

Project 4: Writing Tools

By Sasha S, Ettian K, Aaron A, Liana K
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10 AM Studio

Section I: Data Collection

Brainstorm:

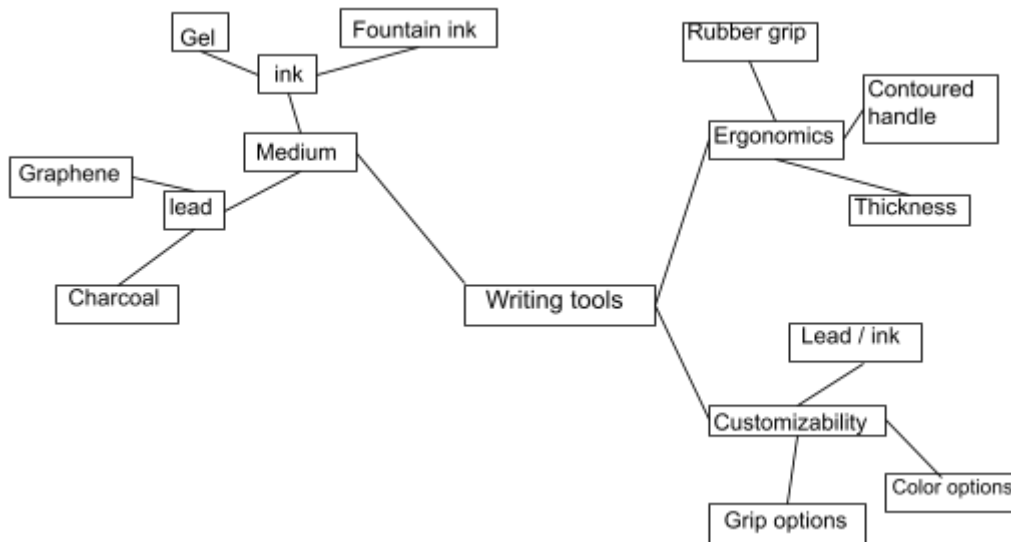


Figure 1: Brainstorming on different writing tools and the different elements that users interact with.

We were inspired to look at writing tools because we each had different tools that we were using on the daily. We also noticed within our friend groups and study groups the variety of writing tools that were being used. Some people used fancy mechanical pencils made of metal, while others still preferred using the regular yellow H.B. pencils. Because of this variety, we thought it would be interesting to look at why people choose to use each writing tool and what makes a writing tool the best. Another reason for picking writing tools was because we each had different issues, **errors, and gaps in evaluation** that we had experienced with our own writing tools in the past and present. We were curious to find out others' experiences and how we could create a redesign that hopefully would solve many of the **errors** or large **gaps in evaluation and execution**.

Research:

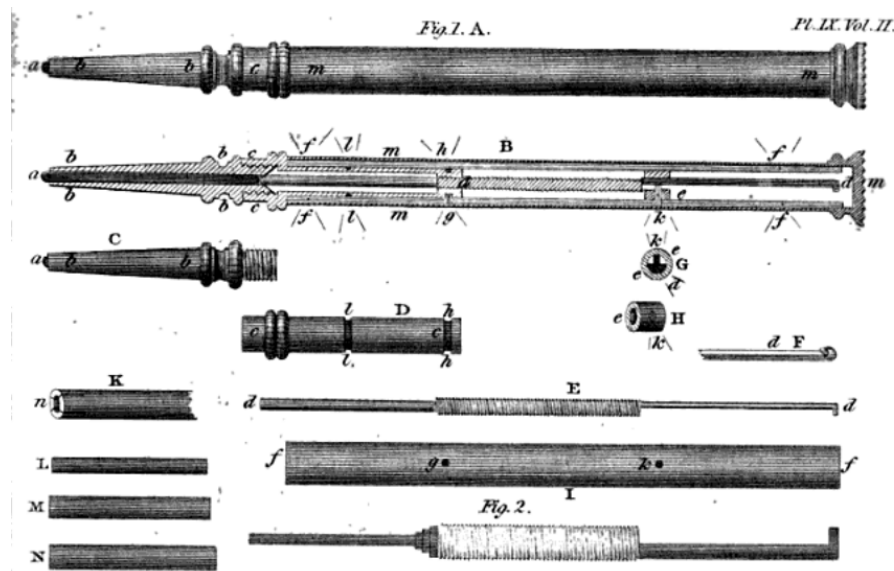


Figure 2: The first patented propelling pencil design by Sampson Mordan and John Isaac Hawkins in 1822 (Veley, 2015).

After some research, we found out that the first “modern pencil,” with graphite surrounded by wood, was invented in 1795 by a man named Nicholas-Jacques Conte (Cole, 2019). Conte would make the pencils by mixing clay, graphite, and water and firing it in a kiln, and then creating a wood casing which could be various shapes (Cole, 2019). They would adjust the ratio of clay to graphite to make the lead either softer or harder (Cole, 2019). The first mechanical pencil that could have led “propelled” out of it, was patented in 1822 by Sampson Mordan and John Isaac Hawkins, as seen above in Figure 2 (Zenzoi, 2021). In Britain they call mechanical pencils, “propelling pencils” (Zenzoi, 2021). It is interesting to learn the history and see how much both of these pencils have changed from their first creations.

Method:

We collaborated on the way we decided on what topic to move forward with, and discussed what task we wanted to make our interviewees do. We decided the criteria for the interviewee should be students, specifically college students who use mechanical pencils because they are a large and easy demographic to access. We each split up into interviewing 3 participants, making sure that they are college students and aged, who use mechanical pencils for the task to be worthwhile. We primarily came up to the students and interviewed them where they were located, so the location was a bit randomized. We decided to jot down the participants' answer via this [data set](#). In terms of our pre- and post questions, we centered them around the **master-apprentice model**, allowing us to see what knowledge and details the participants wanted to share. The post questions allowed the participants to open their ideas up without being influenced by bias.

Activities:(2 or more tasks)

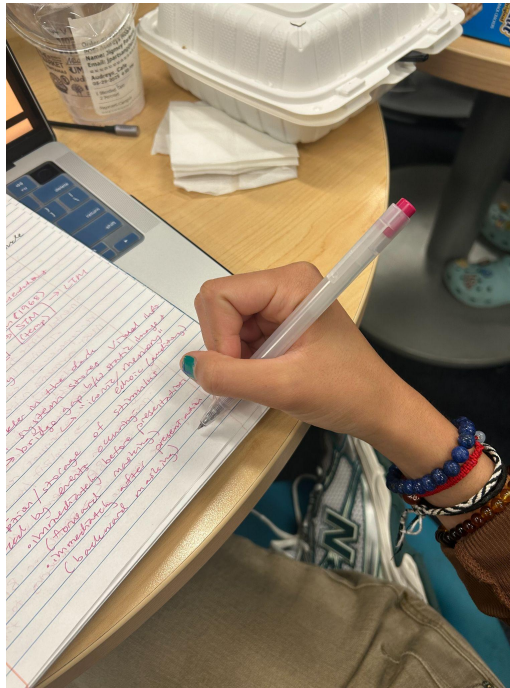


Figure 3: Interviewee number 8 writing using their everyday writing tool.

Task 1: Please use your own most used writing utensil and write 2 to 3 sentences.

Explanation: We want to see how users interact with their own personal writing utensil as well as the medium that they are required to use with it. Each type of writing utensil has a required median, maybe an ipad, tablet, paper, notebook and so on. This task allows us to observe their interaction with the utensil but also the most common task writing utensils are used for...writing. Above in **Figure 3** is a photo of one of the interviewee's writing a few sentences with their daily writing tool.

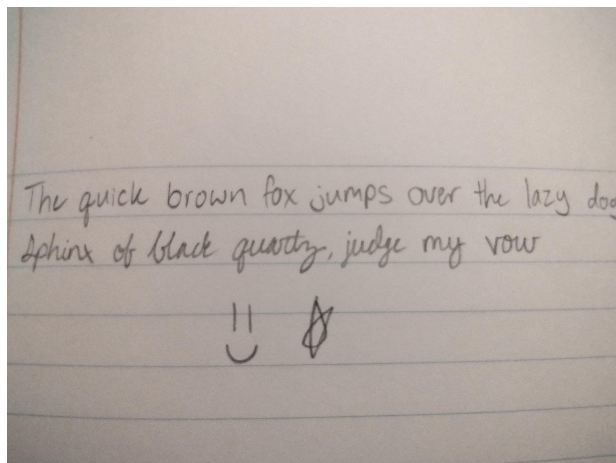


Figure 4: Interviewee 7 wrote a few sentences and drew a smiley face and star. They couldn't erase because their pencil didn't have an attached eraser.

Task 2: Please draw a star/smiley face with your own most used writing utensil then erase it.

Explanation: We want to see how writing utensils are used for non-writing tasks such as drawing and erasing. We want to observe if users have any significant changes or struggles with these tasks, especially erasing, a common and necessary aspect of a writing utensil that is neglected. **Figure 4** shows interviewee 7's writing and drawing with their everyday writing tool.

Post Task Question:

- What was your overall experience with these tasks?

Explanation: Open ended question for interviewees to expand on any comments on overall usability, and gives us insight on quantitative and qualitative data about the users satisfaction.

- Did you experience any frustration with any of these tasks?

Explanation: We can understand how to redesign a better writing tool to avoid those frustrations.

Questions:(8-10 questions with why)-- include maybe 1-3 post interview questions

Question 1: What writing tool do you use most often?

Explanation: Reveals users *habitable use patterns*.

Question 2: Tell me more about your writing tool?

Explanation: Gives us insight about what features users notice and value.

Question 3: Walk me through a common issue you experience with other writing tools?

Explanation: Highlights design drawbacks and failures and its breakdown in its usability. Maybe reveal where users struggle with the desired mapping of the design or failures in bridge the **gulf of execution/evaluation**.

Question 4: How does your writing tool get around the issue?

Explanation: This can tell us what aspects of their tool creates a short **gulf of execution/evaluation** and what clear **affordances** are given.

Question 5: Walk me through a positive experience you have with your writing tool?

Explanation: This shows us what experiences users appreciate having with their writing tool and what elements, and **affordances** are essential.

Question 6: Walk me through some drawbacks of your writing tool?

Explanation: So we can see where the writing tool falls short and what to avoid in our re-design.

Question 7: How does your writing tool make up for it?

Explanation: What elements of each writing tool are great and that we should include in our re-design.

Question 8: How do you refill your writing utensil?

Explanation: This could show if there were clear **affordances** showing how to refill the pencil or if it was not clear, and led to **errors**.

Question 9: What's your major?

Explanation: We wanted to ask this question to get an idea if there was any correlation between the type of writing tool used and the area of study the user was in. For example, maybe Computer Science students happened to use more digital tools.

Data:

[\[Click here\]](#)

Contributions:

Each group member administered 3 to 4 interviews each.

Section II: Problems & Analysis

Problems:

Based on the results from conducting our interviews with our 12 participants, we can draw several instances about slips, mistakes, mental models, and potential design flaws in mechanical pencils. In terms of writing tool preferences, 58% of our participants use mechanical pencils mainly for their **affordance** of repeatability and precision. Our participants appreciated the feedback and the consistent line output, enhancing perceived reliability. 25% use pens as they prefer the smooth ink flow and visual clarity. 16% use Apple Pencil as their preferred writing tool due to its ability to customize and ability to switch between tools and colors instantly, emphasizing the flexibility in the design. When summarizing our data for task #1, 2/12 completed this task with a pen, and 1/12 had some trouble as their lead broke whilst writing the sentence.

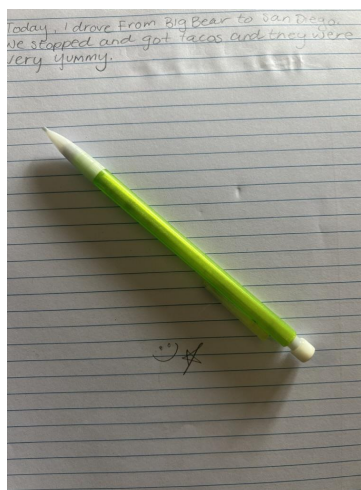


Figure 5: Interviewee 9's everyday writing tool. User mentioned issues on the eraser running out and being unable to replace the eraser. The eraser has worn away on the pictured writing tool.

When summarizing our data from task #2, 5 participants were not able to properly erase their work due to not having a sufficient amount of eraser left and had to cross it out, while 2 participants properly erased their drawings, pencil marks were still left on the paper as the eraser was not sufficient enough. Additionally, participants noted several recurring issues tied to the design limitations of their preferred writing tools. 57% of mechanical pencil users frequently struggled with lead breakage and their eraser degrading quickly, occurring from poor durability **affordances** and a lack of replaceable components. This is shown by the writing tool in **Figure 5** where the eraser had run out and couldn't be replaced. These conflicts interrupted a smooth writing flow and caused users to carry separate erasers, which is neither efficient nor convenient. 63% of pen users complained about ink flow inconsistencies and being unable to erase mistakes, and therefore having to cross out their work instead, making it look unpresentable. The users who preferred to use Apple Pencil mentioned charging needs and how, when misplacing the item, it becomes costly; however, it does provide a variety in functionality as well as being aesthetically pleasing. All in all, the main issue was a mismatch and lack of feedback between the tools' **affordances and the mental model** users had, whether expecting reliable erasing or continuous ink flow.

Regarding design trade-offs, 66% of participants mentioned compensations that make their tool work. For the users who used pens, participants appreciated the smoothness and fluid motion for writing, **trading off** the quality of being able to erase and edit their work for speed and aesthetics. Furthermore, key **trade offs** that were noted in our data was erasability vs permanence, where mechanical pencils and apple pencils were great for sketching and taking notes, however, they **traded off** for needing to constantly refill lead/erasers and recharging the pencil; with pens it looks professional and doesn't smudge, however you are trading off professionalism for being able to correct your work. Another notable **trade off** was tactile feedback vs the versatility of a digital utensil. Non-digital tools gave satisfying tactile feedback with no additional setup needed, while trading off hand cramps or wear over time. Digital tools such as the Apple Pencil provide a wide range of diverse functions, while trading off the need to charge and also being quite costly.

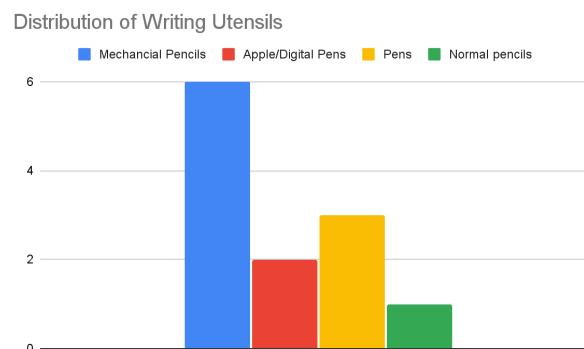


Figure 6 here is a bar graph representing the distribution of the writing utensils our participants used

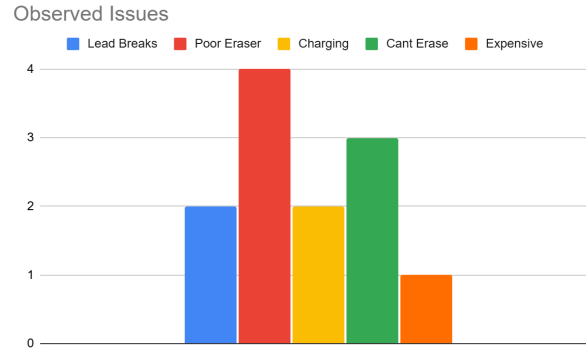


Figure 7 shows the issues that were observed and which were most common.

Successes:



Figure 8: This user (Interviewee 7) has a mechanical pencil which has thicker lead that can be sharpened from a sharpening tool attached to the back of the pencil.

Unique features such as the one shown above in **Figure #** are interesting to learn from. In **Figure #** User 7 shows how their mechanical pencil has a sharpener built into the end of it since the lead is so thick. This fixes two of the issues mentioned by other interviewees. One: thicker lead so it doesn't break as easily. Two: A sharpener built in and small so the user doesn't need to carry around a whole other tool. Looking at features such as this is helpful for thinking about the re-design and how we can create something unique and useful.

Section III: Synthesis & Design Space

Patterns and Trends:

Pattern 1: Users Desire Low-Maintenance, Robust Functionality

One of the biggest takeaways from our interviews was how much users just wanted their writing tool to work without additional work or errors. A majority, 9 out of 12, ran into problems specifically with erasing. Some said their erasers wore down too quickly or didn't work well, while others didn't have an eraser on their pencil at all. Users pointed out how frustrating it was to not know when the eraser or lead was about to run out, often finding out in the middle of a task. This lack of feedback and visibility made the writing process more difficult than it needed to be. Instead of focusing on their notes or sketches, they had to deal with broken or missing components. It was clear that users are looking for a tool that handles the basics like writing, erasing, and refilling without needing extra attention. Tools that failed to support this caused frequent interruptions and made writing feel like more of a chore than it should be.

Pattern 2: Users desires Ergonomic Comfort and Tactile Design Impact Usability

Another major pattern we saw was how much the feel of a writing tool affects the user's experience. Out of 12 people, 7 mentioned things like grip problems, discomfort, or hand cramps. One user talked about how their plastic mechanical pencil would slip when their hand got sweaty. Another described how long writing sessions made their hand ache when using a basic pen. On the other hand, people who used tools with better designs, like triangular grips or metal bodies, said they didn't have these problems. Some even felt that their handwriting improved or that they felt more confident when using them, especially in exams. These responses showed how features like shape, weight, and texture really mattered. When a tool had the right physical details, it felt natural to use and didn't get in the way. But when those features were missing, the writing experience became harder. People had to work around the tool instead of with it, which made using it less satisfying overall.

Variations:**Variation 1: Good Erasers Make a Big Difference**

One of the clearest differences in how people used their tools came down to the eraser. Out of the 12 people we talked to, 7 said they either didn't have an eraser or that theirs didn't work well. These users often showed frustration and had to carry a separate eraser with them just in case. The other group, those with working erasers, said their writing felt smoother and more under control. This shows how much a small feature like an eraser can affect the entire experience. When people trust their tool to fix mistakes, they feel more confident. But when that part of the tool fails or is missing, users lose that trust and the task becomes more annoying.

Variation 2: Digital and Physical Tools Lead to Different Habits

Another big difference came from whether someone used a digital tool like the Apple Pencil or a more traditional option like a pen or mechanical pencil. Out of the 12 participants, 3 reported using digital tools as their main writing method. These users talked about how easy it was to switch tools, erase mistakes, and take advantage of pressure sensitivity. They said it saved them time and helped them stay organized during fast-paced tasks like lectures. In contrast, the remaining 9 participants who used physical tools focused more on the feel of the tool, grip comfort, and how often they had to refill ink or lead. These two groups clearly approach their tools with different expectations. Digital users treat theirs like a multifunctional system, while physical tool users value reliability and simplicity. This shift in mindset affects how each group defines a "good" writing tool and what makes it usable in their daily lives.

Trade offs:

Durability/Low Maintenance vs. Comfort/Ergonomics

- a. A common problem mentioned by a handful of interviewees is short lived erasers and lead that breaks too easily
- b. A concern addressed in some interviews was the quality and comfort of some of the writing tools

Complexity vs. Cost

- c. A dilemma some of the interviewees found themselves in was deciding what is an appropriate amount to spend on their writing tool
- d. Some designs charge more for the materials while others utilize complex components

Design Spaces:

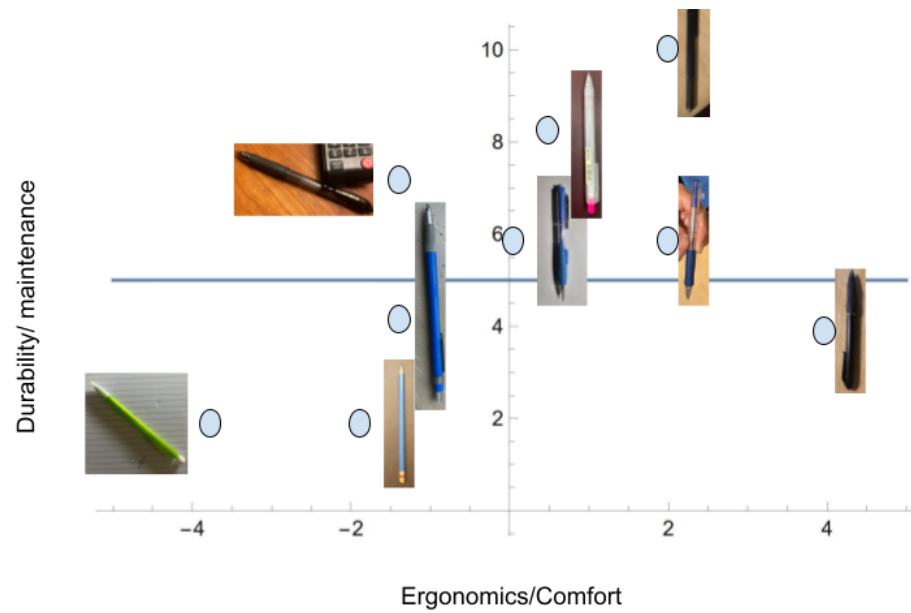


Figure 9: Design Space 1 Maintenance vs Comfort

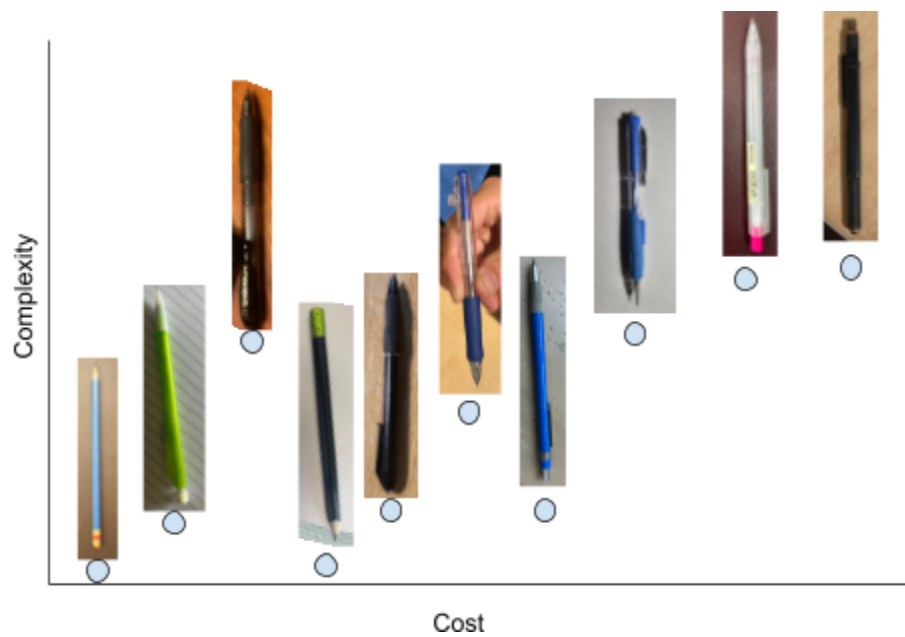


Figure 10: Design Space 2 Complexity vs Cost

Critiques:(From classmates and TA)

Critique Summary

In our first round of feedback, both the TA and our classmates pointed out that some of our interview questions were a bit too technical. Words like “mechanical feedback” or “component reliability” didn’t really land with participants, and a few even got confused or paused mid-answer. It made the conversations feel more awkward than natural. We also realized our task instructions weren’t clear enough. People weren’t always sure what they were supposed to do, which meant the feedback we got from different users was harder to compare. The critique made it clear that we needed to keep things simple and grounded in how people actually talk and use these tools day-to-day.

Improvements Made

After getting that feedback, we made some important changes. We rewrote our interview questions using more everyday language—for example, instead of asking about “component failure,” we’d ask things like “what do you do when the lead runs out?” or “how does the pencil feel after writing for a while?” This helped make the interviews more relaxed and easy to follow. We also fixed up the task section by breaking it down into three simple parts: using the eraser, putting in new lead, and just holding the pencil like they normally would. During the task, we gave short instructions and offered small visual or verbal hints when needed. These changes made the sessions smoother and helped us get more useful info, especially when comparing how people weighed comfort versus durability.

Section IV: Redesign

Iterations:

When we started brainstorming ideas we really wanted to take into consideration the insights we were able to gather from our interviews, patterns, and unmet needs as well as design spaces. We wanted a pencil that was ergonomic, tactile, robust, eraser focused, as compatible with electronic devices. We also found that users wanted **feedback** from their pencil, to tell when their lead was running out and also for their erasers. So our idea for design came into having these components in one pencil. Our brainstorming led us to this initial drawing on the right. Thicker lead, large grip, viewport into the pencil that works as feedback for how much lead is left, as well as a thicker eraser that is replaceable, grip for the eraser side, and a soft pad for interacting with electronic devices if need be. We also wanted strong physical **affordances** for grabbing, at both ends while also maintaining that the lead portion affords primary direction by having an oriate/ focused tip. We also want to ensure that we are maintaining or adhering to preexisting user mental models regarding pencils, specifically to pushing out lead, that when you push on something more lead will be released.

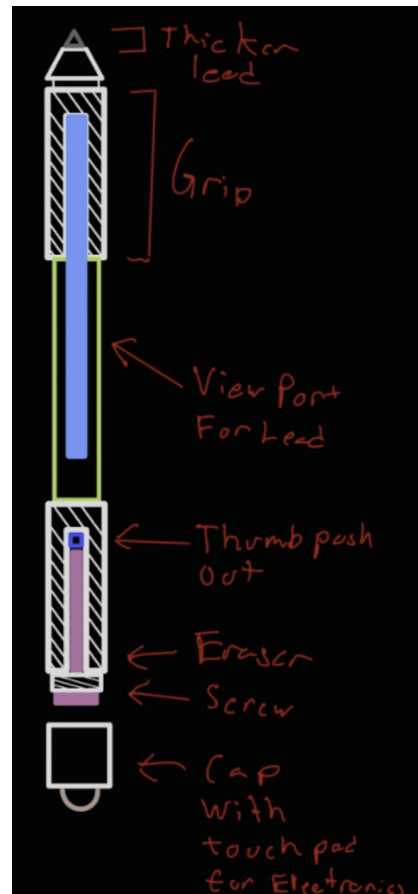


Figure 11: Re-design 1.

Rationale:

We chose these design decisions to improve the user experience, we explicitly used data from our interviews, acquired and abstracted insights, and used those insights to drive our decision making. We also made some design driven decisions such as making sure that both the front and back side grips afford grabbing, but also that the front affords drawing. Some of these physical features include the grip and the pointed tip. In addition to all the new features that provide strong user experience feedback, such as the view port for both erase and lead, and an interface for electronic touch screen devices makes our design unlike anything currently available. It explicitly meets user needs, but having a strong design emphasis on eraser as primary function of the pencil as opposed to a secondary or not a function at all like some of our interviewees cases. As well as the cohesive design choices such as using steel and heavy plastics makes the user experience feel more professional, as well as making the pencil longer lasting.

Design Tradeoffs:

Based on our design tradeoffs of comfort and durability, our pencil is not only comfortable and ergonomic using knurl grip but it's also extremely durable given its physical elements being made of steel and hard plastics, it won't break on users. Additionally the pencil maximizes on cost, being made of steel tubes that are lathes which is relatively inexpensive, as well having minimally complex design given all the features in the design. It consists of screwing a series of tubes together, and that is how it is securely fastened, given that anyone can maintain the pencil.

Redesign Final:

We modeled our final design in Onshape and made it from four main steel parts that can be easily manufactured with basic tools like lathes and knurling machines. This makes it easier to produce without needing a complicated setup. The lead window shows how much lead you've got left, which helps avoid running out mid-task. The eraser pops up when you push on the top, and we kept the familiar lead-clicking mechanism the same to avoid confusing users. We're also planning to add a small engraved arrow near the eraser to make it obvious how to use it. Overall, this final design gives users something that's reliable, easy to use, and just better all around.



Figure 12: Re-design final: mechanical pencil.

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