take. For example, Meter, Yokoi and Pressley [3] mentioned that some students record verbatim so as not to distort the meaning of the material or when course material is specific or/and when tests require exact meaning. In regard to this, self-regulation during note taking is believed to be vital for learners, since it allows the note taker to synthesize the information as it is being recorded. However, self-regulated note taking by college students is normally characterized by recording formation that *they* think is important [6].

Einstein et al [7] discussed that self-management is apparent when student reorganize lecture content during note taking. Importance is usually drawn through observing cues from lecturers or presenters who place emphasis on material by re-reading or writing it on the board, slowing the rate of speech, repeating specific info or mentioning that it is important. In regard to this Meter, Yokoi and Pressley [3] argue that factors, such as the learner's familiarity with the material being taught, expectations of examination demand, the individual's level of understanding, organization of lecture itself as well as the lecturer's pace, all affect and motivate note taking.

C. Writing vs. Drawing, Linear vs. Non-Linear

Depending on how class material is presented to learners, most students are habituated to following a linearly progression of encounters. Such habits further present themselves in their note taking approaches where visual information is usually interpreted and recorded in text format. As mentioned by Ainsworth et al [8], effective learning strategies help learners organize their knowledge more effectively and drawing can be one such effective strategy. Drawing and other visual forms of representations enhance engagement in learning, encourage the use of more effective

strategies and promote the development of a number of crucial skills including those in creative reasoning, communication and use of multiple literacies for knowledge construction and representation [8]

However, research has revealed that students rarely use visual presentation while taking notes. This is especially common in science and engineering, where students need to learn and manage many abstract concepts that would be considered as having low image-ability [9]. Whereas individuals' drawings emerge from a learner's knowledge of visual conventions, the lack thereof could be attributed to the rarity of learners being systematically encouraged to create their own visual forms [3]. Meter, Yokoi & Pressley [3] discussed the shortcomings of presenting and recording information visually for students as being influenced by the pace of the lecturer where students find difficulty in listening, interpreting and recording visual information at the same time. Uesaka and Manolo [10] supported this by attributing the problem to the inability to make correct inferences and lack of spontaneity.

D. Sketchnoting, an Alternative to Traditional Note Taking

Sketchnoting, when practiced frequently, allows the learner to take such visually driven notes in real time. As mentioned above, these types of notes are essentially visual maps, which combine written words and images. Structure is provided through variations of containers, dividers, and other simple visual elements such as arrows and lines [2]. There are many different styles from purely using words to create meaning through placement on the page as well as through visual hierarchy created by framing the text in different ways. Other styles, such as often used by visual practitioners, incorporate metaphors that are being visualized through simple shapes and forms to synthesize complex information quickly [11] [12] [13].

Generally, Sketchnotes can turn traditional notes into meaningful synthesized interpretations of discussions, lectures, debates, and the like. These notes are taken in real time, which requires full attention as well as prior practicing of these basic shapes, icons, and forms. Additionally the Sketchnoter can draw from either an individually developed visual library of shapes, forms, icons, images, and arrows or from existing libraries such as Bikablo [14]

Sketchnotes are messy by nature and can contain spelling or content mistakes. The Sketchnoter then finds a way to integrate these mistakes into the overall visual representation of said talk or presentation.

E. The Potential of Sketchnoting

As mentioned, one of the authors currently explores opportunities of Sketchnoting as it pertains to the industrial design curriculum. As such, five areas have been identified for further exploration through in depth research.

Sketchnoting has the potential to foster:

1. Sketch confidence

For some sketching is the litmus test for creativity. Many people think because they cannot draw they are not creative [15]. Sketchnoting can provide a low barrier entry point to drawing.

2. Creative confidence
Once students are more confident in their sketching they more freely share ideas and in addition have more ideas.
3. Design ability
Once students are more confident in their ideas, they have more diverse ideas and often go beyond the obvious first solution.
4. Generative Sketchnoting for idea generation
It can serve for low fidelity idea generation, giving people with different skill sets an equal visual voice.
5. Change in learning behaviours
It could have potentially significant influence on student class engagement and learning behaviours.

III. MOTIVATION

Why would a new note taking methodology help engineering students? This research team saw an opportunity for engineering to gradually move to adapt this non-linear, low complex, and low barrier note taking methodology. The goal is to help students make critical connections and gain new perspectives by being able to visually capture processes and thoughts and to communicate them in a visual way. In addition sketchnoting might help with overall critical thinking and analysis. From an engineering perspective Sketchnoting could provide a more 'right-brain', visually enhanced, non-linear, systems level approach that not only captures the immediate connections and important characteristics of students' perspectives, but additionally could help them make better meta connection and identify holistic synergies of their thoughts in relation to the lessons and their knowledge in general.

IV. IMPLEMENTATION

Over the course of two years, Sketchnoting has been used as a medium of communication, idea generation, and note taking in Industrial Design. Observations indicate that many of the students are empowered and inspired with this alternative note taking methodology that captures their ideas and thoughts in a cohesive and non-linear fashion. Students increasingly use this method in classes from technological literacy, to lecture, to studio classes.

In Spring 2017, Sketchnoting has been directly introduced to the Freshman Engineering class in the department of Electrical Engineering. Students were exposed to the basics of Sketchnoting learning how to break complex forms down into simple shapes using combinations of dots, lines, squares, triangles, and circles (Figure 1). The introduction was 50 minutes long, thus covered only the very basics of Sketchnoting. The course, however, consisted of mainly freshmen and a few graduate student mentors and teaching assistants were present. Three of these graduate students, coincidentally, were previously exposed to generative

Sketchnoting at a three-hour workshop conducted by one of the authors. Generative Sketchnoting employs low-fidelity workflow generating ideas using the same form of simple forms, shapes, keywords, and short phrases as traditional Sketchnoting. It fosters quick idea generation and allows to capture thoughts collectively in team setting.

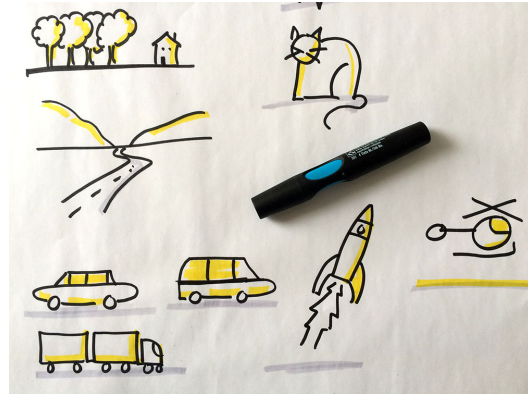


Figure 1: Sketchnote visuals

All in all, 10 engineering students were exposed to the basics of Sketchnoting and 3 student mentors to both the basics and Generative Sketchnoting.

V. DISCUSSIONS AND EARLY RESULTS

Early results obtained from interviewing mentors and through observations in the freshman class where Sketchnoting was introduced show that this methodology has been positively received in the engineering class.

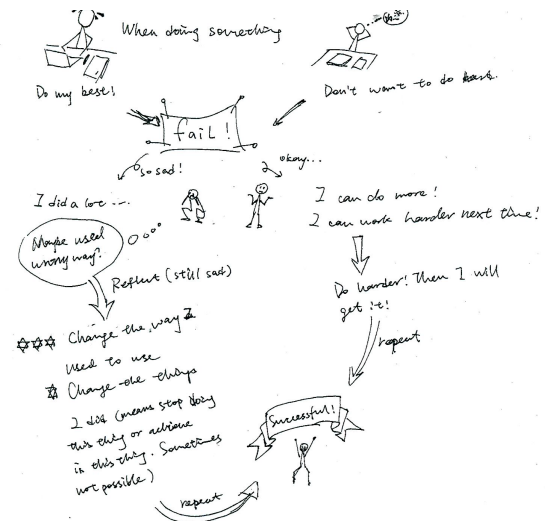


Figure 2: Mentor's Sketchnote after 2 hours of training

In the interviews that were conducted with mentors of the freshman class, they mentioned that they had themselves never heard of this methodology before, even though some of them used doodle in their note taking. They pointed out that as they practiced using simple imagery, frames, and shapes, they

started to get accustomed to it and also started applying it in their personal studying sessions.

One of the mentors mentioned that being able to visualize her research on a page using this methodology has helped her to process and connect her ideas better as seen in figure 2 and 3. Another mentor mentioned that it has helped to change her mindset on how she views and interacts with information. She went on to say that visualizing what she is learning has helped her to interpret information in a way that was personal and memorable.

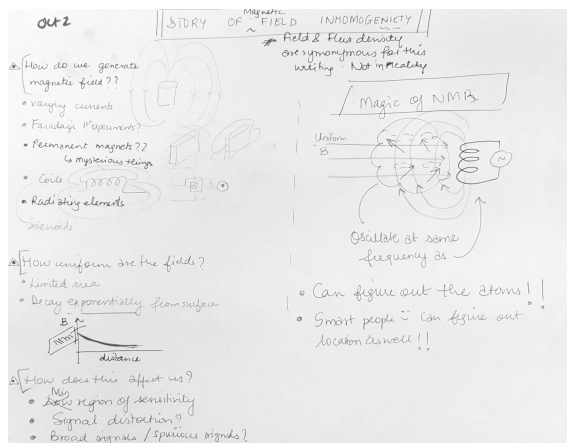


Figure 3: Mentor's class notes before sketchnoting

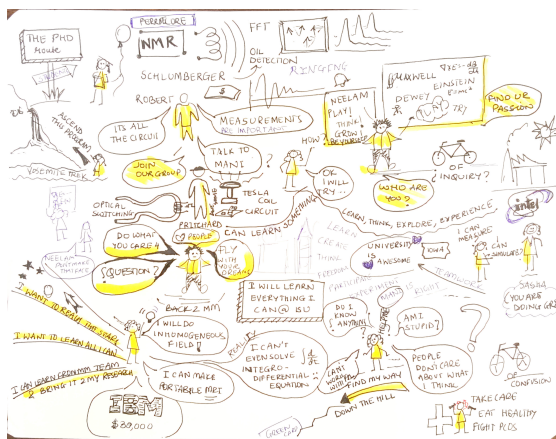


Figure 4: Mentor's notes after learning sketchnoting

Though the mentors generally approached the new methodology with positivity, they hinted on the fact that it was still hard for them to apply it in the more technical engineering classes. Additionally, they mentioned that its adaptation might rely heavily on how notes are presented in a lecture.

In general, the biggest challenge that the mentors faced in applying Sketchnoting was being critical of their own sketching ability and not effectively planning out the spacial arrangement of elements on a page because they are recording notes live in class.

VI. CONCLUSION AND FUTURE WORK

Based on these initial successes, the class observations, and the mentor feedback, the research team saw an opportunity to

develop a Sketchnoting tool. This tool would help engineering students be more strategic in conducting their note taking for a deeper understanding, focusing on learning and easier retention. Simply teaching Sketchnoting basics did not deem enough, therefore the team started to develop specific visuals and templates. Currently still in the development phase, the team created a first attempt to provide a system that makes it easy for students track their notes and see where they need to study more and see which topics they fully understood. At this point, the system is envisioned in form of a designed notebook that contains several visual cues (Figure 5).

This visual tool will be a two-part approach; the teacher provides visual and verbal cues, which the students can easily incorporate in their notes. Thus the first step was to identify general common visuals or metaphors that can serve as clues. The overall idea is to teach the teacher on how to present his/her work in a more visual way in addition to providing a supplemental tool that students use, which goes hand in hand with the instructor's teaching style incorporating visual cues such as those shown in figure 5. The second step would be to organize and present notes with visual cues using a note taking template such as the one shown in figure 6, making them more relatable in addition to making them more understandable.

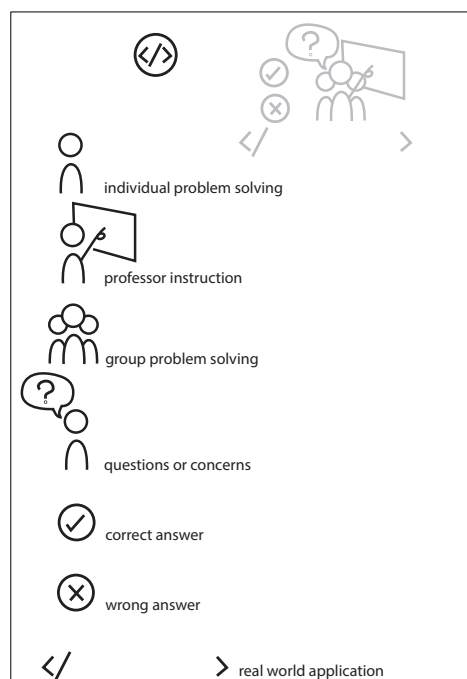


Figure 5: Visuals cues for engineering literacy classes

In closing, this research paper is an attempt to bring Skechnoting into freshman engineering classes. The aim is to provide the students with an alternative to traditional note taking in order to foster learning and retention, as well as visual outputs and the ability to communicate on paper and in team settings beyond the written or spoken word.

VII. REFERENCES

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