



Visual Notetaking: Opportunities to Support Student Agency in Active Learning

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Abstract

Engineering educators might be interested in innovative strategies to support student learning. We propose a creative design approach to support engineering students' learning: visual notetaking. In this work, we designed, offered, and researched a 10-week seminar on visual notetaking for thirteen undergraduate engineering students at the University of Washington. During the seminar we engaged in weekly conversations on visual notetaking topics such as layout, color, and text hierarchy. Afterward, we interviewed nine of the thirteen enrolled students and analyzed their artifacts generated from the seminar. We report our findings in two parts: first, we describe the iterative process of designing our visual notetaking seminar; second, we present vignettes and artifacts to highlight student experiences' in the seminar. One of our contributions to engineering education includes sharing our detailed curriculum design such that educators can promote visual notetaking practices in their contexts. Second, we encourage the engineering education community to consider how we can create opportunities for students to design their own active learning experience within traditional engineering classroom settings.

Introduction

As members of the engineering education community, one goal we might have is to create powerful learning experiences for our students. As educators, we might seek to support our engineering students in becoming self-directed learners who make intentional choices about their academic endeavors. Prior research highlights the role of educators in designing active learning classrooms [1], promoting a reflective culture [2], [3], and using project-based curriculum [4] to support student learning. We ask, what are smaller, more attentive opportunities for students to design their own active learning experience within classroom settings? We take a provocative approach to supporting engineering student learning through visual notetaking.

Visual notetaking is a method of representing ideas without always relying solely on words. Notetaking offers a large design space and opens up opportunities for metacognitive conversations about student learning. Further, visual notetaking helps us question the everyday and unexamined in engineering learning. Our work makes the familiar strange by facilitating students to take colorful and whimsical visual notes. We explore two research questions:

RQ1: How do we design modules that facilitate learning visual notetaking in a ten-week seminar?

RQ2: In what ways and to what extent might participating in a visual notetaking seminar be of educational value for engineering students?

We organize our findings by first, offering takeaways from designing an educational experience around visual notetaking (RQ1) and second, exploring the extent of which a visual notetaking seminar might be valuable for students (RQ2). This investigation flips the script from educators designing learning to supporting students as designers of their own learning experiences.

Related work

Defining visual notetaking

Visual notetaking refers to the process of drawing, organizing, and creating notes from information presented to users. Visual notetaking, sometimes referred to as sketch noting, includes components of lettering, flow, order, icons and color [5]–[7]. Others refer to visual notetaking as visual learning, a strategy that uses graphics, images, and animation to enable and enhance engineering learning [8]. Visual notetaking is a process that can take place in the classroom during lecture, in homes while reading a book for leisure, or in public spaces while listening to a research presentation. We build on existing visualization research as “mechanisms by which humans perceive, interpret, use and communicate visual information” [9].

Visual notetaking in educational contexts

Based on our own experiences as educators and prior research, we find visual notetaking is used in a range of academic contexts. Within our institution, a Marine Biology professor who received a distinguished teaching award asked his undergraduate students to generate weekly summary sheets [10]. In the summary sheets, he asked students to make connections to the learning objectives displayed in a pictorial format that used flowcharts and diagrams rather than text. Additionally, students enrolled in an interdisciplinary design master’s program received class credit for attending weekly seminars by turning in visual notes from the presentations. Research in chemistry education highlights the value of card creation to support students comprehension of periodic table elements [11]. Yet, within engineering education, few examples exist of research that focuses on developing students’ creative abilities [8] through visual notetaking.

Cognitive processes within visual notetaking

Visual noting can be seen as a design process [12]. Specifically, taking notes can be seen as a cognitive process where notetakers first think divergently, then collect their thoughts, and finally converge to a “single realizable design” of their notes [12]. When taking visual notes, students can take up and practice flexible cognitive processing models. A breadth of industries use sketching as a way to think through possible solutions to problems [12]. For example, Roam presents visual notetaking methods as a new way of looking at business problems and ideas [13]. Roam argues thinking with pictures can help discover and develop new ideas, work through problems in unexpected ways, and think outside of the box.

When framed as sketching, visual notetaking is a process in which students are developing low fidelity designs. Visual notes are dynamically evolving designs thus freeing the “user from worrying about technical limitations or assumptions and encourages them to explore different solutions” [12]. Furthermore, a low fidelity framing of visual notetaking opens up opportunities for students to share their designs, thoughts, and creations with each other to iterate on the artifact. When asking engineering students to envision visual notetaking as a design process, it is important to keep in mind that not all students might know the language or framing of design thinking, convergent thinking, or divergent thinking. We posit this as an opportunity to introduce the culture and knowledge of design thinking mediated through visual notetaking.

Visual notetaking supports cognitive processing in three parts. Computational offloading means different external representations such as graphs and models reduce the amount of cognitive effort to solve problems [14]. Re-representation, a process in which students present the same information in different ways, can both support and limit cognitive processing because of interpretation of conventions [14]. Finally, graphical constraining, such as the creation of icon representations, requires closeness between abstraction and the real world in order to support students’ cognitive understanding of the material [14].

Student experience in education

Equity in education literature highlights the importance of centering the lived experiences of students [15] and tailoring curriculum to ensures student academic success by cultivating their funds of knowledge [16]. Here we highlight the importance of attending to students’ existing study habits and tailoring visual notetaking practices to students’ funds of knowledge. Further, [17] provide empirical evidence regarding the influence of motivation, interest, and perceived ability in determining student success within engineering. We posit that visual notetaking can support aligning engineering course material with student motivation and interests. We see the potential for visual notetaking to support student agency in make sense of engineering content being presented in their courses through their own creative representations in notes.

Part I. Iteratively designing an educational experience on visual notetaking

Seminar context and curriculum

In working together through advising relationships and teaching assignments, Wendy, Andrea, and Jennifer noticed the different ways in which we took, referenced, and shared our notes. We designed the seminar as an opportunity to collectively learn about visual notetaking and its affordances for educators and students. Our 10-week seminar was offered in the department of Human Centered Design & Engineering (HCDE) at the University of Washington. Enrollment in the seminar was open to anyone who expressed interest and students received academic credit toward their undergraduate degrees. Our seminar consisted of thirteen undergraduate students at different academic stages from various majors and a shared design interest. We met once a week

to engage in collaborative visual notetaking activities. Table 1 below provides an overview of the curriculum and we encourage readers to see Appendix A for additional details on each activity.

| Week | Topic | Week | Topic |
|------|---|------|--|
| 1 | Introduction to visual notetaking | 6 | Principles of the use of color |
| 2 | Principles of making text visual | 7 | Principles of lettering |
| 3 | Principles of layout | 8 | Creating and sharing tactile notes |
| 4 | Imagery and creating an icon library | 9 | Final reflection |
| 5 | Mid-point reflection on “Today, 5, 10 years...” | 10 | Potluck celebrating the seminar work generated |

Table 1. Overview of Seminar Weekly Content (See Appendix A for details)

The curriculum was iteratively designed by three co-authors (a master’s student, a PhD student, and a professor). Overall, the curriculum was informed by online resources on visual notetaking and sketch noting, reflective activities, and our prior teaching experiences. Students learned about the use of visual elements in their notetaking practices through structured weekly modules. For example, for one module students created tactile notes and engaged in a conversation of accessibility and notetaking (Figure 1). Throughout the seminar students were asked to take notes once a week and post them on a virtual notebook that everyone in the seminar had access to through Google Drive. Students also made meaning of their experiences in the seminar through two structured reflection activities. We individually and collectively generated multimodal artifacts grounded on the concepts we were learning about visual notetaking.



Figure 1. Examples of tactile notes created during the seminar

Seminar approach: a learning together spirit

We designed the seminar by drawing on the human-centered design process, equity in education literature, and our ongoing research on how to support student reflection in higher education. During the seminar, we leveraged the breadth and depth of strategies students already enacted in their notetaking practices. By participating in in-person brainstorming activities and working collaboratively, students learned from each other. They iteratively improved how they took notes visually in a way that felt most productive to their individual needs. We posit that the in-person

and social nature of our seminar contributed to a collaborative learning environment where students engaged in peer discussions, peer debriefs, and collective knowledge production. Future research can explore creative ways in which the seminar content and pedagogy can be delivered through online methods while retaining the community-based learning environment. Throughout the quarter, we realized that we were collectively theorizing what visual notetaking meant to us as learners, notetakers, and scholars. Taking a playful seriousness approach to our instruction, we uncovered scholarly questions of what it means to take notes, to share notes, to learn varied forms of content, to remember, and to be intentional in our notetaking practices.

Our seminar incorporated many reflective elements given that two of the educators were actively involved in ongoing research on reflection in engineering education. Reflection as a form of metacognition that involves stepping out, thinking about, and connecting forward [18] helped us make sense of our experiences during the seminar as an ongoing practice. We designed reflection activities that took into account where students were in the quarter, what topics we had been discussing, and made use of a creative range of materials and formats.

Iteratively designing the seminar

Curriculum. We turned the notion of visual notetaking into a meaningful educational experience within the constraints of a 10-week academic quarter. Originally, we planned on using an existing visual notetaking online resource and then adapting the instruction for our seminar. Serendipitously, the online resource we found had 10 visual notetaking modules. Halfway through the quarter though, we learned half of the resources would have to be purchased. Thus, we modified our curriculum on a weekly basis, drawing on knowledge from each other and inspiration from those around us. As we designed around this problem, we communicated to the seminar participants that we would decide together what topics to cover and the kinds of activities we wanted to engage in during the seminar.

Iteration. As designers, engineers, and educators, our approach to the design of the seminar was iterative. We created and respected opportunities to listen, observe, and respond based on how students were taking notes. For example, one week we designed a tactile note taking activity after being inspired by Dr. Bennett's research on accessibility in design [19]. When shifting the curriculum to accommodate for this new idea of creating tactile notes, students were responsive to the whimsical but important nature of activity. We ended up having a critical discussion about empathy and design inspired students' approach to accessibility in notetaking. For the topic of lettering, we learned a student had prior lettering knowledge from social media and took it on herself to lead and teach a mini-series on lettering components during the seminar. Another week, we noticed a number of students had strong drawing and doodling skills. We gave them blank squares of colorful paper and asked them to generate as many icons as they could without having a specific desired outcome in mind. After each student drew their unique and creative icons, we worked together to cluster the kinds of icons created. We decided to make an icon

booklet, which still exists today and is shared among our department (Figure 2). In these ways, our curriculum was co-constructed among all seminar participants.

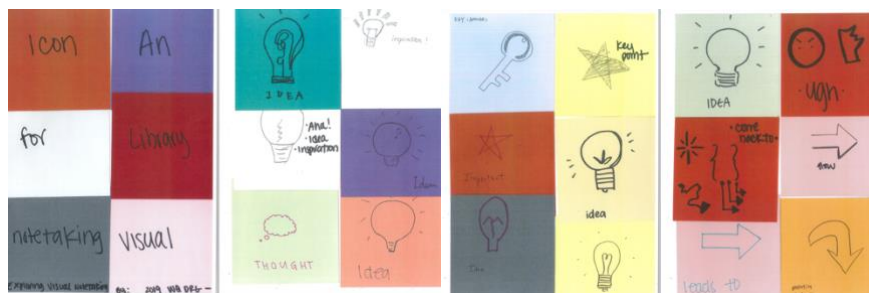


Figure 2. Examples of icons created during the seminar

Seminar Characteristics. Certain seminar characteristics were not directly connected to the curriculum but influenced the overall educational experience. To start, throughout the process we were transparent and honest with students that we would be actively be collectively making sense of the experience. This transparency set the expectation for everyone that we would collectively be responsible for our educational experience, rather than the educators having a specific vision or goal we sought to accomplish. We chose to have students take visual notes every week so that we could self-evaluate our progression over the quarter, but we did not give explicit guidelines as to what students had to take notes on. This meant students were not required to take notes in another class and put their grades in jeopardy when experimenting with notetaking. Given the nature of visual notetaking and undergraduate learning, it was not difficult to design activities that both engaged students and served a purpose. We learned a collective online notebook was a great way to not only organize and share our weekly notes with each other but offered support for generative group conversations. In the end, our collective online notebook served as documentation of our 10-week visual notetaking journey.

Part II. Intentionally attending to students' experiences in the visual notetaking seminar

Approach: understanding the student experience

All 13 students enrolled in the seminar gave written consent for us to analyze the artifacts they generated. We recruited 9 out of 13 enrolled students to participate in semi-structured interviews via two email requests and they gave their verbal consent to be audio recorded. After the first draft of this paper was written, we followed up with the 9 interview participants via a google form to ask their major at the time of the seminar, their pronouns, and if would like to change anything from the draft. We also asked participants whether they would like to be named or pick a pseudonym for the representation of their work in this paper. 6 out of 9 students that were interviewed chose to have their name represented in this paper, the other 3 did not respond to the survey and were given pseudonyms. Table 1 provides participant details. Participants were not compensated. Finally, our research was exempt by our university's institutional review board.

| Name | Pronouns | Department (Year) | Artifact | Interview |
|-------------|----------|-------------------------------|----------|-----------|
| Emily | she/her | Engineering (3th) | Y | Y |
| Amy* | she/her | Communication (4th) | Y | Y |
| Kristin | she/her | Engineering (2nd) | Y | Y |
| Schawnergy* | he/him | Art (3rd) | Y | Y |
| Trinity* | she/her | Interested, engineering (1st) | Y | Y |
| Yifan* | she/her | Interested, pre-science (2nd) | Y | Y |
| Fred* | he/him | Interested, engineering (1st) | Y | Y |
| Sharon* | she/her | Interested, engineering (2nd) | Y | Y |
| Ziva* | she/her | Interested, engineering (2nd) | Y | Y |
| Sunny* | he/him | Engineering (4th) | Y | N |
| Josie | she/her | Engineering (4th) | N | N |
| Zara | she/her | Engineering (3rd) | N | N |
| Zoey | he/him | Engineering (3rd) | N | N |

Table 2. Details on student participants, *represents student name

The interviews were structured in two parts. In part one we asked students questions about their motivation for enrolling in the seminar, about their experiences during the seminar, and about the potential impact of the seminar on their education. In part two, we conducted an artifact probe to prompt discussion about the students' creations during the seminar. Interviews were semi-structured, lasted between 30-45 minutes, and were led by the first author. We audio recorded each interview and transcribed parts based on our analytical memos. Following the interviews, two undergraduate students enrolled in the seminar supported the collective analysis of the data.

Data analysis

To analyze our qualitative data (interviews and artifacts) we began with an inductive process of open coding [20]. During the first round of analysis, each researcher listened to, annotated, and synthesized key takeaways from three interviews. Collectively, we generated eight themes that arose from the interview data that informed our criteria for the development of each student's portrait. During the second round of analysis, researchers developed each student portrait based on the following criteria: "In these portraits we will discuss their visual note taking practices prior to the seminar, highlight one artifact they created during the seminar, and present one key takeaway of their experience." Finally, during our third round of analysis the research team came to a consensus about the four student portraits we wanted to highlight in our findings by: a) synthesizing our analysis of interviews, portraits, and artifacts; b) engaging with existing

research in engineering education and visual notetaking; and c) reflecting on our collective experience in the seminar. To ensure trustworthiness of our work [21], we engaged in peer scrutiny among other education researchers and engineering educator.

Positionality statement

Qualitative research and analysis are inherently personal [22], [23]. Our prior experiences and lenses informed the way we designed and offered the seminar, our research process, and our data analysis. Given our subjectivity that might have influenced our study, we reflect here on the lenses that informed our approach. We are educators who are committed to centering the student experience in engineering education. Some of us were primarily in the role of educators while others held the role of undergraduate students within an institution of higher education. Furthermore, we take a sociocultural theoretical perspective [24], [25] to support engineering student learning. These lenses informed the design of our seminar and our analytical approach.

Student artifacts

We present four student portraits of their experiences taking visual notes during the seminar and their perception of the seminar experience a year later. In these portraits we discuss their visual note taking practices prior to the seminar, highlight one artifact they created during the seminar, and present one key takeaway of their experience. In doing so, we honor students' experience of the seminar and their perception of its role in their engineering education.

Schawnery was a third-year undeclared major student. For Schawnery, seeing other's visual notes gave him insights into other students' learning processes in different courses. He enrolled in the seminar because it was not as selective as other research groups and he was interested in engineering education. Schawnery was interested in how visual notetaking processes could benefit his own education and teach him learning techniques that may otherwise seem obscure.

Our interview with Schawnery highlighted how visual notetaking can benefit a student's memory about course content. During his interview, Schawnery recalled details of the course in which he took notes even a year after the course had ended (Figure 3). Schawnery recalled information from the lecture which was not directly correlated to his field of study. Schawnery pointed out how this reminder of the course content by just referencing these papers was an example of the potential lasting impacts visual notetaking can have. Furthermore, this suggested to him that the extra effort put into the initial documentation of information from the course could later reduce the amount of time needed to recall course content later for an exam or an assignment.

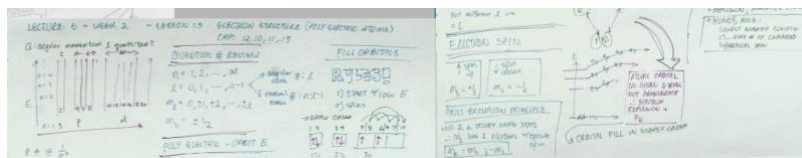


Figure 3. Schawnery's visual notes taken during the seminar

Ziva was a second-year undergraduate student intended engineering major when she enrolled in the seminar. The seminar interested her because she was passionate about graphic design and wanted to create connections between her academic studies and personal interests. Ziva noted that she did not take visually appealing notes prior to the seminar. She was expecting to learn more about specific lettering, organization, and drawing techniques. Ziva was already familiar with Cornell notes and had a basic visual system that she tried to follow. However, she felt that she did not have enough time to reorganize her notes after class. She would simply jot down bullet points and important concepts as they were presented verbally in lecture. During her interview, Ziva wondered whether instructors expected students to take notes, since they would send out lecture content at a later time, which made the notetaking process more difficult.

Ziva saw the potential of motivating herself to review her own notes more often after seeing visually aesthetic notes on social media. As Ziva progressed through the seminar, she began to organize the content of her own notes based on themes from the content. She applied visual notetaking in her user research class and practiced visual notetaking in different contexts outside of class. She became more intentional in highlighting key information as well as developing what visualizations were most important to put into her notes. This was particularly evident for her visual communications class which had a high demand to filter important information occurs as information accumulated. Sometimes, writing notes became a distraction, especially when there wasn't enough time for new information to settle in her mind. Ziva found herself wishing for more connections between notetaking, current industry practices, and theories of learning.

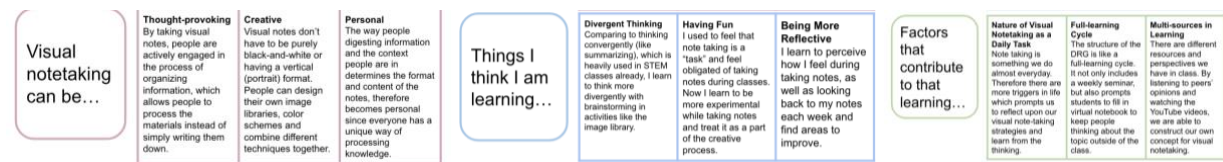


Figure 4. Ziva's submission from Week 5 "Meaning-making in Motion"

In her artifact, Ziva described her perception of visual notetaking, her takeaways from the seminar, and factors which contributed to her learning (Figure 4). Contrasted with her original perception of visual notetaking as creating a visually appealing piece, she viewed the process of visual notetaking as "thought-provoking" and "creative" which allowed her to have fun and be more reflective throughout the process. Ziva also attempted to define the cognitive processes behind visual notetaking. Ziva described the structure and design of the seminar as a learning experience that contributed to her learning visual notetaking for in and out of classes.

Emily was a second-year engineering student. Emily noted her love for taking notes on paper growing up and her curiosity about the department, as key motivators for enrolling in the seminar. Before the seminar, Emily considered her notes messy and noted that she had a hard time going back through her notes. She mainly took notes on paper for science classes and used graphs, underlines, boxes and bullet points in her notes. Emily broke her wrist a couple of days

before the seminar started. As such, while taking the seminar she was enrolled in our university’s disability resources notetaking service. Due to her wrist being in a cast, that quarter she put more time and intentionality into her notetaking practices. Emily observed differences between the hand-written notes that were sent to her and her notes on the laptop. She felt notes were harder to go over when she did not take the notes herself. During our interview, Emily shared that she thought everyone had a different “notetaking style.” She said that for her the process of understanding course concepts while writing down explanations for them helped her with remember course content. Emily described her current notes as a lot more “visual” and comprehensible for other people after the seminar. Overall, Emily thought the seminar taught her how to effectively take notes. It also helped her to make sense of the actions involved in taking notes and how to help herself going back to her notes by taking “good” ones.

After taking the seminar, Emily considered visual notetaking to be beneficial for her conceptual understanding and processing word problems, but not as feasible to do while working with formulas from science classes. In her physics class, Emily only took notes during lecture sessions, but she also hopes to incorporate the process into lab sessions. In terms of mediums, Emily hopes the professors could be more open to different mediums, as in both digital and hand-written notes. Emily’s more memorable session is the group activity when students split up and work on huge posters on the wall. She enjoyed working in a group setting, learning and trying to comprehend other people’s notes and their reasoning. She also remembered watching videos on notetaking styles, and she used the techniques from the videos in her current notes.



Figure 5. Emily’s artifact from Week 9 “Blurbs”

In her artifact, Emily created a digital visualization to summarize visual notetaking (Figure 5). Apart from describing the topics and materials explored during seminar, she provided a definition of visual notetaking as “a personalized, engaging method to spicing up your mundane notes”, which correlated to her interview note of everyone having a unique “notetaking style.” In describing her artifact, Emily also noted the influence of her peers on her learning during the seminar. This artifact highlights Emily’s change of sentiment towards visual notetaking, from considering her notes messy and never going back to review her notes prior to the seminar to describing visual notetaking as “creative, rewarding, efficient.”

Yifan was a second-year pre-science major student. Prior to the seminar, Yifan considered herself a visual person, who learned information through writing instead of reading. She was interested in the research process of visual design and saw the potential for the seminar to inspire her

design process. Before the seminar, Yifan was interested in notes but thought her notetaking process was inefficient although her attention to detail helped her remember information. She preferred taking notes with bullet points, with lined paper, and colorful highlighters. Yifan thought most of her notes for her science classes were unorganized and lacked images in general.

After the seminar, Yifan continued to explore new mediums for notetaking and now uses dotted paper to take notes. She thinks that having a notebook with both dotted and lined paper can help her incorporate both texts and images in her notes. For Yifan, her current notebooks serve two purposes: one as a reference booklet and another to help her re-organize her notes. Overall, Yifan thought the seminar helped her reflect on her intentions of taking notes. She also thought the seminar helped her make connections with other design students. Yifan saw notetaking as an important process to reinforce concepts that she already understood, but found it challenging to take visual notes when trying to understand new ideas.

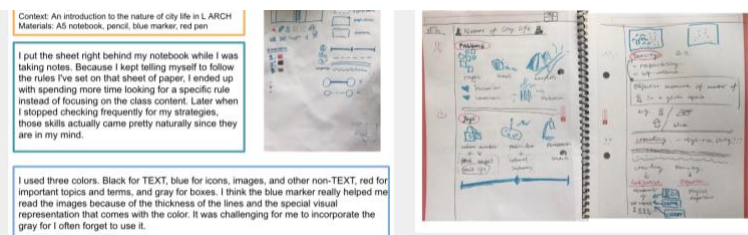


Figure 6. Yifan's artifact from Week 7 "Incorporating Color"

In her artifact, Yifan reflected on her notetaking experience in her architecture class while trying to incorporate a consistent color scheme (Figure 6). Yifan described notes in this image as having a visual organizational system. Yifan also talked about her learning process to incorporate the color system, which moved from distracting to natural. She also described the use of different tools and colors as beneficial to her process of synthesizing of knowledge. In contrast to her previous practice of using an excessive number of colors while taking notes, in this artifact Yifan reflected on her intentional choices of colors and visual organization.

Discussion

We offer three key takeaways from this work. (1) Tiny changes lead to big conversations. Bringing in craft materials facilitated a conversation about the role of accessibility in notetaking. We highlight how asking students to sketch out icons for notetaking led to a conversation on the pedagogical meaning behind each icon. (2) Students are willing and eager to engage in conversations about academic practices. We observed that students in our seminar wanted to ask their professors to take visual notes of their own lectures to see their thinking rationale. (3) Visual notetaking is worthy of further attention for seeing immediate impact of student learning. We were pleasantly surprised to hear student reactions on a weekly basis about the impact taking notes in their courses was doing for their thinking and learning.

Our research findings hint at broader questions of how we, as engineering educators and designers, can support students to be active agents in the design of their learning. A rich body of literature exists in education that focuses on how educators can design and set up active learning experiences for students. This work helps us begin to question power dynamics in enabling and designing active learning situations within engineering education to shift power to the students.

Future work

Our experiences with visual notetaking left us with questions for future work as we move forward in our roles as educators, designers, researchers, and learners. We are left wondering how technology might support or hinder the future of visual notetaking. With rising concerns about sustainability and the clutter involved in taking physical notes, future work could explore questions around digital visual notetaking (with different digital creation and organization tools). We are also left wondering about the application of visual notetaking in different classrooms outside of engineering. What might we learn from a student taking visual notes in an art classroom that can support a student taking notes in an engineering classroom? Further, we posit future work could explore how undergraduate students appropriate and utilize word processors to take notes in courses. Given the speed of material being delivered during lecture, we could ask how future technologies might affect note taking practices as different software becomes available. Finally, we call for future attention around the role visual notetaking might play in fostering engineering educational culture of diversity, equity, and inclusion. How might visual notetaking promote a sense of belonging and agency in the engineering classroom?

Conclusion

We find this research to be revelatory toward the locus of active learning. A dominant narrative within engineering education is characterizing lectures as passive learning. Recommendations from engineering education research calls for educators implementing changes to the lecture format in a way that makes it more interactive. We believe our research has the potential to shift the dominant narrative around lectures as passive by giving students a design tool make lecture more engaging for themselves through visual notetaking. For engineering education, visual notetaking through its use of icons, coloring, and layout, draws critical attention to the potential for change supporting engineering student agency in their active learning.

Acknowledgements

We greatly appreciate the sustained engagement of all students enrolled in our seminar.

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Appendix A. Visual notetaking curriculum

Weeks 1 & 10: Introduction & Celebration

During Week 1, we clarified expectations of the seminar and tried to convey a “we are all learning together” spirit when describing what the next ten weeks would look like. Next, we watched a TED talk together on women’s issues and took individual notes to set a baseline.

During Week 10, we celebrated our work and engagement with the seminar through a potluck where every student brought a food item and creatively connected it to the theme of visual notes.

Week 2: Making Text Visual

We asked students to try visual notetaking for a total duration of 20 mins. We noted this could occur in one of their core classes, in a lecture, while watching a video, reading an article, or taking notes from a textbook. We described that we would be asking them to take notes for a set amount of time but that they could change what they would like to take notes on every week.

Our meetings started with asking each student to take 30 seconds to share their notes and their process from the past week. Students were welcome to discuss the subject they took notes on, what materials they used, or if anyone around them asked what they were doing, etc. Next, students laid out their notes around the room and engaged in a studio critique session with post-it notes of each other's notes to discuss positives using pink post-it notes, purple to discuss strategies to draw from in the future, and blue post-it notes for questions they had.

Finally, we watched a video from the website Verbal to Visual on “How to Sketchnote without Drawing” <https://www.verbaltovisual.com/how-to-sketchnote-without-drawing-vtv-episode-8/>. After watching the video we discussed the key strategies they outlined for visual notetaking, strategies to implement for the next week, and we considered the differences between our individual mental frameworks of visual notetaking and the video’s process.

Week 3: Layout

After each student shared what it was like to take notes over the past week, we engaged in a storytelling activity through visual notes. We reminded students that one of the themes we had been exploring thus far was: *How might visual notetaking be public?* For this activity, we gained inspiration from one of our HCDE colleagues who wrote an article in the Seattle Times about the power of storytelling <https://www.seattletimes.com/education-lab/student-voices-storytelling-shouldnt-be-confined-to-the-humanities/>. We asked students to create visual notes in such a way that shares a story about anything with a partner. Some examples ranged from stories that show who the students are and where they come from. their undergraduate journey, their experiences learning a new hobby, or a fictional story of them embodying a natural element. We said they

chose the story you want to tell through visual notes. Following, we watched and discussed a video on visual notetaking from Youtube.

Week 4: Imagery and Icon Library

As the seminar was approaching the halfway mark through the quarter, we asked students to reflect on the progress so far. We also asked them to find inspiration from others' notes, explore questions of context, and layout. We gave them the following prompts:

Compare your notes now to your notes at the start of seminar, how have they changed? What areas have had significant improvement? How have you stayed true to your style? From observing your peer's notes, what is one aspect of visual notetaking that you'd like to improve on? How does the environment in which you take notes influence your visual notes - compare notes taken in lecture to reviewing notes at home alone? After learning about and practicing layout strategies, which ones resonate with you? Which didn't work well? Why or why not?

Then we watched and discussed a short Youtube video on imagery:

<https://www.youtube.com/watch?v=92z3v7fx9Io>. Finally, we collectively created an icon library after providing the following instructions:

Warm up. [5 mins] Draw 3 images related to nature, one per card.

Individually. [20 mins] Draw 20 images that you think will be useful in your visual notetaking practice along with a description per card. They may include: Icons (arrows, location, drop pin), People & faces (stick figures, angry, happy, confused), Scenes (open to interpretation), Discipline-specific (images for a particular academic topic), Lines and frames (picture frames, lines with meaning), Objects (bikes, water bottles, keypad)

Group. Gallery Activity. [15 mins] Tape your cards to the poster with the category that best represents it. If you don't see a poster with a category that fits it, start a new one: Poster titles, Icons (arrows, location, drop pin), People & faces (stick figures, angry, happy, confused), Scenes (open to interpretation), Discipline-specific (images for a particular academic/theoretical topic), Lines and frames (*picture frames, lines with meaning*), *Objects (bikes, water bottles, keypad)*

Week 5: Mid-point Reflection "Today, 5, 10 years..."

In the middle of the quarter, we designed a "today, 5, and 10 years" two-part reflection activity with the goal of exploring: *What kinds of things are people learning as a part of being in the visual notetaking seminar? What factors are contributing to that learning?*

Prework. We asked students to fill out a template (Figure A) prior to the seminar which asked them three things: 1) *Visual Notetaking can be...* 2) *Things I think I am learning...* 3) *Factors that contribute to that learning*

| | | | |
|---|------|--|--|
| | Name | | |
| Visual notetaking can be... | | | |
| Things I think I am learning... | | | |
| Factors that contribute to that learning... | | | |

Figure A. Template we asked students to fill out before the seminar

In the moment, group activity. Prior to class, we printed out all of the student submissions and cut them into strips: can be, learning, and factors. We divided the number of students into three groups. One group took the “can be” submissions, another the “learning” submissions, and the last taking “factors” submissions. We gave each group tape, scissors, and poster paper and told them to read through the submissions and write 3 (or more) takeaways on the poster paper.

Sharing. Each group then shared their key themes from all of the submissions. Some snippets included: Visual notetaking can be...be creative, efficient, stressful, rewarding, and useful; Things I am learning...relate to organization, sharing, intentional learning, and techniques; Factors that contribute to learning...practice, watching videos, group activities, group diversity, and a level playing field.

In the moment, individual activity. Once all the small groups shared their insights from their posters we sat down as a large group again. We asked students to visually note on a piece of letter-sized paper: How the six themes will matter for them today, one year from now, ten years from now.

During Week 3, we had asked students to do a reflection activity on a blank sheet of paper and their creative responses were so different and personalized - thus, we repeat the creativity. The written and visual responses were fascinating to look through, they had a depth of creativity, critical thinking, and meaningful insights (Figure B).

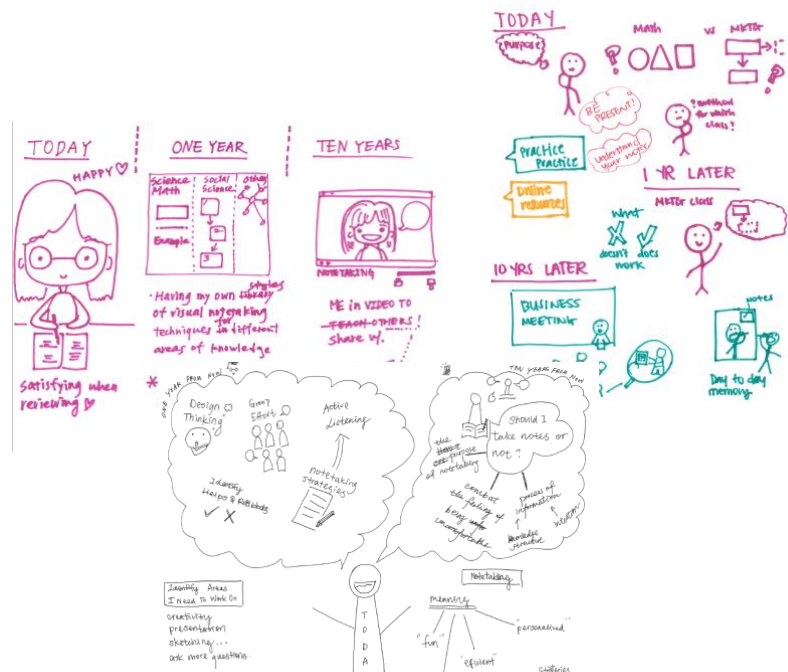


Figure B. Visual reflection student responses response to how our learnings in the visual notetaking seminar will matter to them today, a year from now, and 10 years from now

Week 6: Coloring

This week, we had planned a virtual seminar meeting due to a snow day at our university. To prepare for the meeting, we asked students to gather: A blank piece of paper, Any coloring materials they might use for visual notetaking. Examples: color pencils, highlighters, pens, markers. We encouraged them to be creative. For our check-in we asked each student to take 2 minutes to draw out a visual notetaking icon or a scene that expressed how they had been feeling during the snow day and share it on the video camera. We then watched two videos on coloring: two color approach <https://www.youtube.com/watch?v=PD3nJkwmRpM> and three color approach <https://www.youtube.com/watch?v=rgEPfa3FJu0>.

We described our color activity as follows:

“Take a minute to pick a specific context in which you will be taking notes, e.g. a specific class, a specific situation where you work. Next, take a minute to put yourself in the context. Close your eyes and if you’re sitting in a classroom, imagine what do you need? How could you create something that helps you take visual notes?”

We then asked students to take about 15 minutes to design a one-pager handout for their visual notetaking strategy.

Envision you put this on placed this one-pager on your desk while in the class to help you take notes. What would be most helpful to refer to? This may include color, icons, layout, and any other elements you want to include.

Finally, students shared virtually by displaying their one-pager to the group and answering one, any, or all of the questions we provided:

What was your thought process of making this? What did you make? How do you envision yourself using this? What could you add next time?

Week 7: Lettering

We started this week by asking students to imagine:

If you were going to create a flyer for “selling” visual notetaking to others - what would it have on it? Think of this as a marketing material tool. How would you promote visual notetaking? What would be appealing to others?

We encouraged them to take the freedom to maybe include testimonials, blurbs of the potential benefits, ways to use visual notetaking, etc. To spark creativity, we said:

You might imagine your audience being your professor where you took visual notes, maybe your audience is your mom to tell her what you have been up to in the seminar, or maybe it is your friend who’s been intrigued with all the drawing you have been doing lately.

We then gave them five minutes to create a flyer using an 8.5 X 11 sheet. When the time was up, we shared our designs to the whole group. Next, each student shared their experiences taking notes over the past week with a peer.

This week based on student interest we had one of our undergraduates enrolled in the seminar give a 15-minute presentation on lettering. She had told us over the seminar of the quarter that lettering was something she felt really passionate about and wanted to share her expertise. After her lecture and a group discussion on lettering, we took the rest of the time practice lettering by making our own alphabet set.

Week 8: Tactile Notes

Inspired by a conversation about accessibility research with a wonderful colleague Dr. Bennett, we decided to create tactile notes this week. We brought in different materials, tools, and objects to the seminar and gave students the following instructions:

Given the materials in these boxes create a tactile visual notetaking sheet. Thinking about accessibility, this sheet might be something that someone with visual, mobile, or hearing impairments might interact with. This sheet can be notes on how to bake a cake. The notes are open to be about anything, as long as they are tactile.

Week 9: Final Reflection “Dice and Blurbs”

For this week we designed a final reflection activity to engage in collective meaning making of the seminar. At this point, we knew our students were very willing to try new strategies for visual notetaking, share their insights from the weekly activities, and have an open mind for new activities. To plan for this reflection activity, we relied heavily on an excel spreadsheet created by Dr. Turns to help scaffold their reflection through prompts. We changed some of the questions to be about student identity, what it means to be a learner, and edited the column about lens to be clearer it was from the perspective of someone. We shared that the goal of this reflection activity was to make sense of all the experiences we had in the past 8 weeks. Students had an active role in reflecting on their experiences, collectively generate the knowledge, and feeling supported in understanding what we learned. Prior to the seminar, we printed out the reflection prompts (Figure C) and made the columns the color of the dice we had available.

| | Looking back: Events | Looking back: Reactions | Thinking about: Explanations | Thinking about: Lens | Thinking about: Assumptions | Thinking about: Takeaways | Projecting forward: Connections | Projecting forward: Actions | Endings: Wrap-up |
|---|--|--|--|---|--|---|--|--|--|
| 1 | Think back over this past week. What's been going on in the past week? | Think about what surprised you? What was it? | Say more... | What do you think 12 year old you would say about this? | Can you find an assumption you have about being a good learner? What if you questioned that assumption? | What is a small thing you can takeaway from all of this? | How can you connect your thoughts so far to being a social learner? | What is something about this conversation you could talk to your friend about? | Look back over your thoughts in this reflection--what are three key ideas? |
| 2 | Think about your first and last efforts with visual notetaking... how were they the same or different? | Think about what frustrated you. What was it? | Why do you think you had this reaction (i.e., your response to the prior questions)? | What would a potential employer have to say about this? | Can you find an assumption you have about yourself and your salient identities? What if you questioned it? | What is a question you can takeaway from all of this? | How can you connect your thoughts so far to your goal of being a successful student? | What is something you could do next Monday about this if you had no finals? | What could you title this reflection to make yourself want to read it later? |
| 3 | Think about the last time you took visual notes in a social setting (classroom, a lecture, a talk)... what happened? | Think about what was natural and tedious. Tell me about it | Ok, unpack this a bit... | How do you think a family member would respond to this? | Can you find an assumption you have about school and what is acceptable in school? Let's question this... | What do you know now that you didn't know before? | How can you connect your thoughts so far to a goal of being a confident learner? | What is something you might want to read about further? | What could you title this reflection to make your roommate interested in reading it? |
| 4 | Think about this entire quarter... what were some highlights? | Think about what was uncomfortable. What triggered it? | What is an analogy that might get your thinking moving farther along? | Think about your roommate - what would they have to say about this? | Can you find an assumption you have about doing well in school and what counts as doing well? What if you questioned it? | What is one thing you might share with your peers about this? | How can you connect your thoughts so far to a personal professional goal? | What is something you might want to do the next time you talk with an educator in your life? | If you assigned a color or ice cream flavor to this reflection, what would it be? |
| 5 | Think about a time this quarter where you did not take visual notes...What happened during that experience? | Think about what was pleasantly fun. What was it? | Why? | What do you think an educator would say about this? | Can you find an assumption you have about doing well in the classroom? Let's question this... | What do you think is worth remembering from these thoughts? | How can you connect your thoughts so far to a personal life goal? | What is something you might explore by finding online resources? | If you were to add a visual to this reflection, what would it be? |

Figure C. Reflection chart depicting students’ thoughts throughout the quarter

Students were split into groups of three: One person as the facilitator, one person responds to the prompts, and one person as the note taker. Each person will respond to a prompt using dice for

~15mins. The goal was to randomly respond to one box in each column. We asked students to start from the left with "Looking Back" and work their way to the right as they respond to one of the prompts per column. Roles were switched every 15 minutes.

When explaining roles, we offered students the following pointers:

- Trusting that each person owns their experience - is an expert of their own experience...
- Facilitator might remind the person responding, here are some things you've said already
- Facilitators, help your peers stay in the story that they are sharing as they move along prompts...
- Notetakers, take notes on what might be most helpful for the person sharing when they are writing up their blurb.

The dice allowed for a game-like quality where we had dice rolling everywhere and at a given time you might roll all nine dice. Some students lined up the dice at the top of the sheet while others placed it on the corresponding row (dice number) and column (dice color). We received positive reactions to this reflection activity.

15 minutes was just enough time to get everyone to share their responses to the prompts. Some said they wanted to write a letter to educators and TAs, others wanted to incorporate more creativity into their blurb in addition to words and asked if they could write about one specific week or the whole quarter. Although the blurb assignment was open ended, students felt comfortable because they had generated a lot of content in the reflection activity. They all liked the game like quality, and this might have gone well because the whole seminar has had a tone of playful seriousness throughout. One group was confused and did not realize until the end that each column proceeded the next one. Overall, everyone seemed to have meaningful conversations about the seminar through this activity.