nebula

A studying tool to turn notes into connected knowledge

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Introduction

College life involves more than just academics. Students must balance their time and energy across classes, extracurriculars, jobs, and other commitments. However, exams often take center stage, leaving students scrambling to study as deadlines pile up. As fellow students navigating the same demands, we set out to explore how learners, particularly those studying life sciences, can make the most out of their time in college and improve academic performance. In this study, we focus on 3 learner groups — non-majors, novice majors, and expert majors — with the goal of identifying patterns in their study habits and addressing unmet needs with a digital studying tool.

- What are some similarities and differences across learners with varying motivations, studying preferences, and learning challenges?
- When and how do they learn best as well as struggle? How can we create a solution that supports this diversity?
- Do subject and timeline play a role in students' studying approaches?
- Can we build upon or contribute something meaningful to popular tools like flashcards, note taking apps, and mind-maps?

User Research

Participants. Participants were recruited via personal connections, ranging 13 majors as well as all 4 years and beyond. The majority were life science majors, from UCLA, upperclassmen, and female.
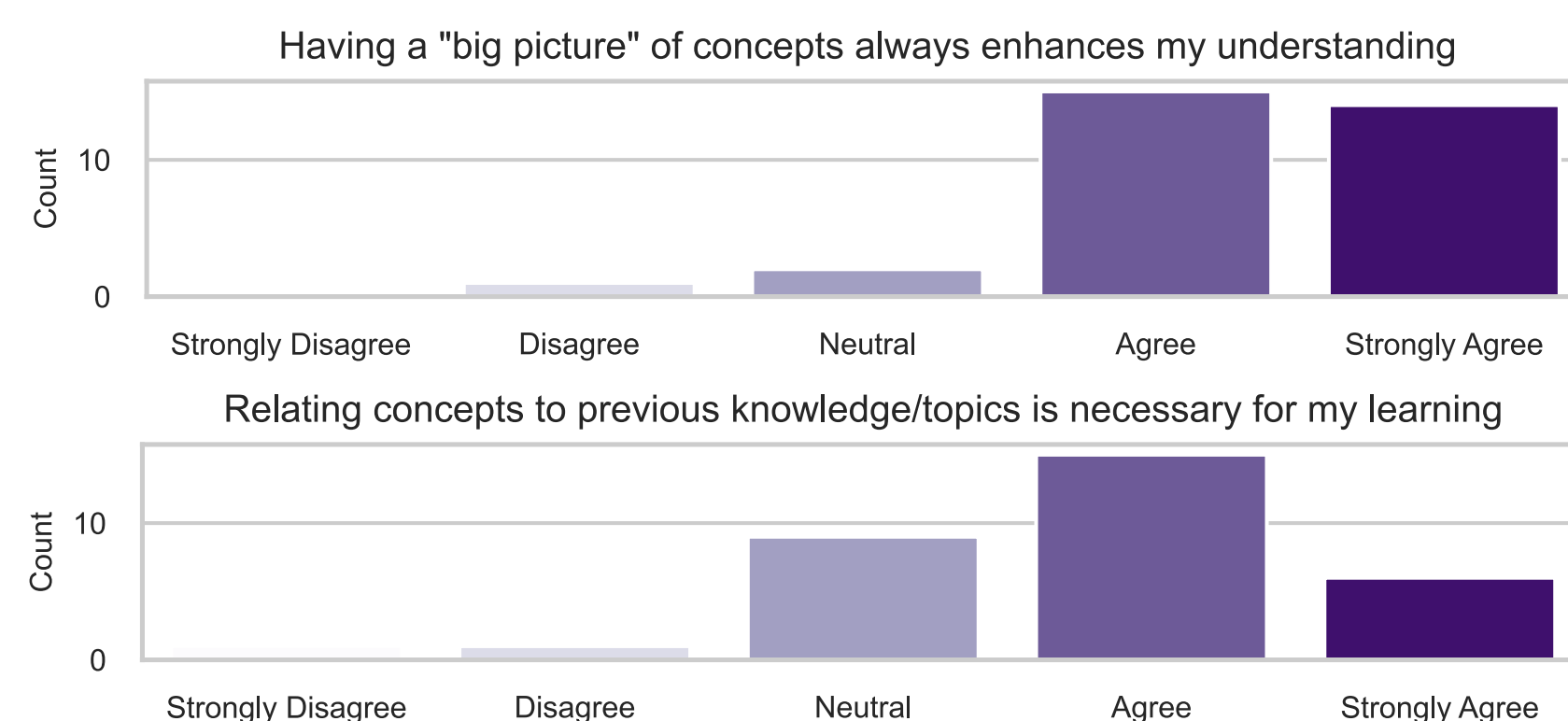
User Interviews. We conducted 25 semi-structured interviews with life science majors in different stages of their education and non life science majors who have taken life science classes to better understand how studying habits compare across the 3 user groups. Different question sets were used depending on the user group participants fall under. All but 3 interviews were conducted online.

Survey. We received 32 survey responses, allowing for quantifiable data and structured comparisons. The survey included questions on feature desirability, tool usage frequency, agreement with statements, and invited participants to submit life science notes for further analysis.

Key Findings

Across user groups, most students rely on lecture-based notes (often digital, sometimes handwritten) and revisit these notes during exam preparation, frequently refining them in a second pass. While tools like flashcards, mind maps, and visual aids are widely acknowledged as helpful, their use is often limited by the time and effort required to set them up. Students overwhelmingly described life science courses as memorization-heavy, yet preferred high-level conceptual understanding over brute memorization when possible. Visualization (especially flow diagrams) was considered helpful for connecting ideas, but tight timelines often led students to insert lecture slides or images rather than create their own. Ultimately, efficiency and time constraints were the most influential factors shaping study behaviors.

Selected Survey Results

Having a "big picture" of concepts always enhances my understanding

Relating concepts to previous knowledge/topics is necessary for my learning

Students in memorization-heavy courses often rely on active recall and concept mapping to study but current tools like flashcards and mind maps address these needs separately. With limited time and other responsibilities to juggle, many abandon these tools due to limited learning value and tedious setup of the creation process.

System Overview

We introduce Nebula, a studying tool combining the best of both worlds – mind maps and flashcards – to help students externalize relational structures between concepts for longterm memorization. Our development process aims to address the following design goals:

1. Simplify the flashcard and mind-map creation process to reduce the amount of choices irrelevant to studying users have to make.

2. Minimize the learning curve of Nebula's interface.

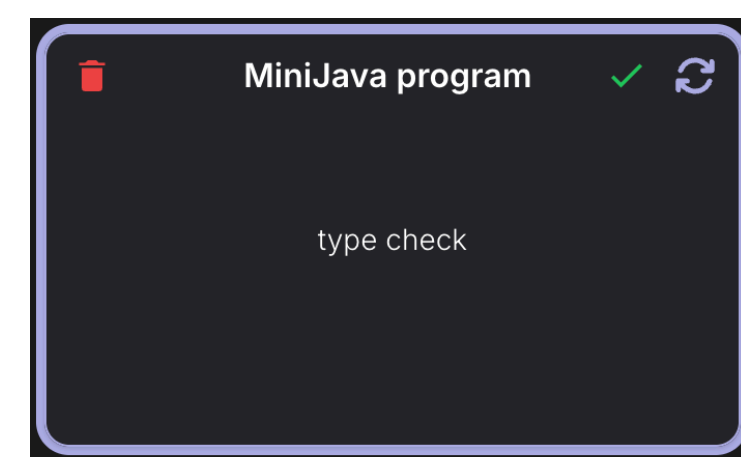3. Ensure applicability across a wide range of academic disciplines.

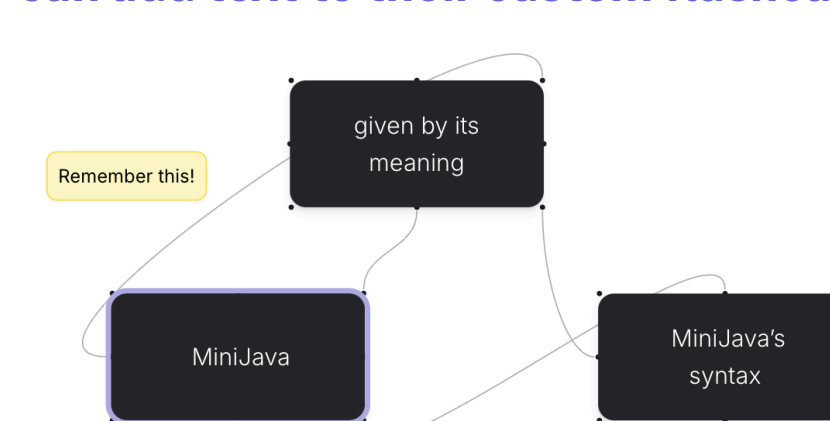**Users can add pdfs of their notes to create flashcards out**
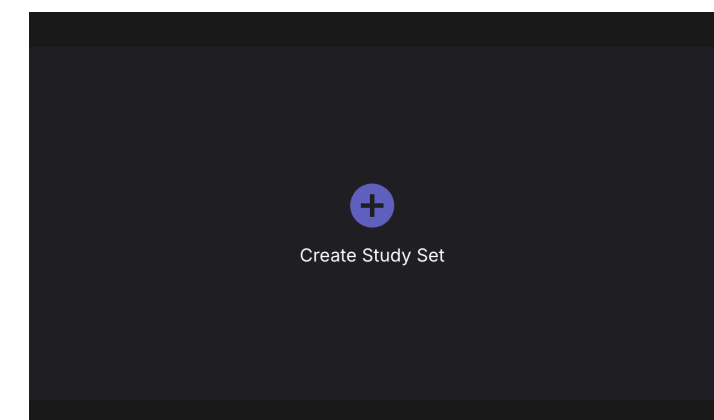
Those flashcards can now be connected to form a mind map!

Using the highlight feature, users can add text to their custom flashcards
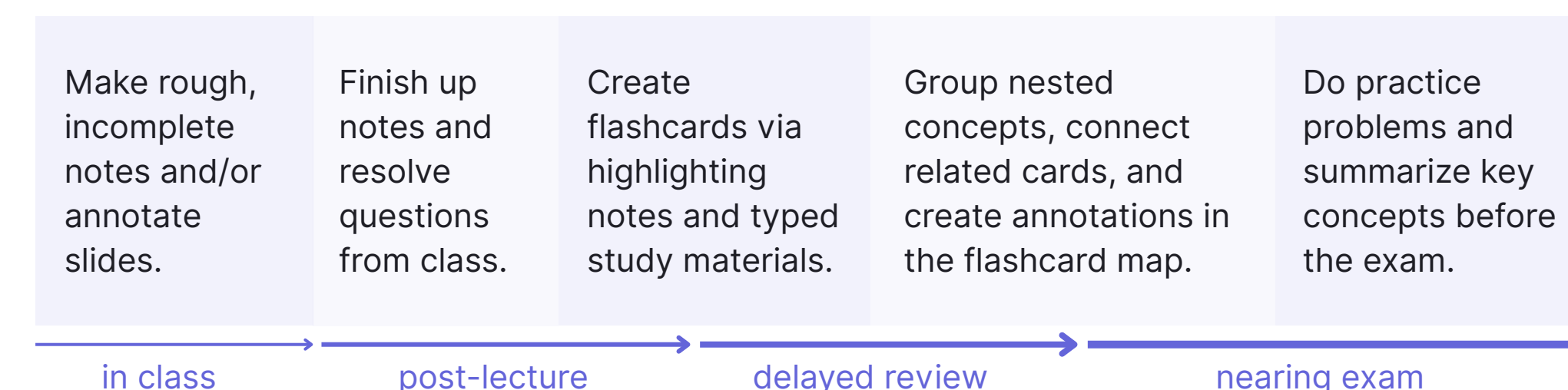

Using the highlight feature, users can add text to their custom flashcards

Personas & Usage Scenario

We developed 3 user personas that reflect a spectrum of study habits, motivations, and tool preferences – from students who cram for required science courses with minimal interest to those with refined workflows who are building strong foundational knowledge for pre-professional goals.

Make rough, incomplete notes and/or annotate slides.	Finish up notes and resolve questions from class.	Create flashcards via highlighting notes and typed study materials.	Group nested concepts, connect related cards, and create annotations in the flashcard map.	Do practice problems and summarize key concepts before the exam.
in class	post-lecture	delayed review	nearing exam	

Evaluation

Methods. Our evaluations were conducted in-person and over Zoom, with users running the application on team members' machines. Each evaluation was conducted with at least one team person present. Users generally had free reign with little guidance on our ends. The present team member will observe the user's behaviors as well as their interaction with the site, noting any positive and negative feedback verbalized by users, as well as any frustrations or confusions exhibited through actions.

Evaluator Feedback

1. Flashcard creation process is unclear. Having more on-screen directions would improve workflow
2. Quick referencing highlights from generated flashcards is very helpful for content review
3. Card creation on the mind-map is barebones. Would prefer having labels for connecting edges
4. Want more styling options for the graph, to add more visual organization to graph
5. Have buttons visible but dimmed to visually indicate that the action is unavailable
6. Would like to have a page to review flashcards created, without the mindmap

Next Steps

1. Provide popups and tooltips to improve workflow efficiency for users
2. Add toolbar to graph view to enable styling modifications like node colors and line types (dotted, dashed, solid, etc.)
3. Improving node connection interaction flow with visual indications for valid connection points
4. Add a page for traditional flashcard review, with interactions such as card editing and flipping

Discussion

Limitations

The most common limitation our users faced during testing was that they could only create one set of flashcards/mind map set from a single PDF, which limited the scope of their creations.

Many users cited that they wished the graph experience was easier to maneuver. A common complaint we got early was that the connecting of the edges did not feel intuitive. Due to how the graph library is setup, corner edges must connect to the edges in the center of the graph. This system is unintuive and many users feel this is too restricting. Future iterations should design around this library limitation.

Beyond the graph, there is also library limitations for creating flashcards using highlights. The library used has some input issues where it can "explode" the highlights across the entire page which many users expressed frustrations with.

Future Work

Our immediate goals for Nebula is to have a complete system that is able to keep the mind maps that users make to be persistent. This app would include some backend database and User Authentication to allow users to store multiple sets of flashcards/mind maps.

For goals on a longer timeline, Nebula is currently geared towards Users who primarily study on their laptop. In the future, we would want to find some way to make Nebula more accessible to iPad/Tablet Users. Additionally, We want to allow Users to be able to export their mindmaps into another file format, such as a pdf, a GoodNote file, or potentially an Anki Set.