



Designing for Learning Growth

Encouraging metacognitive practice to
support growth mindsets in students

Chen Ni

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support growth mindsets in students

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Abstract

In college, students are often required to complete large, long-term projects and must do so somewhat independently (Ambrose et al., 2010). Those who have the skills to continually learn and adapt in the face of adversities are more likely to thrive not only in the demanding, academic environment, but also in a challenging workplace, and life in general. Based on research by Carol Dweck and her colleagues, adopting a growth mindset—the belief that one can get smarter and learn more through hard work and effective strategies—helps create a love of learning for students and cultivates their resilience to turn setbacks into opportunities to grow.

Despite the potential benefits of adopting a growth mindset, college students are not always equipped with a growth mindset. At the same time, many approaches aimed at aiding the development of a growth mindset are directed at learners at a low educational level, but few target college students. Also, for many of the interventions, students receive knowledge, but they do not learn how to apply it effectively.

It is often beneficial for students to monitor their learning processes using metacognitive skills to foster a growth mindset. By acquiring these skills, such as reflecting on their learning processes, students can develop a sense of control over their learning, which can lead to adopting a growth mindset. Even though monitoring one’s learning process holds enormous benefits, “students tend not to apply metacognitive skills as well or as often as they should” (Ambrose et. al, 2010, p. 202). This insight suggests opportunities to support students in applying these skills. This thesis investigates various forms of support, including prompts from educational tools and feedback from instructors and peers. It aims to encourage and scaffold students’ learning in an effort to develop a growth mindset by applying metacognitive skills to the monitoring of their learning processes.

First of all, I would like to thank my advisor Stacie Rohrbach for challenging, inspiring, encouraging and supporting me throughout the process of this thesis. Thank you for being the one who led me into the field of learner experience design and for inspiring me to explore the domain continually in the future. The skills, knowledge, and approach you gave me were immensely valuable.

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Many thanks to Ken, for lending your ears, and for trusting me even at times when I felt like I wouldn't be able to pull it off.

Finally, I would like to thank my classmates for all the valuable feedback you gave me and the kind words that supported me through the process. Without you all, this thesis project would not be.

Growth Mindset

The belief that one can get smarter and learn more through hard work and effective strategies (Dweck, 2006).

Fixed Mindset

In contrast to a growth mindset, a fixed mindset is a belief that one’s qualities, like intelligence, are carved in stone and cannot be changed (Dweck, 2006).

Self-Efficacy

One’s “belief in their own ability to succeed” (Dirksen, 2016, p. 219).

Resilience

The process of adapting well to adversities.

Metacognitive Skills

The requisite skills for becoming an “effective self-directed learner.” Ambrose et al. suggest these skills include: “assess the demands of the task, evaluate one’s own knowledge and skills, plan one’s approach, monitor one’s progress, and adjust one’s strategies as needed” (Ambrose et al., 2010, p.191).

Metacognition

“The process of reflecting on and directing one’s own thinking” (National Research Council, 2001, p. 78).

Self-directed Learner

Learners who use metacognitive skills to monitor their own learning (Ambrose et al., 2010).

Value

A goal’s “subjective value.” Value is one of the key influences on one’s motivation to pursue a goal (Ambrose et al., 2010).

Expectancy

“Expectations for successful attainment of a goal.” Expectancy is another key factor that indicates one’s motivation to pursue a goal (Ambrose et al., 2010, p. 69).

Scaffolding

“Build supports to make the learning incline less steep. Then gradually reduce those supports until learners can handle the incline on their own” (Dirksen, 2016, p. 42).

Paired with new tasks in higher education, students may encounter new outcomes that arise in the learning process. Some of the challenges instructors observe that impede college students’ learning growth include but are not limited to: fear of failure and risk-taking, hesitation to receive criticism, and lack autonomy. The challenges listed are some of the characteristics of what Dweck describes as a fixed mindset.

Based on research by Carol Dweck and her colleagues, the beliefs students have about learning can have a significant impact on their learning achievement. In contrast to having a fixed mindset, students who adopt a growth mindset are more likely to persevere through setbacks and challenge themselves, which would lead to constant learning growth. Collectively, students with a growth mindset have the potential to transform a culture to one that adopts and embodies resilience in learning and practice.

This thesis investigates the role of practicing metacognitive skills, as part of students’ learning process, can have on their educational mindset and growth as a student. I hypothesize that by acquiring and practicing these skills, such as reflecting on their learning processes and adjusting strategies, students can develop a sense of control over their learning, which can lead to adopting a growth mindset.

Through my thesis research, I explored the following research questions:

How might the design of learning tools support and encourage students to monitor their learning processes effectively in an effort to develop a growth mindset?

More specifically:

- **What constitutes a growth mindset and what characteristics of it warrant highlighting in the design of learning experiences?**
- **How do students respond to educational setbacks and what strategies do they normally use to persevere through setbacks?**
- **What are the affordances and limitations of digital and physical learning experiences and how can they be leveraged in helping students develop the skills to monitor their learning processes?**
- **How can a learning experience be conceived to support students to build up a sense of control over their learning?**

Project Goals and Significance

Not only do students need a high level of autonomy to thrive in a demanding college environment, but the skills to self-direct their learning are also critical when students enter the workforce. “In our always-on, fast-paced, flattened world of work...time, goals, project plans, workload, and “just-in-time” learning must all be self-managed and self-directed in today’s wound-up work world” (Trilling & Fadel, 2009). Those who are adept at self-directing and monitoring their learning are more likely to persevere through educational setbacks and maintain a healthy lifestyle. This study aims to uncover approaches that help college students:

- **Increase their self-awareness of their learning behaviors, patterns, and growth**
- **Develop the metacognitive skills needed to adjust strategies that yield better learning performance**
- **See the benefits of applying metacognitive skills in daily educational practices**
- **Develop a positive belief in their skills (growth mindset) to achieve the desired learning outcome through hard work and effective strategies**

Scope and Limitations

Throughout the year-long study, I worked with students at various educational levels within the university setting, which yielded valuable insights that would benefit from additional research and analysis.

Based on the insights I gained from user research, age (undergrad vs. grad) is not necessarily the indicating factor for which students are more likely to adopt a growth mindset. “In many ways, the differences Dweck identifies between fixed and growth mindset are most apparent during times of transition and challenge” (Korstange, 2016, p.10). Therefore, I chose to focus my interventions on design students who go through a transitional phase in their learning environment, such as freshman coming from high school and MA students who often come from practice and adjacent fields. The reason for choosing design students is because most of my resources and knowledge are in this domain.

By choosing to focus my interventions within the design domain, further investigation into how transferrable the interventions are to a broader context outside of the design discipline is warranted. Since I recruited most of the research participants from Carnegie Mellon University, the insights are most relevant to the learning context on this campus.

Assumptions Made

Driven by the discoveries I made in the user research phase, I roughly divided learners into three categories based on how much intrinsic value they see in practicing metacognitive skills.

The proposed design investigates the role of an AI-powered learning tool can have in supporting students practicing and applying metacognitive skills, assuming that:

- **Students would use the tool either because of grades or learning goals.**
- **Technology is advanced enough to recognize the meaning and context of students’ writings rather accurately.**



Motivated
Learners

- They tend to:
- Understand the value of reflection
 - Feel intrinsically motivated to reflect
 - Adhere well to a weekly reflection schedule
 - Document their learning thoroughly
 - Share reflections openly with peers and instructors



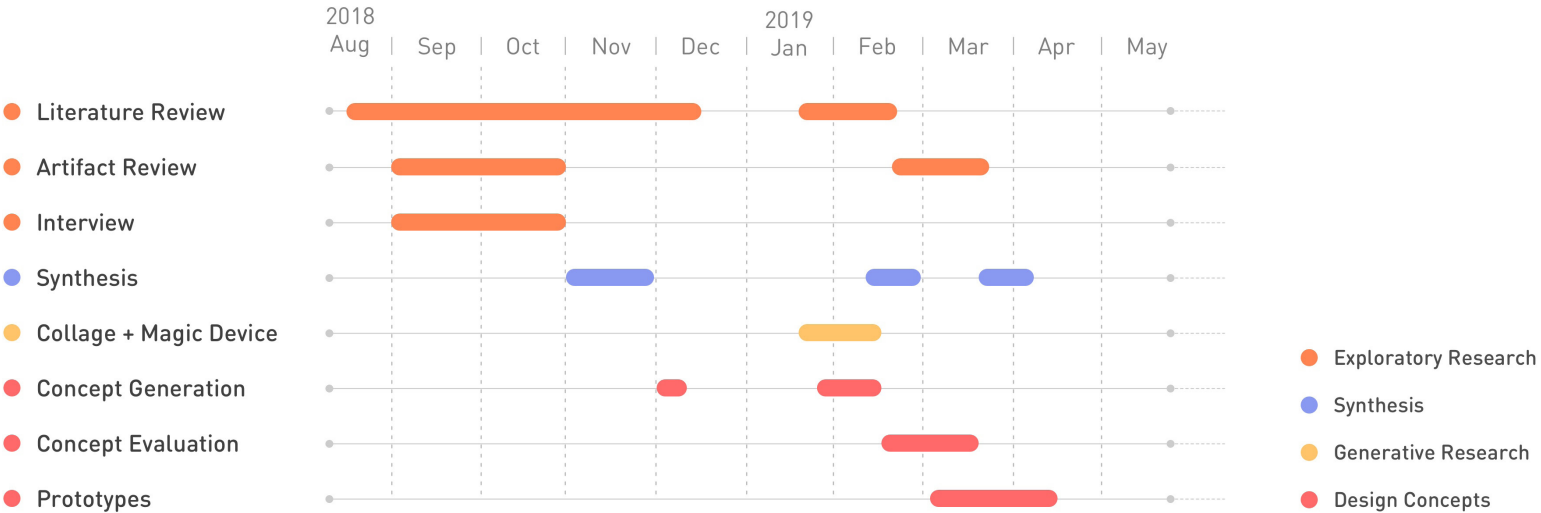
Uncertain
Learners

- They tend to:
- See some value in reflecting
 - Reflect at a relatively surface level
 - Feel unsure about what to write sometimes
 - Prefer sharing with a small group of people
 - Need extrinsic reward/punishment (grades) to keep them motivated



Evading
Learners

- They tend to:
- See little value in reflecting
 - Spend the least amount of effort required
 - Stop reflecting altogether if it is not graded
 - Reflect at a relatively surface level
 - Prefer keeping reflections to themselves or just share them with instructors (for grading purpose)



Design Process

Exploratory Research

Introduction

Throughout the project, I read literature and studied artifacts to gain a deep understanding of what constitutes a growth mindset and the affordances/limitations of existing learning experiences that are used to foster a growth mindset. Also, I conducted research activities with instructors and students to gain a sense of the current mindset students have about learning. Many factors go into developing a growth mindset, but literature and artifacts often pointed me in the direction of helping students develop metacognitive skills. The following section summarizes the research I conducted for literature reviews, artifact reviews, and research activities, and how the insights I gained informed my next steps.

Literature Review

The literature reviews helped deepen my understanding of the problem space, identify design opportunities, form research questions, and develop frameworks and guidelines that directed my design.

The first section of the literature reviews investigates the meaning and formation of a growth mindset, which is the underpinning concept of the study, and its connection to resilience and self-efficacy. The second section explores the concept of metacognition, its significance to learning, how it can be developed, and its correlation to a growth mindset. The third section contains frameworks and insights that guided the design concepts.

Growth Mindset and its Connection to Resilience and Self-Efficacy

Mindset, the New Psychology of Success; Carol S. Dweck

In this book, Dweck introduces the concept of a growth mindset. She suggests that adopting a growth mindset helps create a love in learning for students and cultivates their resilience to turn setbacks into opportunities to grow. Among the many methods Dweck introduces, teaching students directly about neural plasticity is the one she identifies as the most important.

Dweck’s concept heavily influenced my thinking on the project. She made me understand that the beliefs students have about learning can have a significant impact on their learning achievement. Dweck cautions that “effort is key for students’ achievement, but it is not the only thing. Students need to try new strategies and seek input from others when they are stuck” (Dweck, 2015). The concept inspired me to investigate ways to foster students’ growth mindset through design interventions that help students examine their effort and improve their learning processes.

The Road to Resilience; American Psychology Association

This online brochure explains the concept of resilience and suggests strategies for building resilience. Resilience is closely related to a growth mindset because both skills require one to trust in his/her agency to achieve a desirable outcome or bounce back from obstacles. As the article points out, having supportive relationships is critical to building resilience. The insight caused me to hypothesize that leveraging peer-to-peer and peer-to-instructor support might be a means to help students develop a resilience that is also critical to adopting a growth mindset.

Design for How People Learn; Julie Dirksen

In this book, Dirksen explains the elements and procedure to design a great learning experience. Similar to any design practice, designing an effective learning experience requires educators to know the users (learners), identify the problems (learning gaps), set goals, create solutions that are specific to the problems, evaluate designs, and iterate. In addition, Dirksen discusses strategies that can be used to tackle different learning gaps, such as a skill gap or a motivation gap.

One of the chapters in the book talks about self-efficacy, which is closely related to a growth mindset. Self-efficacy is one’s belief that he/she has the ability to succeed. Dirksen suggests that “when fear, anxiety, or discomfort with the new behavior has been identified as one of the main issues, practice becomes particularly important” (p. 222). Given this insight, I hypothesized that introducing design interventions when students practice their skills could serve as an opportunity to strengthen their self-efficacy.

Neuroplasticity: learning physically changes the brain; Sara Bernard

In the article, Bernard argues that much research from neurology has shown evidence that our brain is continually forming and developing throughout our lives. The idea of a growth mindset, that our intelligence is malleable is backed by scientific findings. The effective strategies to exercise our brain include 1) Practice. Repeated practices strengthen connections between neurons, which helps build a more efficient network in the brain. 2) Build connections. Neurologist and educator Judy Willis once said: “Whenever a new material is presented in such a way that students see relationships, they generate greater brain cell activity and achieve more successful long-term memory storage

and retrieval.” 3) Demystify how the brain works. Letting students know that they can literally strengthen their brain through practice and review is empowering, which can be especially beneficial for students who label themselves as “not smart.”

Knowing why intelligence is malleable from a neurology perspective indicates that effort and effective strategies are critical for academic growth. The first two strategies caused me to consider the opportunities for tools/framework to support deliberate practice, which requires both repetition and reflection.

Metacognition and What it Affords Learners

Teach Yourself How to Learn; Saundra Yancy McGuire and Stephanie McGuire

Similar to the idea expressed by Dweck in *Mindset*, McGuire identified effort and effective learning strategies as two critical components to learn more and learn better. McGuire introduces a series of effective learning strategies informed by neuroscience research. The overarching learning principle suggested is metacognition: “When you use metacognition, you become consciously aware of yourself as a problem solver, which enables you to actively seek solutions to any problems you may encounter, rather than relying on others to tell you what to do or to answer your questions” (p. 289).

Using metacognition helps students become more aware of their learning process. They get a better sense of which actions lead to a desirable/non-desirable learning outcome. Once students understand that changing their behavior changes their learning results, they are more likely to switch from a fixed mindset to a growth mindset. This insight suggests opportunities for interventions that integrate the learning of metacognitive skills into students’ learning process to foster a growth mindset.

How Learning Works; Susan A. Ambrose et al.

Ambrose et al. introduce seven research-based learning principles that cover a wide range of learning behaviors, such as factors that motivate students to learn. These principles can be used to aid the design of a course. For each principle, the authors explain the rationale behind it, its implications, and practical suggestions for how to incorporate it into a learning experience.

As suggested in the text, students can increase their expectancy—a belief that one can successfully achieve desirable learning outcome—by attributing their performance with controllable causes such as efforts and learning approaches. Having a supportive learning environment can also help increase student’s expectancy as they know they can get support when they need it. The insights lead me to consider design opportunities that provide support to students and guide them to analyze their performances objectively as a way to increase their expectancy. The skills that are essential for students to monitor their learning performances are what Ambrose et al. describe as metacognitive skills. Echoing McGuire’s idea about metacognition, Ambrose et al. also underscore the significance of applying metacognitive skills for students to become effective, self-directed learners. The discoveries caused me to hypothesize that by developing metacognitive skills, students can develop a sense of control over their learning, which can lead to adopting a growth mindset. However, learning metacognitive skills is often challenging. The authors suggest that “students tend not to apply metacognitive skills as well or as often as they should” (p. 202). They further suggest “scaffolding students in their metacognitive processes” as a way to promote learning of these skills (p. 214). Therefore, I determined that the design interventions should evolve as students become more competent in applying the skills so that students have more agency to monitor their learning.

Frameworks and Insights that Guide the Design Interventions

Develop Growth Mindset Through Reflective Writing; Ryan Korstange

In the paper, Korstange argues that “intentionally developing student abilities in process reflection can help them develop a growth mindset” (p. 6). He compares various theories of reflective writing and suggests approaches to assess the effectiveness of students’ reflective writing assignments.

Korstange suggests that instructors ought to “ask questions more than to give answers” when they give comments to students’ reflective writings to encourage them to reflect more thoroughly (20). The insight reinforced the nature of support that my design intervention provides—asking questions. Korstange also pinpoints the critical components among the various theories of reflective practices: “think about a specific learning experience, make connections to and from that experience, and strategize as to how their thinking or action will change as a result of the reflective process”(p. 9). Understanding the backbone of effective reflective writing enabled me to identify what was missing in an ineffective reflection, which informed questions to ask students to probe them further.

Graduate Design Studio Syllabus; Peter Scupelli

In the syllabus, Scupelli introduces the course’s subject, timeline, and requirements, one of which is to document the project process through personal reflections. He suggests that metacognition is crucial for “design agility,” which enables designers to “apply what they know to disparate domains.”

Referencing John Flavell’s model of metacognition, Scupelli suggests students to apply three categories of reflection:

- **Metacognitive knowledge – Reflecting on what they know, and when and how to use the knowledge.**
- **Metacognitive regulation – Coming up with plans, monitoring the process, and evaluating its effectiveness.**
- **Metacognitive experiences – Monitoring their motivation, effort invested, and distractions they encounter.**

The framework provided me a great structure to categorize the prompts used in my design. It also brought to light the significance of addressing feelings in one’s reflection. As a result, many of the components in my design support learners in reflecting on how the learning process makes them feel/affects their motivation.

Promoting Student Metacognition; Kimberly Tanner

Tanner introduces the concept of metacognition and its significance to learning performance when undergraduate students study biology. She developed a set of questions for students to ask themselves that aim to aid their thinking when they reflect. Tanner categorizes the questions into three phases of a learning process (plan, monitor, evaluate) and into different context (homework, quiz, etc.).

Tanner’ list of self-reflection questions served as a great reference when I developed the prompts for the design intervention. The way she structured the questions also influenced the categories I developed for the design.

About Learning; Bernice McCarthy

In the book About Learning, McCarthy explains the differences between learners and their individual learning needs. McCarthy also introduces the 4MAT educational framework and its application in classrooms and organizations. Traditionally, classes focus on teaching knowledge and information. In comparison, McCarthy stresses the importance of going through the whole learning cycle (4MAT), to help students:

- **see the value and relevance of learning a subject;**
- **grasp the information they need to know for the subject matter;**
- **apply what they learn in classes to solve real problems;**
- **extend their learning in class and explore their ways of using the knowledge and skills learned.**

McCarthy’s writing helped me see how different learners and their needs can be. To respect students’ individualities and adapt to their various needs, I hypothesized that the design interventions should afford various ways for students to capture what they learn.

Artifact Review

Through the study of artifacts, I investigated the existing interventions in the field of study and their affordances/ limitations. The process not only helped me identify opportunities for design, but also helped me define what the project is not.

The first section describes various artifacts that foster a growth mindset through direct teaching or indirect learning practices. As the study progressed and the focus became focused on promoting a growth mindset through metacognitive practice, I reviewed a handful of learning tools that support reflection. The third section concludes with artifacts that are not used in a school context but provided inspirations for my design.



Fig. 5.1 Interface of Brainology



Fig. 5.2 Students write on bulletin boards

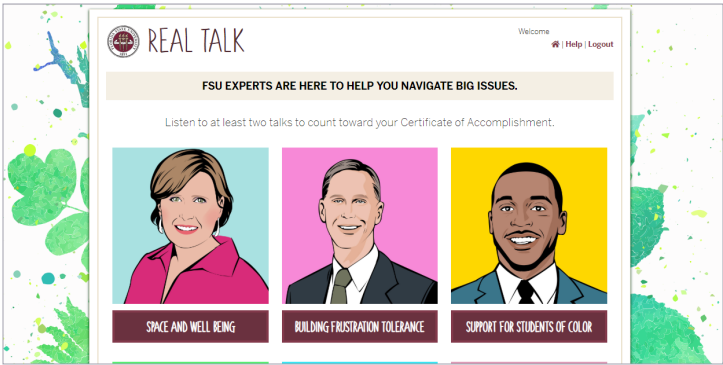


Fig. 5.3 Website resources for stress management

Artifacts that Foster a Growth Mindset

Brainology

Brainology teaches students how to develop a growth mindset. It is a learning curriculum that comprises a digital program and classroom activities that explain how the brain works and effective learning strategies. The curriculum targets a low educational level, making it unsuitable for the target audience of this study, which is college students.

Best Fail Ever Campaign; University of Montana

To increase students' resilience and convey the message that it is okay to fail sometimes, University of Montana organizes bulletin boards around campus for students to share their own "best fail ever" stories. The campaign helps students develop a healthy mindset when they encounter setbacks, but it does not necessarily point students to actionable methods to cope with setbacks. My project strives to help students not only realize the value of educational setbacks but also help them persevere through the setbacks by adapting their learning strategies.

Student Resilience Project; Florida State University

Student Resilience Project is an online toolkit that contains interactive resources that give tips on stress management. Among all the recordings, narratives of students sharing their challenges and how they overcame them were reported to be the most popular, which seems to suggest the effectiveness of leveraging support from peers as a way to foster resilience. As a result, the project led me to investigate opportunities for leveraging individual voices for sharing meaningful content.

WOOP Student Activity Name _____

WOOP helps people do the things they really want to do.

W	WISH What is an important wish that you want to accomplish? Your wish should be challenging but feasible.	My wish: _____
O	OUTCOME What will be the best result from accomplishing your wish? How will you feel? Pause and really imagine the outcome.	Best outcome: _____
O	OBSTACLE What is the main obstacle inside you that might prevent you from accomplishing your wish?	My obstacle: _____

Fig. 5.4 Student activity page

This activity is designed to allow you to reflect on your exam performance and the effectiveness of your exam preparation. Please answer each question sincerely. Your answers will be reviewed by the instructor to help assist her in how to best support your learning.

1. Approximately how much time did you spend studying for this exam? _____

2. What percentage of your test-preparation a time was spend in each of these activities?

a. Reading textbook section(s) for the first time	_____
b. Re-reading textbook section(s)	_____
c. Reviewing lecture slides	_____
d. Doing practice test questions	_____
e. Working with a study group	_____
f. Doing the <i>Learning Actively</i> activities at end of each chapter	_____

Fig. 5.5 Exam wrapper

Woop Playbook; Character Lab

Created by Character Lab, this Playbook is a "ready-to-use resource" for anyone who wants to help learners cultivate self-control and achieve goals. More specifically, the Playbook comprises an overview that explains the activity (WOOP), a facilitation guide, a prep activity worksheet and an activity worksheet for WOOP. The core of WOOP includes four steps: wish, outcome, obstacle, and plan.

Turning an abstract concept such as building self-control into solid steps that can be practiced is interesting to me. I questioned, how might I take inspiration from WOOP and design activities that can be easily implemented by users to cultivate a growth-mindset? The WOOP workbook helps initiate a plan for learners, but it does not include a follow-up procedure. For my project, I focused on integrating the intervention into their learning cycle so that learners can constantly monitor their learning and see growth.

Exam Wrapper

Exam wrappers are given to students when an exam is returned to them. They encourage students to reflect on the processes that lead to their performance. Exam wrapper is a great example of an instructional practice that does not teach growth mindset directly but rather fosters growth mindset behaviors. It helps students attribute their learning outcome to controllable causes such as their effort or learning strategies. The artifact inspired me to consider opportunities to support students in reviewing their learning effort periodically that could inform their future steps.

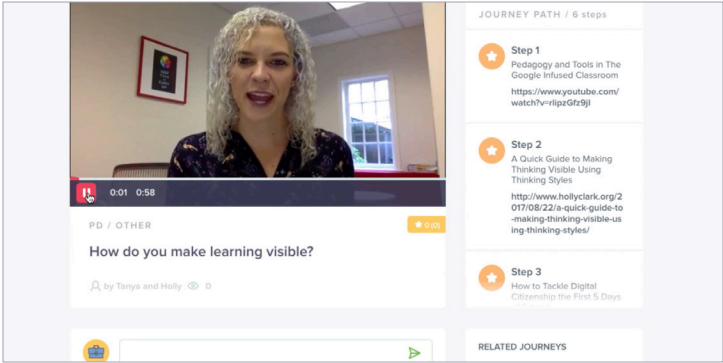


Fig. 5.6 Recap App

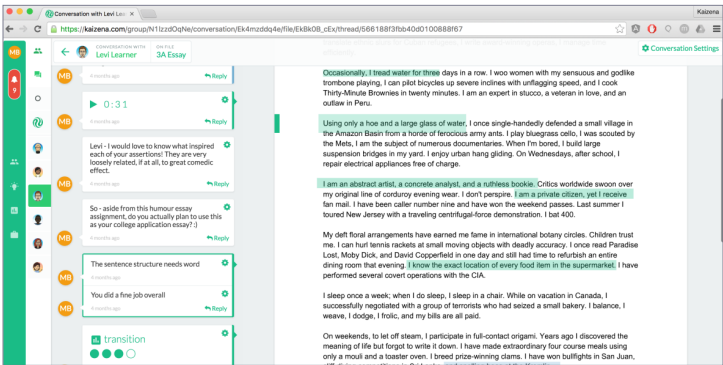


Fig. 5.7 Kaizena App

Learning Tools that Support Reflection

Recap App; Swivl

Recap is an inquiry-based chat tool for discussions among students and teachers. What is unique about the tool is that it enables teachers to collect video responses from students. The process makes the communication more engaging and personal than conventional approaches. Despite its bells and whistles, Recap was not well received by the learning community. It is unusual in a way that it approaches learning as a process of asking questions to pique curiosity and evoke deep thinking, but it requires too much time from students and teachers to record and listen to answers. The amount of effort needed exceeds the value it brings. The failure of this tool reminded me to respect students' and teachers' tight schedules and keep the overhead low when designing the interventions.

Kaizena

Kaizena is an online app that strives to improve the quality of feedback by allowing instructors to leave comments on a word document in multiple ways, including audio clips, text, rubrics, and external links. To encourage a wide range of uses, the tool also comes with an add-on that works with Google Doc. Although Kaizena has a friendly and intuitive interface that makes it easy to use, all features of the App cater to word documents, which restrict more complex usage that is often characteristic of higher education. One of the features I found particularly inspiring allows feedback givers to highlight specific content and assign external links for that particular content. The feature could be especially helpful when students give/receive feedback because the highlights provide context for the feedback.

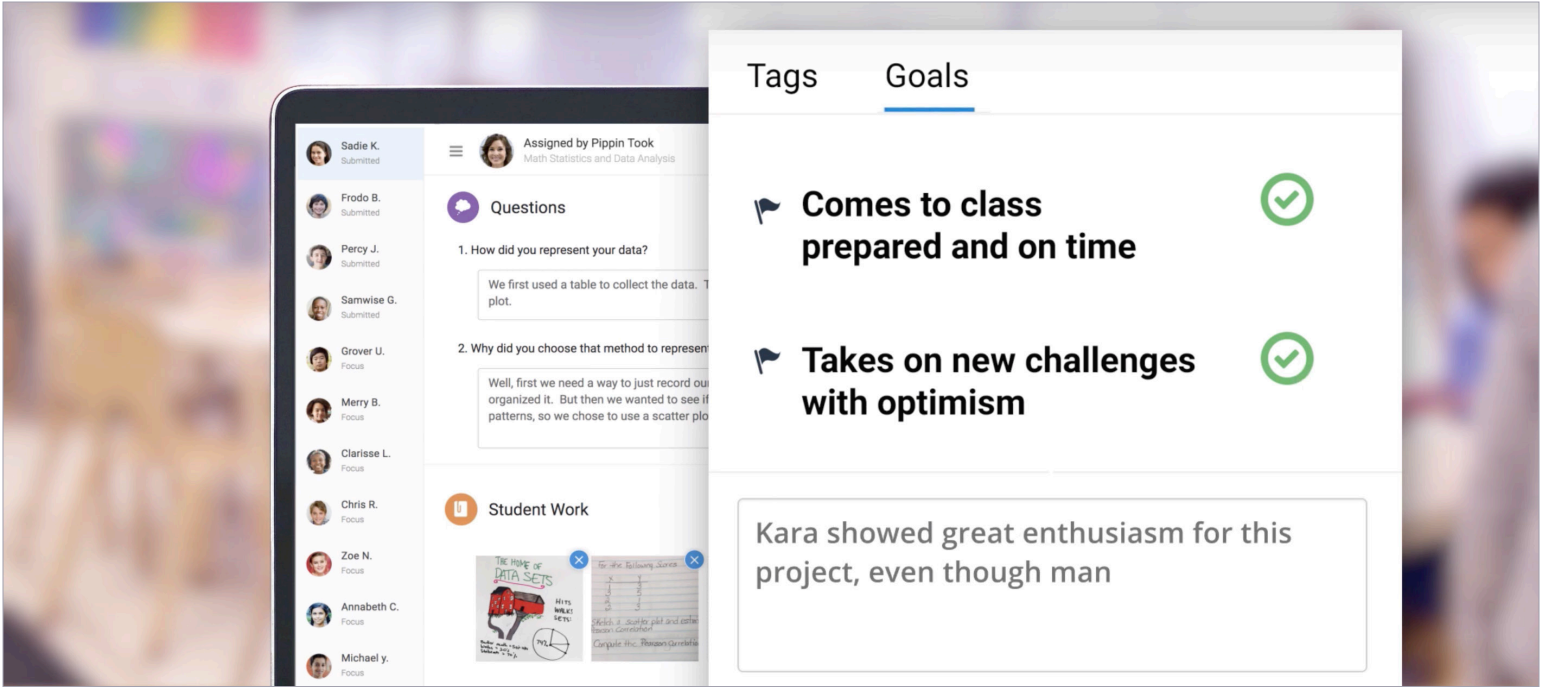


Fig. 5.8 Alt Learning Platform

AltSchool Learning Platform

AltSchool has a mission to build a learner-centered school. One of the elements that guide their pedagogical vision and practices is "enabling learner agency" (Broderick, 2018). Their self-developed platform is used by all students and instructors to support the vision. The platform enables instructors and students to review their goals and track progress for different projects easily. For example, the tool has a built-in function for students to document their in-progress works daily. The platform also breaks down the communication barriers between students, instructors, and parents, enabling instructors to provide timely feedback to students and share updates with parents.

The design of the platform makes it easy for both students and instructors to monitor progress, submit work, and receive feedback, but instructors have to do much hand holding in the process. As a result, it is used mostly by K-12 students because college students generally do not get as much individual support from instructors as younger students. However, I believe this project points to opportunities for positive impact. A digital platform that is specifically designed to encourage students to take the initiative and practice effective strategies that are crucial for cultivating a growth-mindset, such as monitoring one's learning and frequently reflecting, even without much intervention from instructors, can potentially provide the support students need to become self-directed learners.

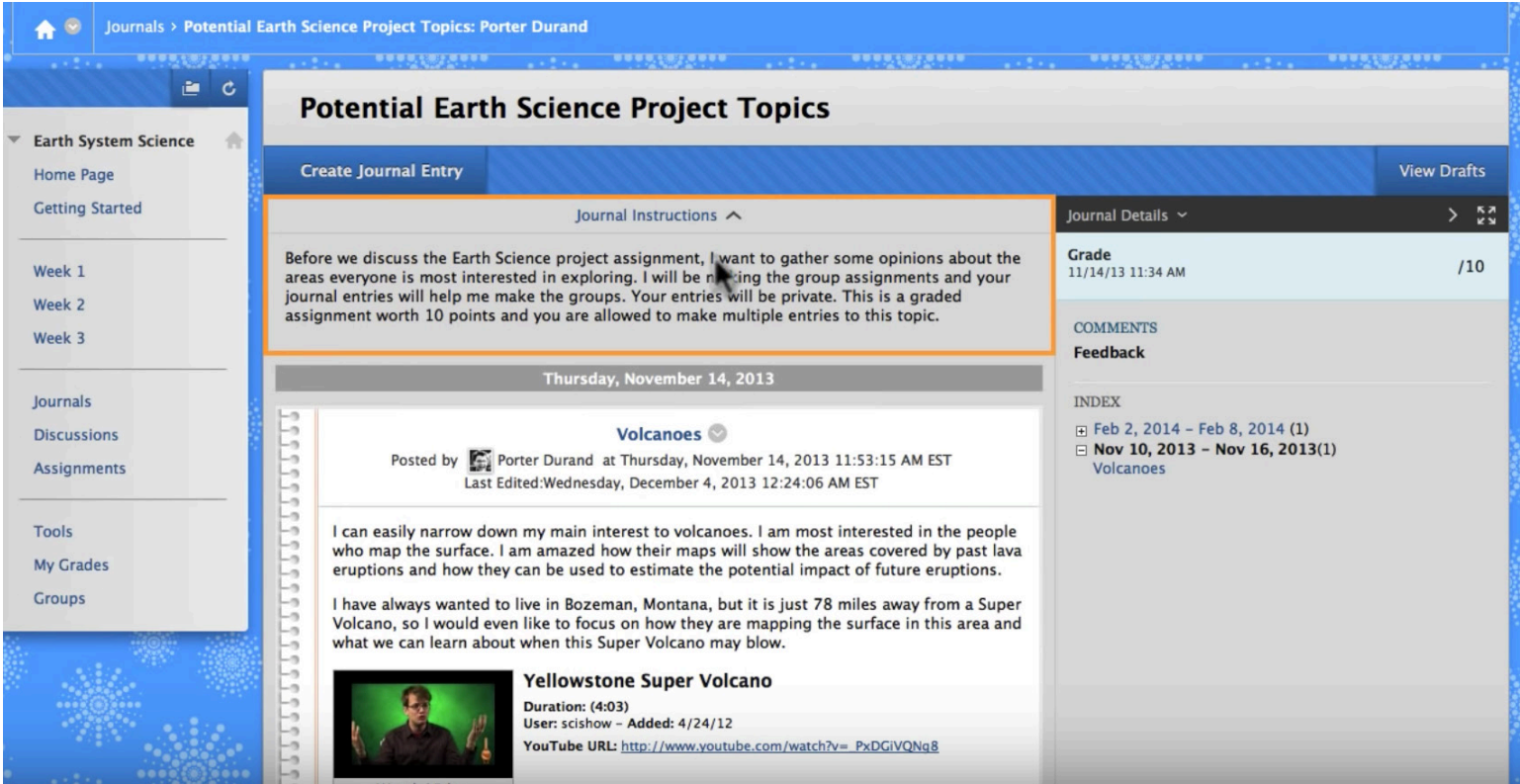


Fig. 5.9 Blackboard

Blackboard

For many years, Blackboard has been the most popular Learning Management System (LMS) in higher education. It is a robust system that contains the features instructors, and students need. However, people have been complaining about its unfriendly user experience and at the same time, its competitors, such as Canvas, have been gaining traction rapidly. In reaction, Blackboard redesigned its system and introduced many new tools.

One of the tools that is most relevant to my project is Journals. The tool enables instructors to collect each student’s reflection; students can also use the tool to initiate their reflection. However, the tool does not have the structure and feedback in place to foster effective reflection. From personal experience, I often forget the discoveries I made, and sometimes make the same mistakes again. To make reflections more meaningful, a reflection tool could nudge students towards making concrete next steps and help them see their learning growth over time.

Non-academic Artifacts that are Influential to the Design Concepts

Medium

Medium is a platform for people to write and read content. Although not designed for educational use, it is a popular tool used by college students to document their learning process. Its friendly and clean interface enables users to focus on the task of writing. The tool’s intuitive and friendly interface inspired my design. However, the tool lacks the scaffolding students need when they start learning how to monitor their process, which was the main focus of investigation for my project.

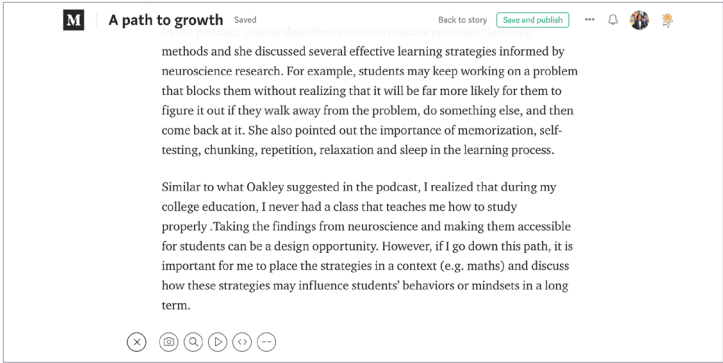


Fig. 5.10 Writing reflection on Medium

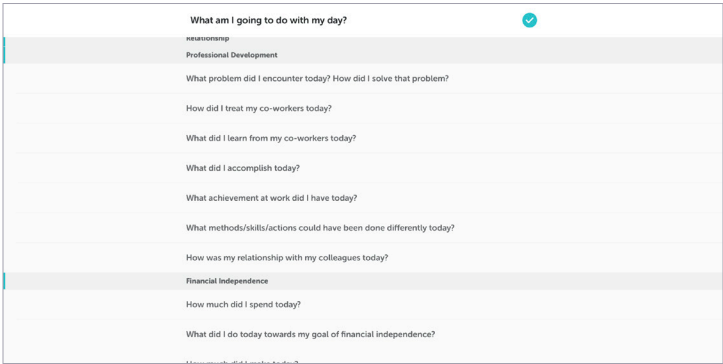


Fig. 5.11 Selecting a prompt from the prompts list in Grid Diary

Grid Diary

Grid Diary is a journaling App that provides structured, reflective prompts to guide users’ reflection, which users may need to aid their thinking. Further, it allows users to replace the prompts with others they find relevant in the prompts list. The artifact inspired me to investigate the idea of a guided reflection. For students who are new to a reflective process, having pre-populated prompts may give them a place to start. On the other hand, it may be beneficial to slowly remove the support as students improve their metacognitive skills to allow for individuality and agency.

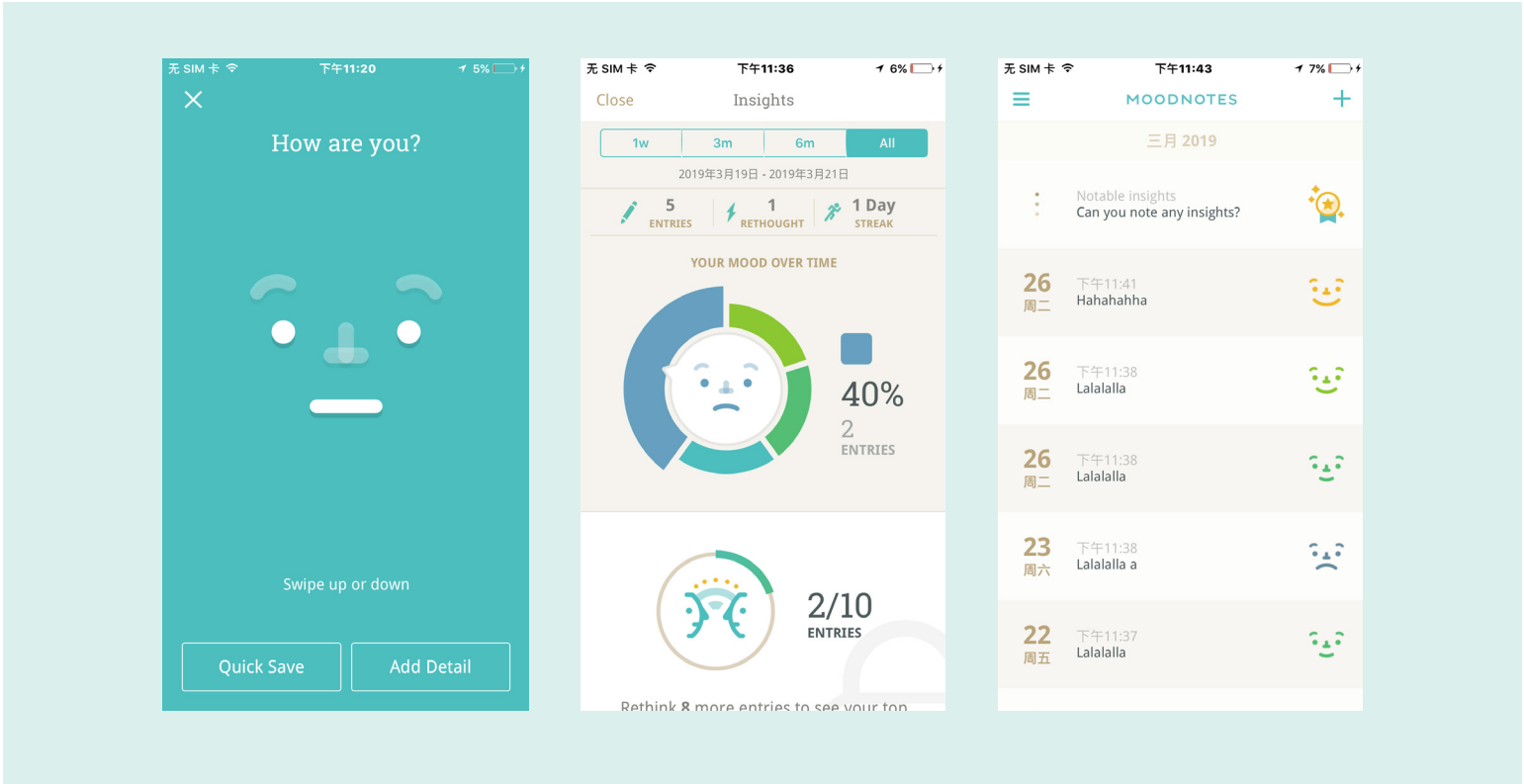


Fig. 5.12 Moodnotes App

Moodnotes

The journaling App enables users to track their mood and causes for their feelings over time. It also allows users to identify common thinking traps, and develop a positive mindset. I found the artifact to be particularly inspiring in its form and interaction.

Some of the elements I brought into my own project included:

1. Using color to reinforce the indicated mood.
2. Increasing users' self-awareness by tracking and showing them how their mood changes over time and the thinking traps that lead to negative emotions.

Conclusions

Insights from literature and artifact reviews informed my design decisions throughout the design process. Early in the process, the insights helped me deconstruct the complex concept of growth mindset so that I was able to investigate each part separately.

The insights also helped me choose the focus of the project. There are many approaches to foster a growth mindset—some through involve direct teaching, others support students to practice skills that are pertinent to developing a growth mindset. However, the insights I gained suggest an opportunity space for designing interventions at a college level to help students practice skills to monitor their learning in daily practices.

Later in the project, I took inspiration from my discoveries to develop frameworks, design guidelines, and create content for design concepts.

Interviews

Many times, the characteristics of a growth/fixed mindset become apparent when students encounter adversities. Early in the project, I interviewed seven undergrad students and six instructors from various disciplines.

Interviews with Instructors

Similar to the questions in the students' interviews, the questions for instructors investigated the common educational setbacks they observed students having, their reactions to how students responded to the setbacks and the strategies they used to foster a growth mindset. Some key questions included:

- What are some common educational setbacks that you see your students encounter?
- How do they typically respond to them? What's your reaction to them?
- What strategies do you find effective in helping students persevere when they encounter educational setbacks? Why?

Interviews with Students

The first part of the interview asked students questions that focused on common educational setbacks that they encounter, the causes and consequences, and the coping strategies they use to persevere through these setbacks. The key questions I asked included:

- Please define what educational setback means to you?
- Why do the setbacks you mentioned above occur?
- What is your view of them?
- How do you typically respond to them? Why?

For the second part of the interview, I gave students a set of factors in card formats, and I asked them to rank the factors in the order of importance for creating a safe and supportive learning environment. The factors included:

Teacher's Feedback	Teacher's Way of Teaching	Classroom Setup	Classmates' Attitude and Performance	Subject Matter
Time	Structure of the learning experience	Learning Material	Learning Activities	Grades

Findings

In general, students and instructors have very different perceptions of educational setbacks. Many students perceive setbacks as something that prevent them from advancing their understanding of a subject matter or getting to a desirable outcome whereas many instructors associate setbacks with students' internal fear of taking risks.

1. For students who are used to a certain thinking style, it becomes particularly difficult for them to go into a discipline which celebrates a completely different thinking style.
2. Students expect a lot more support from faculty whereas instructors think that students are not taking enough initiative and risk.

STUDENT: There is not enough support and feedback. You have to seek it actively, otherwise, there is not much that you can get.

INSTRUCTOR: (Students) are unaware that they need to fail to succeed; they regard writing as a gift, not craft.

3. The value of finding alternative strategies when blocked by setbacks are recognized by both students and instructors.
4. When instructors find ways to alleviate students' anxiety of failure, students are more likely to focus on learning.
5. Students place a high value on working with peers for discussing questions and getting emotional support.

STUDENT: When working together, I realized that everybody is on the same page and we discuss problems together. It also gives me more confidence.

What causes educational setback?

Environmental Block

Ineffective scaffolding or lack of support from instructors



Emotional Block

Students closely associate their performances or skills with self-identity



Intellectual Block

Ineffectvie use of strategies for studying and problem-solving



Bad Time Management

Unable to buget time or prioritize effectively



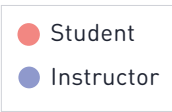
Perceive Low Value

Students see little value in the subject matter being learnt



Perceptual Block

Difficulty in perceiving the problem or the information needed to solve the problem



What strategies help students persist through setbacks?

Support System

Discussing questions, sharing solutions, talking about frustrations and getting emotional support among peers



Effective Strategies

Exploring effective ways to solve problems



Self-reflection

Seeing growth, identifying holes, organizing thoughts, and adapting strategies through reflection



Positive Mindset

Handling problems promptly and confidently and keeping a healthy balance



Anxiety Alleviation

Instructors help remove emotional block for students



Encouraging Instructors

Instructors empathize with students and walk them through problems patiently



Positive Feedback

Getting positive feedback is motivating and fulfilling for students



Timely Feedback

Getting timely feedback helps students adjsut their learning process



Scaffolding

Instructors set an appropriate level of challenge and provide incremental support for students



Prioritization

Deciding what to let go and staying focused



Implications for the Project

The activity challenged my prior assumptions about my audience. I assumed that younger students would be more bothered by educational setbacks than older students. However, the instructors suggested that age was not necessarily the indicating factor for which students had more growth mindset characteristics. Instead, students who go through a transitional phase or enter into a new field are more likely to encounter educational setbacks, and thus, I hypothesized that it might be more beneficial to help these students develop a growth mindset as the first step in their transition. This insight led me to choose to focus my interventions on design students who go through a transitional phase in their learning environment, such as freshman coming from high school and MA students who often come from practice and adjacent fields.

The study also disclosed the distinct opinions students and instructors had for the number of support students should get. The misalignment inspired me to explore design opportunities that would support students in acquiring skills to become self-directed learners and help instructors see the challenges students face. In addition, having a support system was identified as the most important strategy students used to persevere through setbacks. This insight heavily influenced the nature of design interventions I developed later.

Interviewing students and instructors from various disciplines allowed me to discover common challenges and strategies students encounter. Nonetheless, further research activities with design students were needed to help me understand how students within the design discipline vary in terms of their learning preferences and the specific challenges they face.



Fig. 6.1 During a collage activity

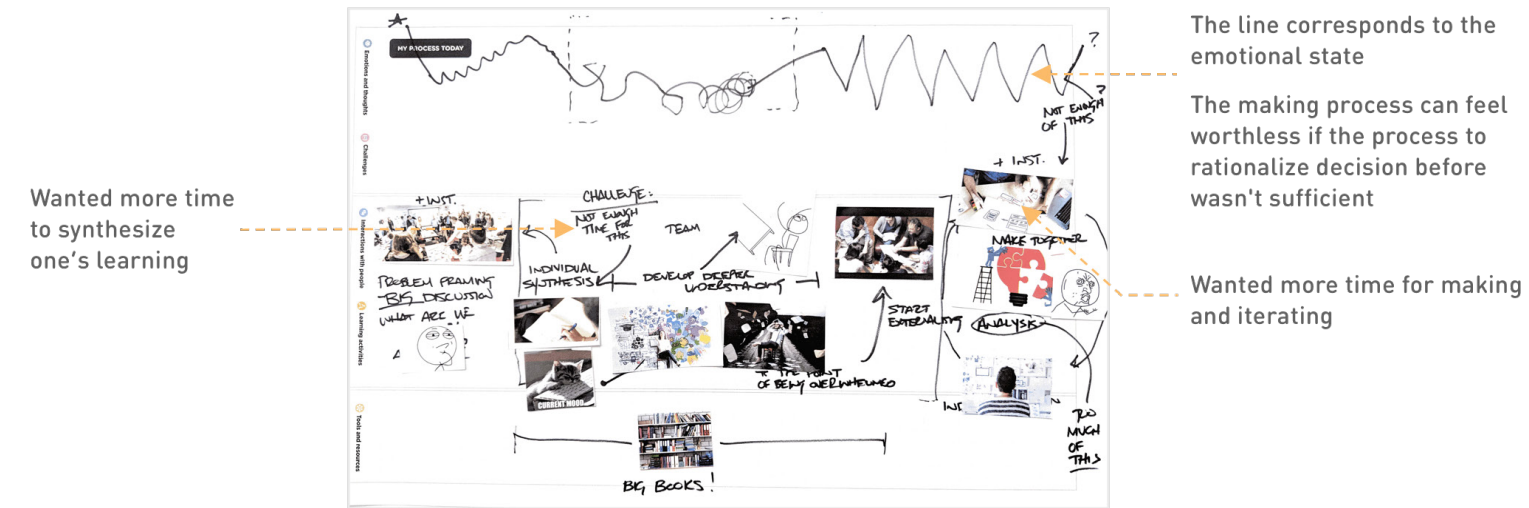


Fig. 6.2 An example of a participant's collage

Collage Activity

For the collage activity and the following magical device activity, I recruited five MA students, who were novice designers, to participate in the activities. The collage activity aimed to investigate the educational challenges MA students encounter throughout a learning experience (e.g., a design studio class).

Prior to the activity, I curated a total of 65 images related to the learning process in design and emotion imagery. I also made a worksheet with prompts to support the participants in making the collage.

During the activity, I asked participants to choose and use the images to depict their learning experience during a design class, considering the following dimensions: emotion and thoughts, challenges, interactions with people, learning activities, and tools and resources. I also asked them to annotate on the worksheet to explain their decisions directly.

Q: What do you wish existed that you feel would help with your learning process in design?
(It can be anything!)

I wish there was a _____ that existed
that would do _____ really well.

Fig. 6.3 Worksheet for the magic device activity

Magic Device

The goals for the activity were to

- discover which interventions people find most helpful to their learning process
- use the insights from the activity to inform the ideas I generated

Using a template I prepared, participants were asked to write a sentence about something they wished existed that they felt would help them with their learning process in design. They were then asked to provide details for their idea and describe its context of use.

In the following example, the participant wished there was a conversational agent that existed that would help him capture his learning process and the decisions he made, and facilitate reflection.

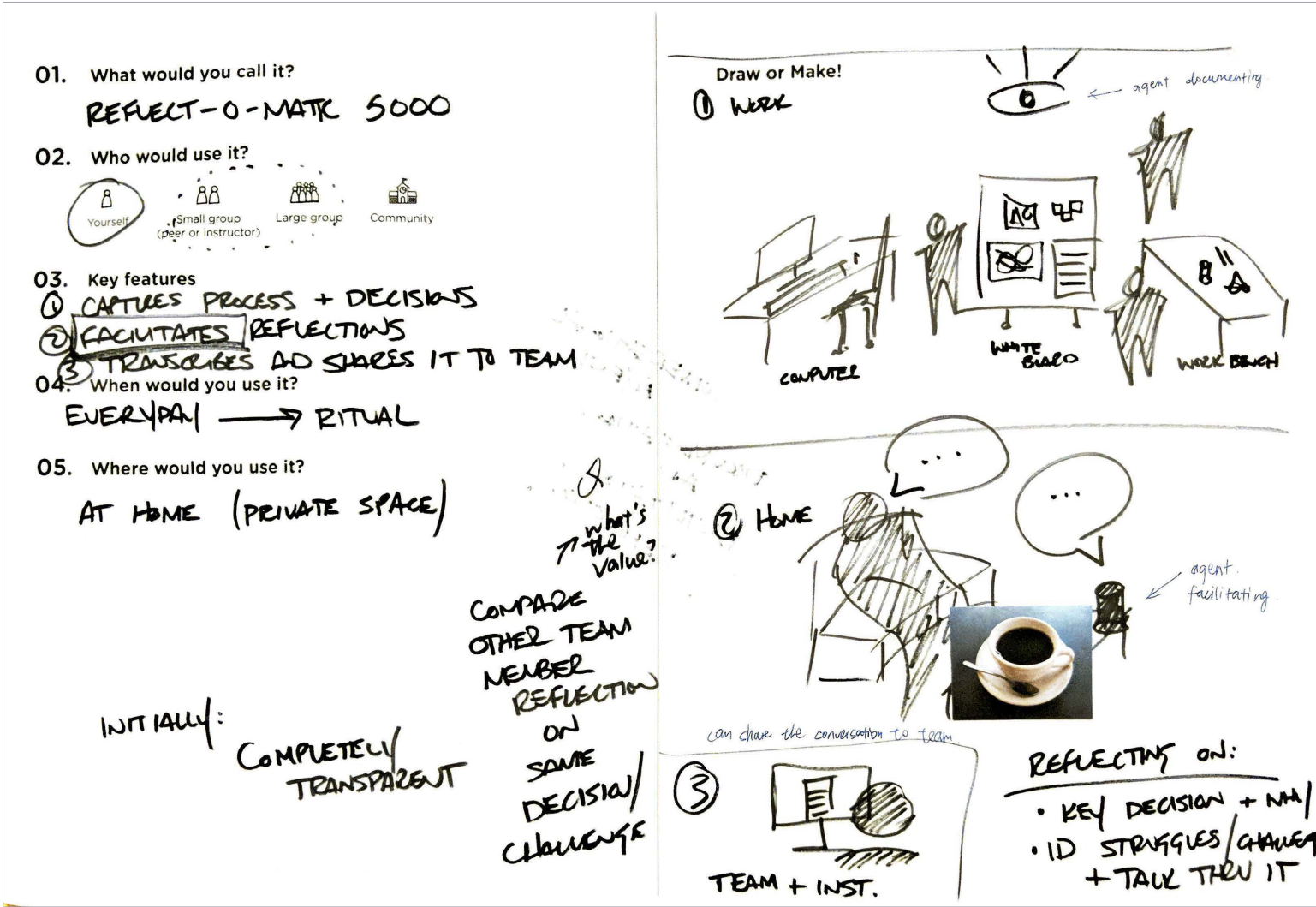


Fig. 6.4 An example of a participant's creation

Findings

Most challenges the participants identified during a design learning experience could be categorized into these groups: teamwork, design process, and technical skills.

Team Work

Many times, group tension and frustration arise as a result of collaboration, especially among students who are new to the design field. Students highlighted the following actions as problematic:

- **Receiving non-constructive and insensitive feedback**
- **Lacking skills to pitch one’s idea and rationale**
- **Struggling to reach a consensus within a group when members have opposing ideas**

Design Process

Often, there is no right answer to a design. The ambiguity sometimes gives rise to the following actions that students identified as frustrating:

- **Scoping a project to an area that is too big to handle effectively**
- **Turning research insights into design directions**
- **Feeling like the design outcome is a gamble if decisions made before during the synthesis phase felt dubious**
- **Having little time to make things at the end of a project can cause frustration and an unsatisfactory design outcome**

Technical Skills

Students who are new to the design field often need to learn various new tools. Learning a new program when time is pressing can induce a high level of stress, especially when not enough external guidance is received.

Implications for the Project

Knowing the common setbacks students encounter during their learning process helped me understand which problems the design interventions could address. For example, team tension was a shared frustration among many of the participants. As a result, one component of the final design supports students in giving constructive feedback to their teammates.

Through the activity of Magic Device, I discovered that most of the inventions the participants designed were for personal use and that the interventions all provided support to students during their learning process. Based on this insight, I developed most of the concepts to aid a personal learning experience.

Insights from both activities also gave rise to the following design principles that guided my design:

Personalization

Through user research, I learned that there is a wide range of learners and each may have prefer a different way of learning. Therefore, it is critical for the design to account for individuality.

Evolving

Scaffolding is an important concept for acquiring metacognitive skills. As a result, the design should be able to evolve and adapt to students’ skills levels.

Low Overhead

Students generally have a busy schedule. Hence, the design should account for time constraints and allows for low overhead.

Supporting meaningful Teamwork

Collaboration is often a critical component in the design. Students said that a good team experience helps them learn tremendously whereas a poor one can cause much frustration. Therefore, the design should support students in building positive team relationships.

Conclusions

Almost inevitably, there will always be educational setbacks in a learning process. The goal of the project is not trying to identify all the potential setbacks student might encounter and solve them one by one to ensure a smooth and painless learning experience for students. Conversely, some failures and frustrations can be helpful and even necessary for students to achieve learning growth. The opportunity, however, lies in the gap between the amount of agency higher education expects from students and the actual skills students have to monitor their learning and adapt their strategies in the face of adversities. During their studies, students often complained about the lack of support they receive from instructors. Concurrently, instructors complained about students' lack of resilience and agency.

The Chinese philosopher, Lao Tzu, once said, "Give a man a fish, and you feed him for a day; teach a man to fish, and you feed him for a lifetime." A good and caring instructor knows when and how to support students. He/she does not only teach students about content knowledge but also nurtures their skills to become self-directed learners. However, the amount of attention and hand-holding students get from college instructors is often limited. Many times, students need to be their own advocates. The design then has the potential to fill in the gap by giving students the support they need to help them take control of their learning.

Through research activities, I learned that students desire tools that support their design process. The supports include, but are not limited to, providing them with structure that indicates effective steps to take, and helping them make sense of the decisions they make. The ultimate goal is to help students feel confident in their action, especially in an inherently chaotic design process.

The discoveries I made led me to explore concepts that support students in their improvement of learning agency, which in turn, bolsters the development of a growth mindset.

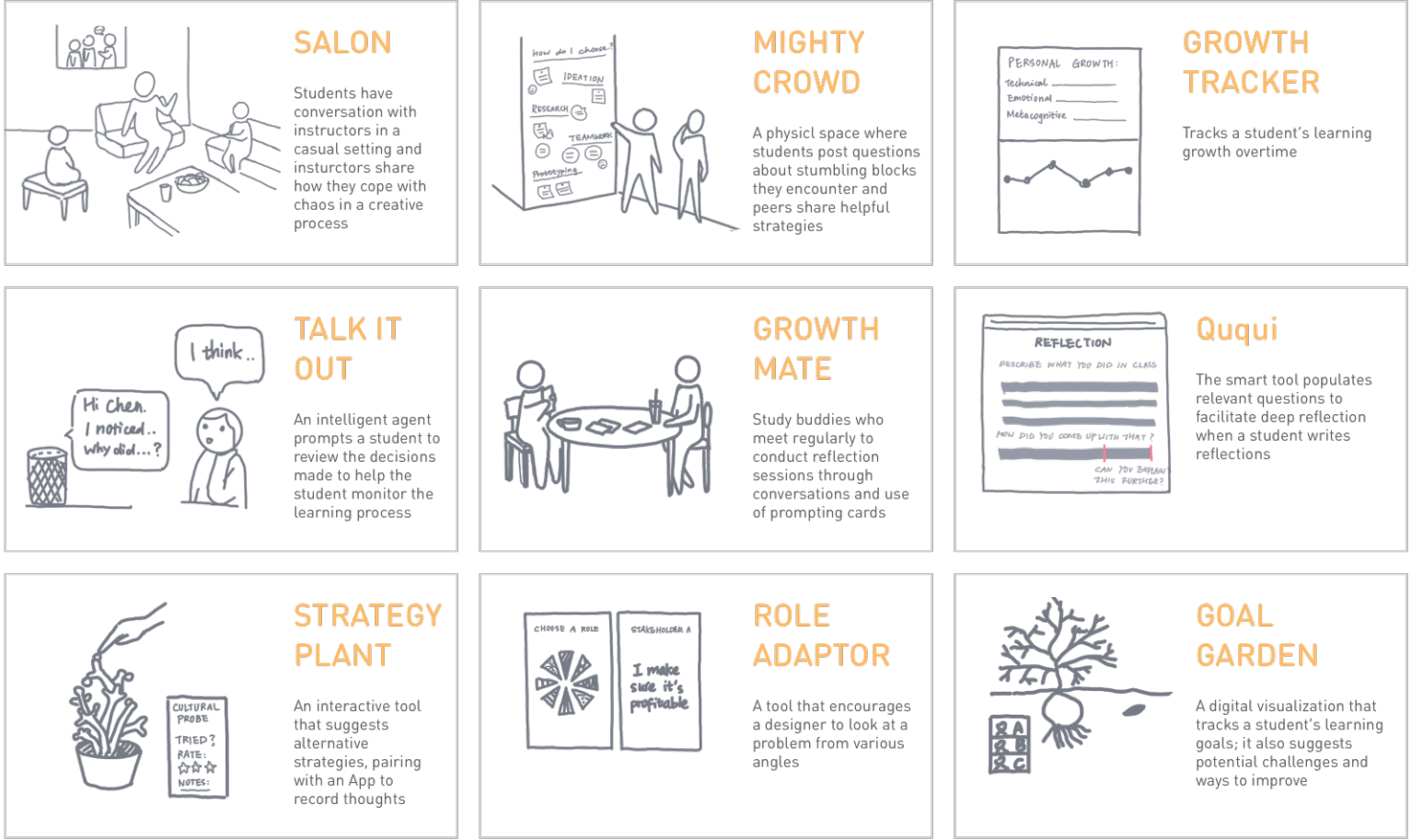


Fig. 7.1 Concepts

Concept Generation

Almost in parallel to the generative research activities, I started to brainstorm concepts, some of which are presented here.

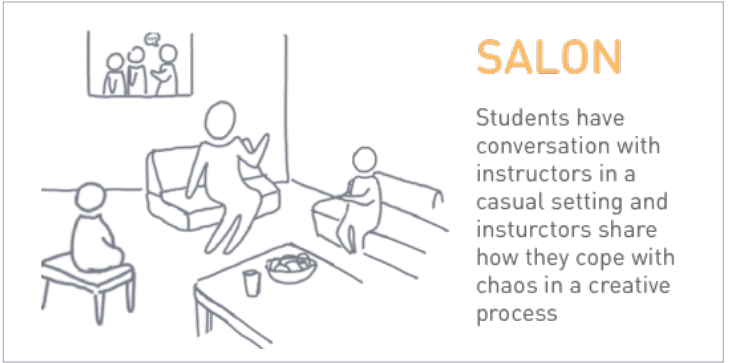


Fig. 7.2 Concept-Salon

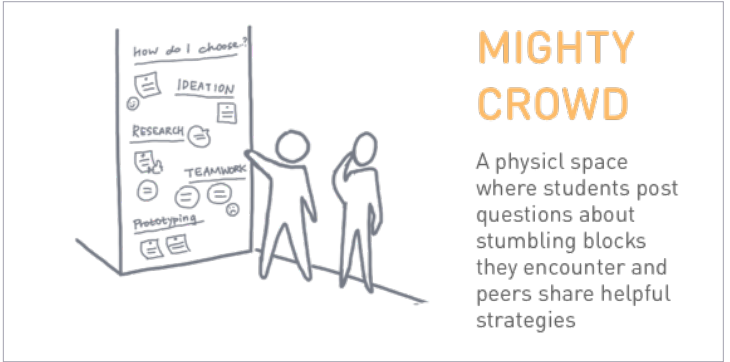


Fig. 7.3 Concept-Mighty Crowd

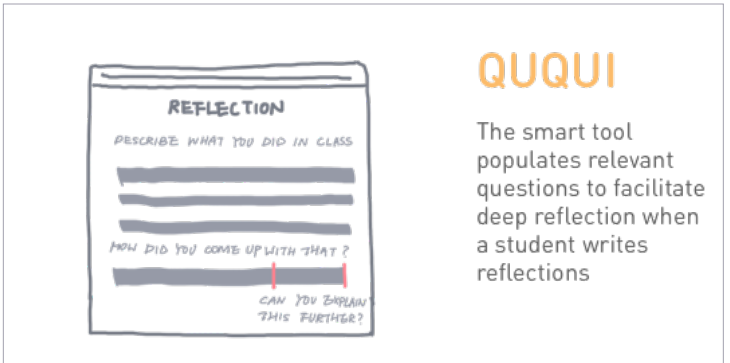


Fig. 7.4 Concept-Ququi

Based on feedback from experts, I chose three concepts that I believed would tackle challenges at different phases in the learning process and that would take various approaches to address problems. I also referenced the design principles (personalization, evolving, low overhead, supporting meaningful teamwork) I established and asked myself questions to inform the concepts I selected:

- Which interventions can leverage the practices students already have to respect their tight schedule?
- Which interventions are closely related to my initial intention of fostering a growth mindset?
- Which interventions might be more effective in supporting the learning of metacognition than others?



Fig. 7.5-Scenario



Fig. 7.6 How it works

Concept 1 - Salon

What It Is

This concept consists of a conversational event where instructors share their personal stories about the ups and downs they encounter and strategies they use during a creative process with students. The accompanying website hosts the upcoming and past events information.

What Influenced It

From my research, I found that students and instructors do not always understand each other. Having small group conversations in an informal setting may help them build a positive relationship, allowing instructors to understand students' struggles and students to see instructors as real people who also experience frustrations and failures in their work.

How It Works

1. Learners use the accompanying website to search and make a reservation for an upcoming salon event.
2. They attend the registered event to get inspired and share their thoughts with others. Learners can also listen to the recorded talks through the website.
3. Learners highlight and save content they find inspiring so that they can reference it later.

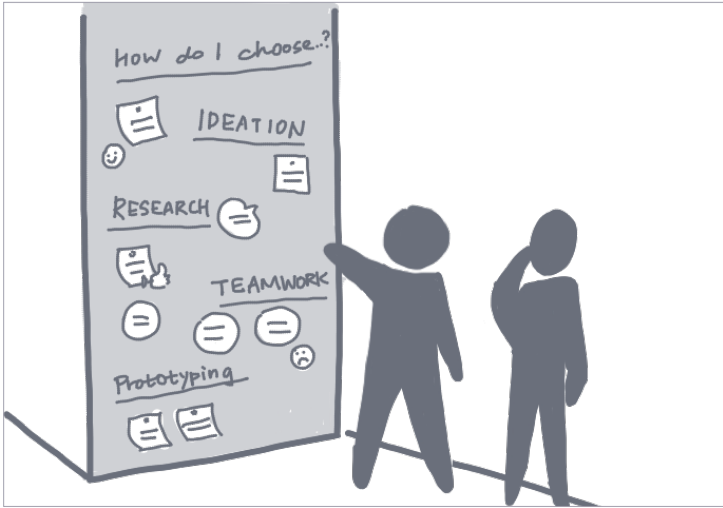


Fig. 7.7 Scenario



Fig. 7.8 How it works

Concept 2 - Mighty Crowd

What It Is

This concept is set in the context of physical and virtual spaces where learners can get support, become inspired, and learn from others (peers and instructors) about the methods and tools they use to get through common stumbling blocks that arise throughout the creative process.

What Influenced It

One of the research discoveries suggests that having a support system and learning from peers are among the most important strategies students use to persevere through educational setbacks. As a result, this concept studies positive learning and support systems by leveraging peers.

How It Works

1. Learners discuss the common blocks people run into during a design process or find a strategy that can support a learner's process.
2. They use the accompanying App to locate and save the tool/strategy they find inspiring.
3. They build knowledge by using and reflecting on the new tool/strategy.

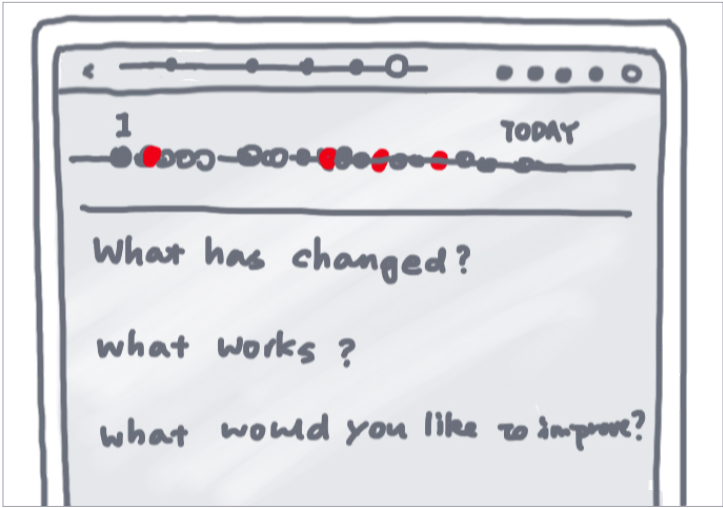


Fig. 7.9 Scenario



Fig. 7.10 How it works

Concept 3 - Ququi

What It Is

This concept introduces to students a smart reflection tool that supports them in developing and applying the skills they need to monitor their learning process effectively and help them become cognizant of their learning growth over time.

What Influenced It

Design students often write reflections that serve as documentation of their process. Through interviews, I found that many students write reflections mainly to attain good grades. In addition, reflecting effectively can be challenging for students who are new to the design field. These discoveries led me to investigate the opportunity to support students in reflecting, shifting it from a task that is often extrinsically motivated to one that has intrinsic appeal.

How It Works

1. During regular reflections, learners choose the relevant prompts from the prompts library to aid their thinking.
2. They receive constructive feedback or a motivational message from their peers/instructors to support their learning.
3. At the end of a project, learners review all the milestones and reflect on the overall learning experience to consolidate their learning and inform their future steps.

All three concepts—Salon, Mighty Crowd and Ququi—provide valid opportunities for meaningful investigation. Nonetheless, as an initial step in encouraging students to work effectively by themselves, I chose to focus on developing the third concept, which aims to facilitate and improve self-reflection.

Concept Evaluation

Prior to refining the concept, I conducted two rounds of evaluative research activities with a total of seven freshman design students and MA students. The goal of the study was to uncover students' fears and aspirations for writing reflections and use the insights gleaned to inform design decisions. The main questions I investigated include:

- What motivates/demotivates students to reflect regularly?
- How might the design component support them in improving their sense of control over their learning through reflecting?

For the first round of study, I focused too much on evaluating the features of my design rather than understanding the values my design provides. Learning from the experience, I revised the research materials and conducted the second round of study, which led to valuable discoveries.

First Round of the Evaluative Study

Prior to the study, I created an extensive storyboard that depicted how the design worked and a semantic differential scale that evaluated different facets of the design. During the study, I walked through the whole storyboard and asked the participants to use the semantic differential scale to rank how the design made them feel.

Seeing the storyboard as one big solution made it difficult for participants to look beyond the proposed design. To move away from explaining how it works and move towards investigating how it could provide value, I removed some of the technical details from the storyboard in the second round of the study.

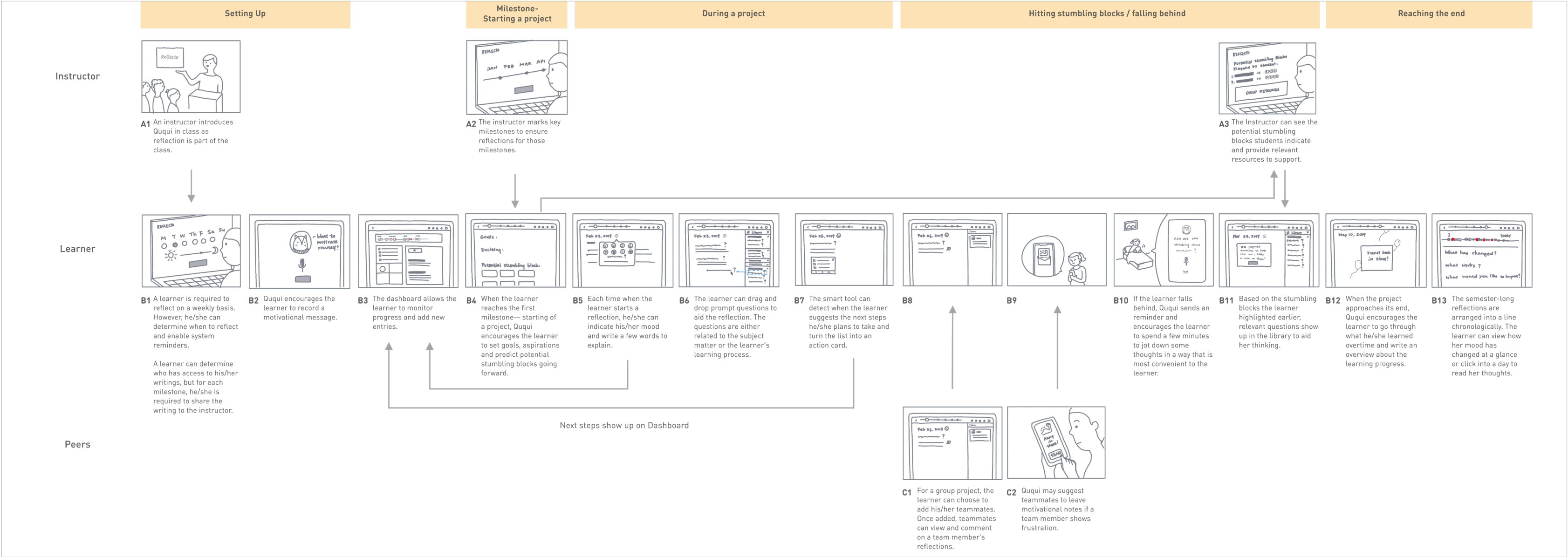


Fig. 7.11 Storyboard

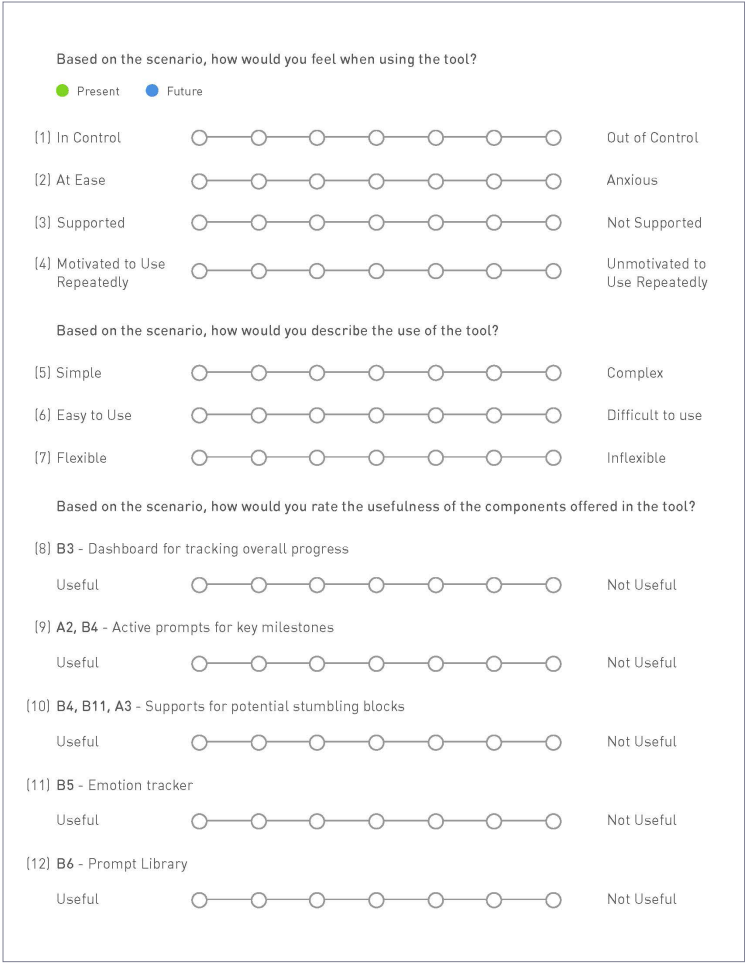


Fig. 7.12 Semantic differential scale

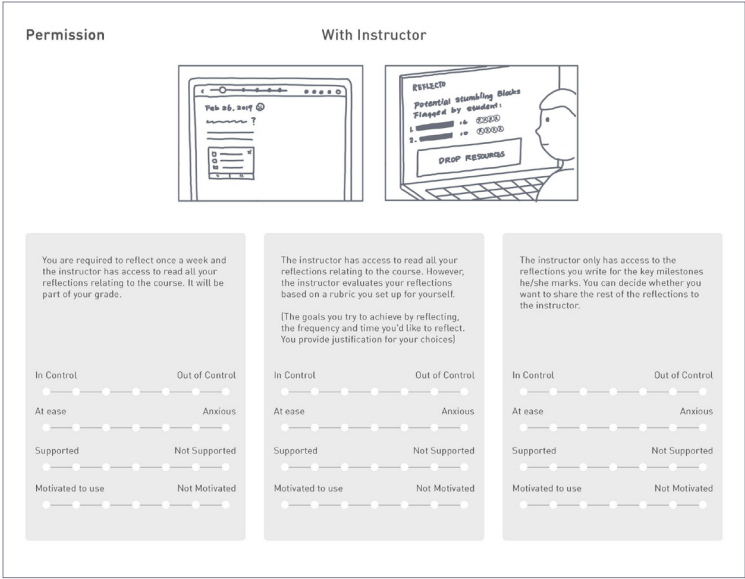
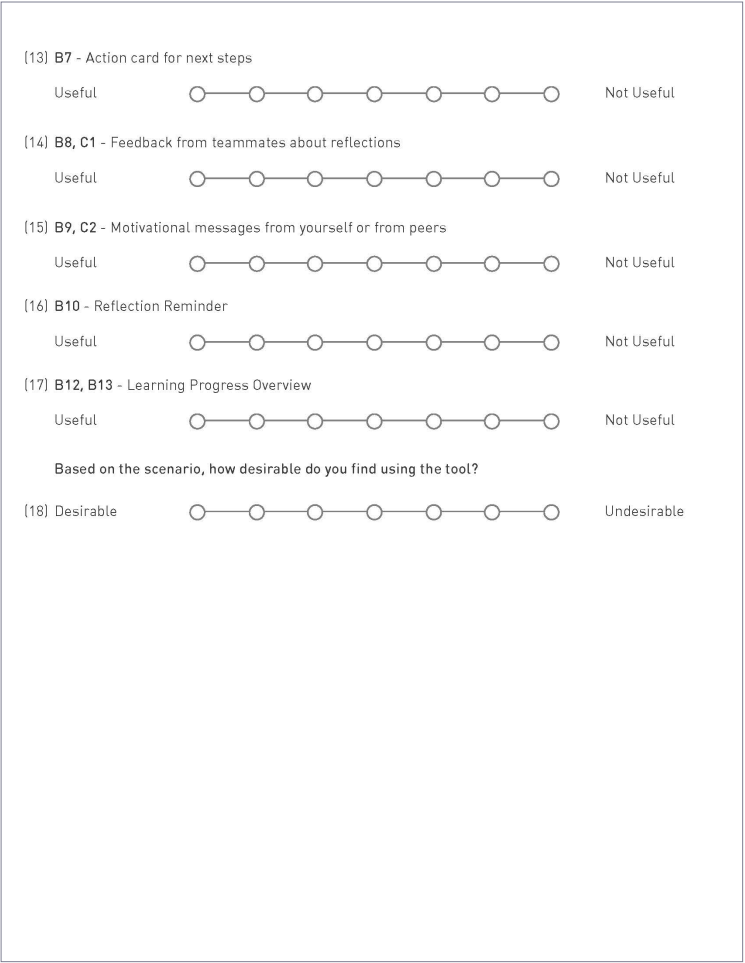


Fig. 7.13 Semantic differential scale

Second Round of the Evaluative Study

For the second round of the study, I broke the whole design into smaller components and generated two to three different variations for each component to learn which variation resonated with the participants most. For example, one component investigates the level of privacy students desire for their reflections. Before showing participants the storyboards, I asked them a few questions to gain a general sense of their current experience with writing a reflection. The questions I asked included:

- What are you using to reflect this year?
- How do you feel about the current reflection process (helpful? burdensome?)
- What would make reflecting more valuable to your learning?
- What do you like and dislike about the current tools you use to reflect?
- Do you go back to your previous posts during a semester?

To wrap up the study and summarize participants' thoughts, I asked the following questions at the end:

- What components of the tool do you find most valuable?
- What would be your concerns for this tool?
- Do you have any other questions or suggestions?

Findings

After the study, I visualized the scale ranking (1-7) from the semantic differential scale to identify which design components were more desirable. I used desirability as the key factor in selecting components for further iteration. I also used the affinity diagram to help synthesize the answers from the follow-up questions. The following findings gleaned from the semantic differential scale and interview questions heavily informed my design priorities and decisions:

1. Reflecting lacks intrinsic value for students – Many students write reflections mainly to attain good grades.
2. Students rarely look at previous posts – Instead of reviewing their previous posts during a semester, most students review them after a project ends.
3. Students prefer control over visibility – Many students only want to share reflection within a small group, if not just with the instructor. Giving students the control can potentially encourage students to write genuine thoughts about their own learning.
4. Students want constructive feedback – Getting constructive feedback from peers or instructors can add tremendous value to writing reflections. However, non-constructive feedback can also be detrimental.
5. Students seek structure initially – Making reflections a part of course requirements that are graded can make students anxious, but they stated that they prefer structure and pressure to keep them motivated to reflect.

6. Students desire proactive prompting – Since new designers desire a lot of support at the beginning of their education, they generally are in favor of proactive prompting, especially when they can choose to skip the prompts.
7. Visualize learning growth – Students want to see their progress and grasp where they stand throughout their learning process.
8. Value of writing reflections – The self-identified values for writing reflections include:
 - See what I am getting better at
 - Feel hopeful and inspired
 - See what does/doesn't work to inform my next steps
 - Ease documentation at the end of projects
 - Make sense of one's own story and choices made

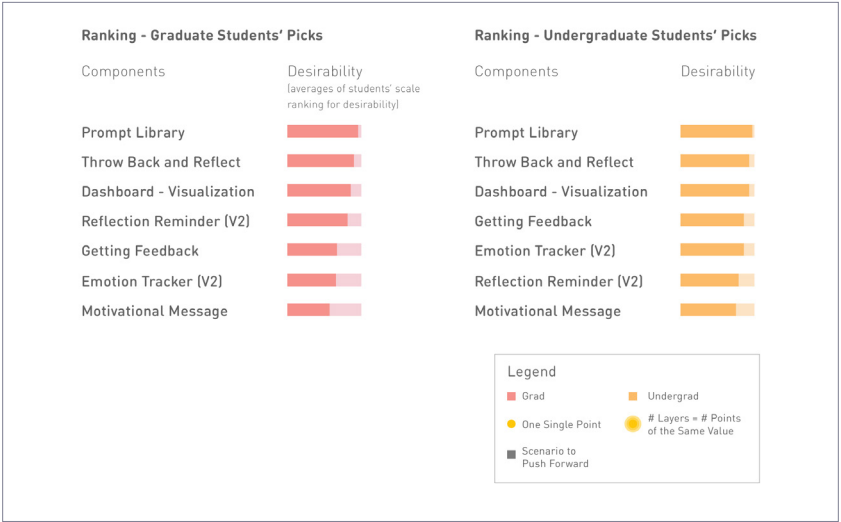


Fig. 7.14 Desirability ranking

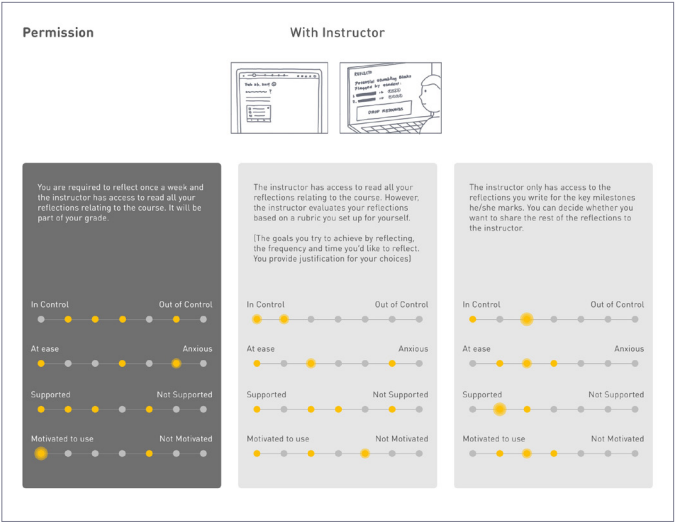


Fig. 7.15 Choosing the variation that resonated with the participants most

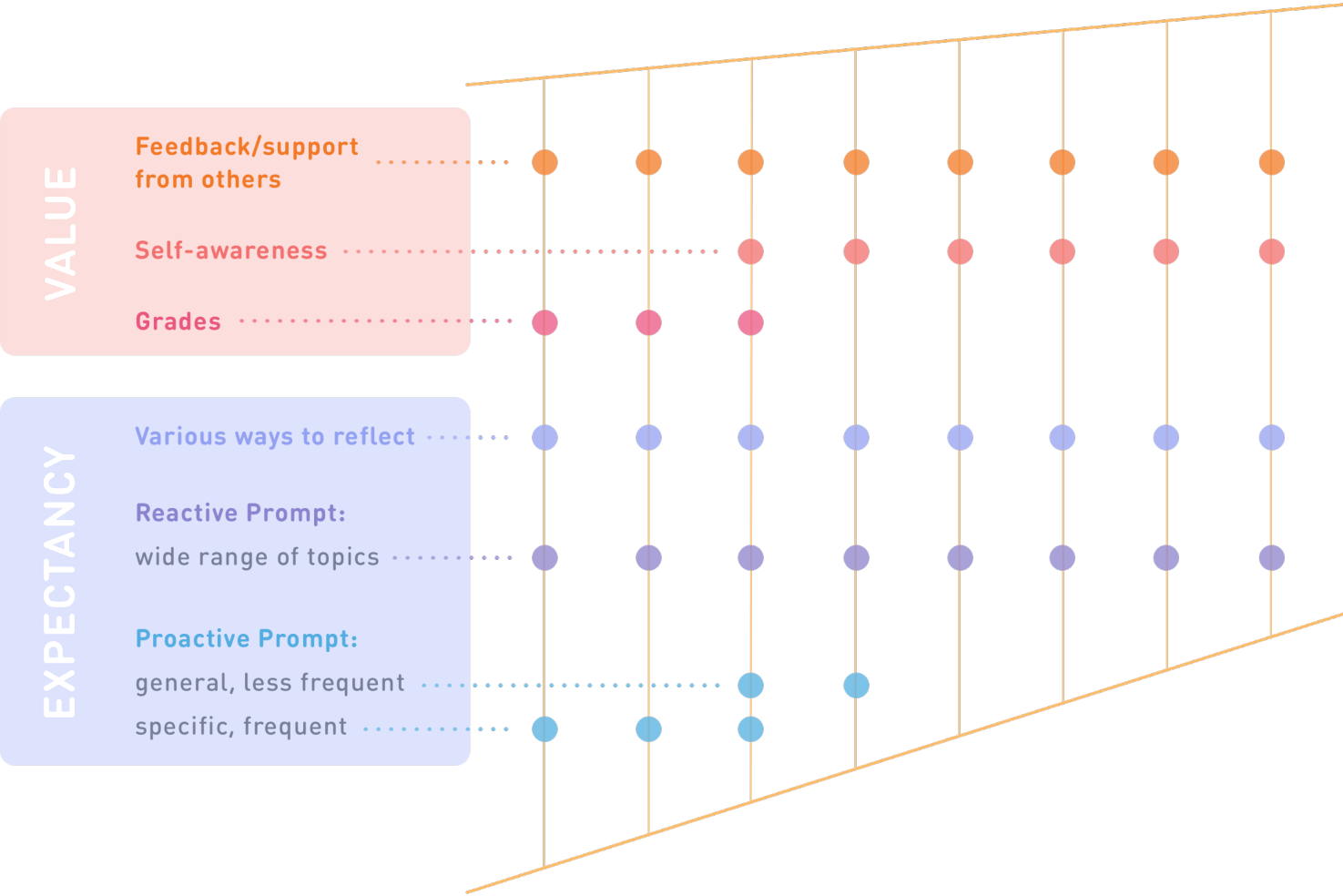


Fig. 7.16 Learning framework I developed to structure my design

Framework adapted from:
Dirksen, J. *Design for how people learn*. Berkeley, CA : New Riders, 2012;

Ambrose, S. A., Bridges, M. W., DiPietro, M., Lovett, M. C.,
& Norman, M. K. (2010). *How learning works: Seven research-based principles
for smart teaching*. San Francisco, CA: Jossey-Bass.

Turning Findings into a Learning Framework

During the literature reviews, I identified two learning theories that are relevant to my study. One is the value-expectancy theory developed by Ambrose et al., the other one is scaffolding the learning incline introduced by Dirksen. Building onto the two theories and referencing the discoveries from the evaluative studies, I developed a learning framework to structure my design.

Dirksen suggests that the benefits students identify in a task (value) and their beliefs that they can accomplish a task (expectancy) have a significant impact on their learning and performance. One of the findings suggests that many students do not see the intrinsic value for reflecting. Besides, many new design students lack the skills needed to conduct effective reflections and thus monitor their learning. Therefore, I hypothesized that by scaffolding the process of acquiring and applying metacognitive skills via the lenses of value and expectancy, students will be more likely to engage in reflecting long term and thus develop a sense of agency over time.

In the framework, the dots represent the support afforded by my design. At the beginning of a learning process, the tool supports students extensively when they write reflections. As students gain competency, the supports are slowly removed to enable students to have more control over the process.



Design Process

Prototypes

The following prototypes show the various forms of support afforded by the different components of the tool and how they evolve as students move along their learning process.

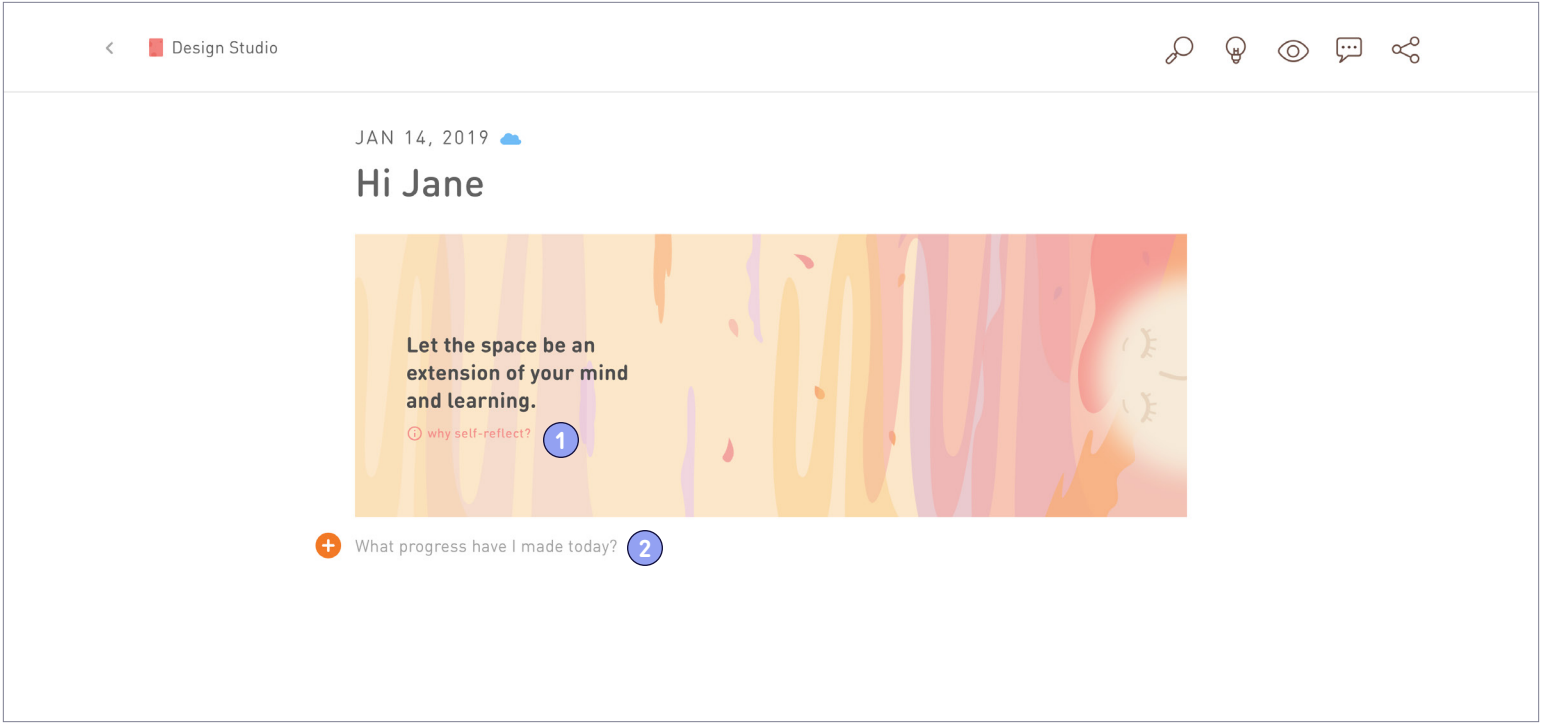


Fig. 8.1 Ququi welcome post

Welcome Post

After students go through the onboarding process of the reflection tool, they see a welcome post. By framing the reflection tool as a space of extension for students’ mind and learning, it encourages students to take ownership of the space and use it to their advantage. It also sets the tone for the prompts, which are framed in first person as if students are asking themselves questions.

- 1 The tooltip explains the value of self-reflection.
- 2 “What progress have I made today?,” the prompt serves to kickstart a student’s reflection process.

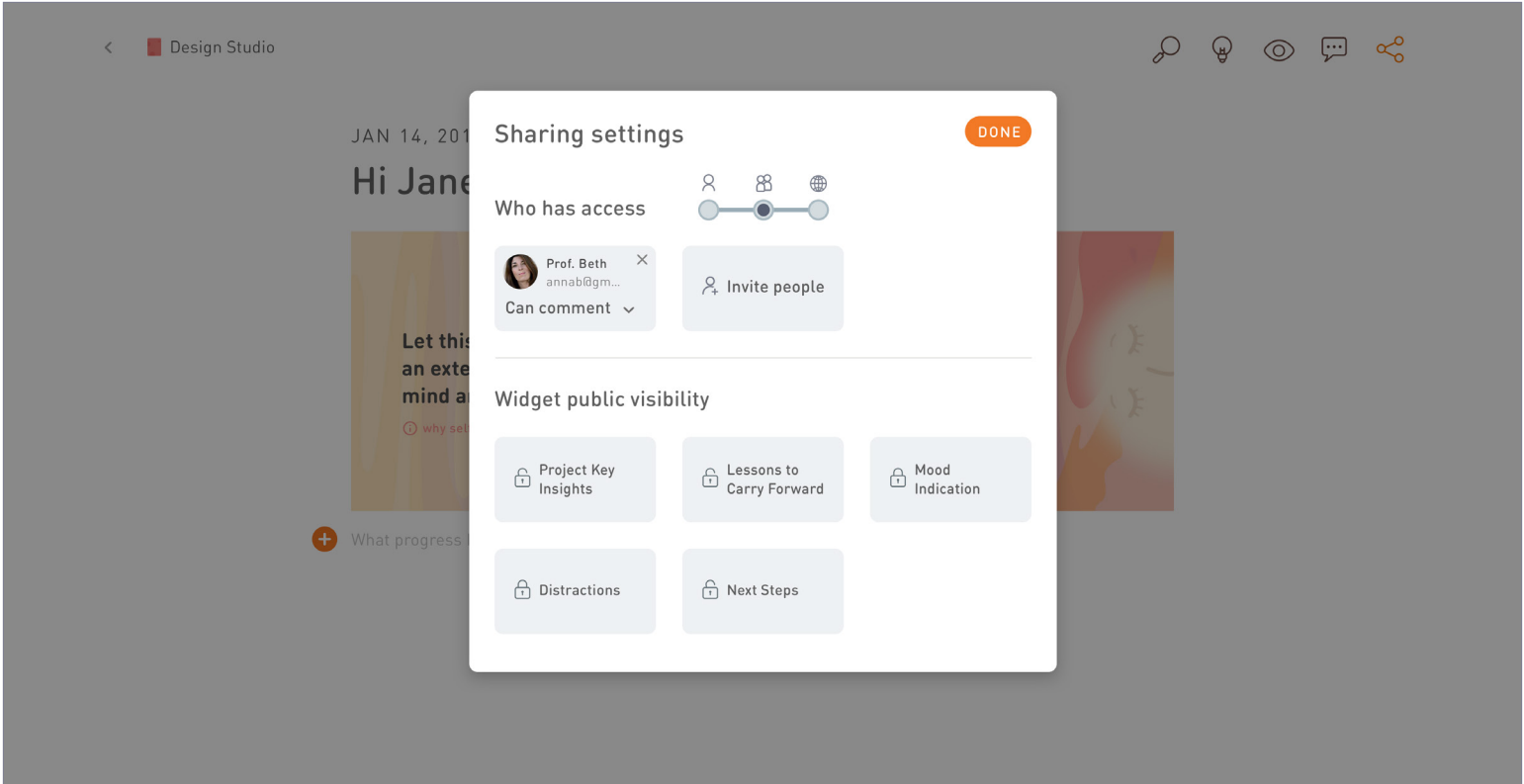


Fig. 8.2 Choosing a level of privacy

Privacy Control

As one of the findings suggests that “giving students the control can potentially encourage students to write genuine thoughts about their own learning,” the tool allows students to choose who has access to their reflections and what content they’d like to share/hide.

Scaffolding Expectancy

As one of the research discoveries suggests, new designers desire a lot of support and prefer structure at the beginning of their education. Therefore, the tool starts by providing students extensive support to reflect effectively.

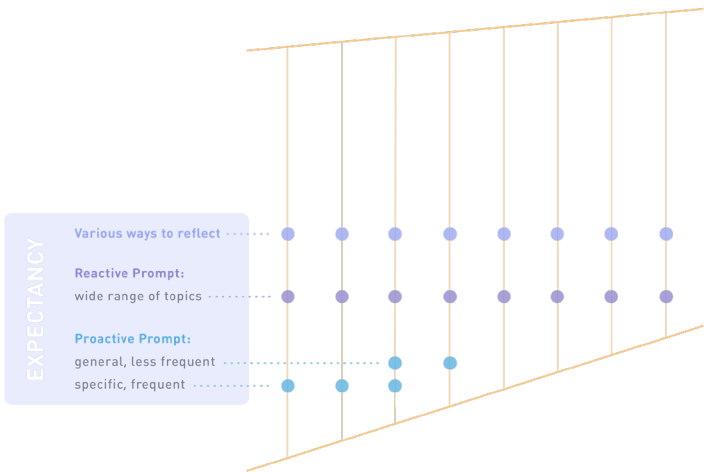


Fig. 8.3 Scaffolding expectancy diagram

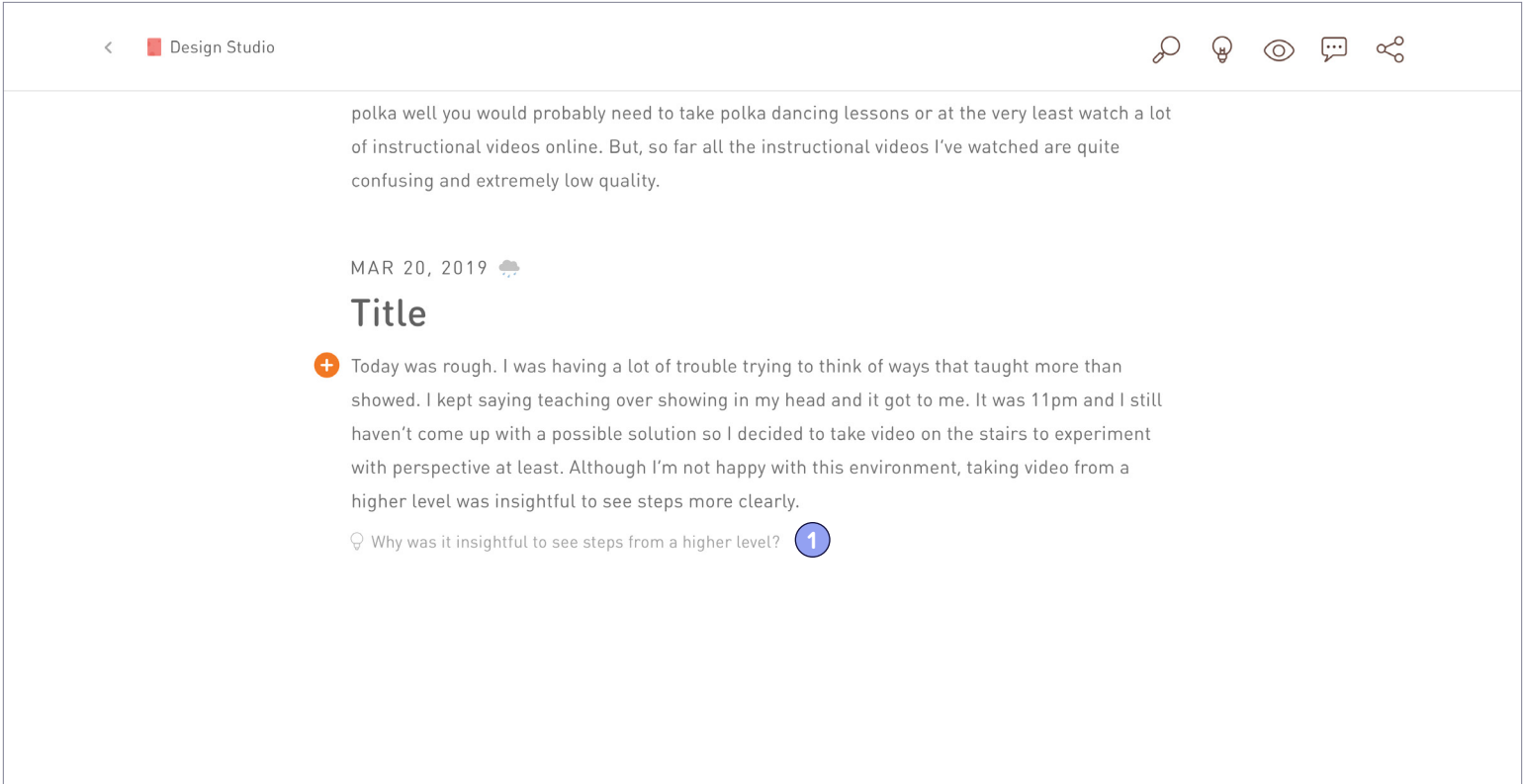


Fig. 8.4 An example of a proactive prompt

Proactive Prompts

The tool proactively suggests relevant prompts when students write their reflections, encouraging them to reflect beyond the surface level. As students get better at asking themselves important questions that lead to meaningful learning, the proactive prompts are shown less frequently and become less specific.

1

For example in a student's writing, she mentioned that her actions led to insightful points with no further explanation. The tool follows up with questions that encourage the student to reflect on what the insights were, why they were useful, and what she plans to do with them.

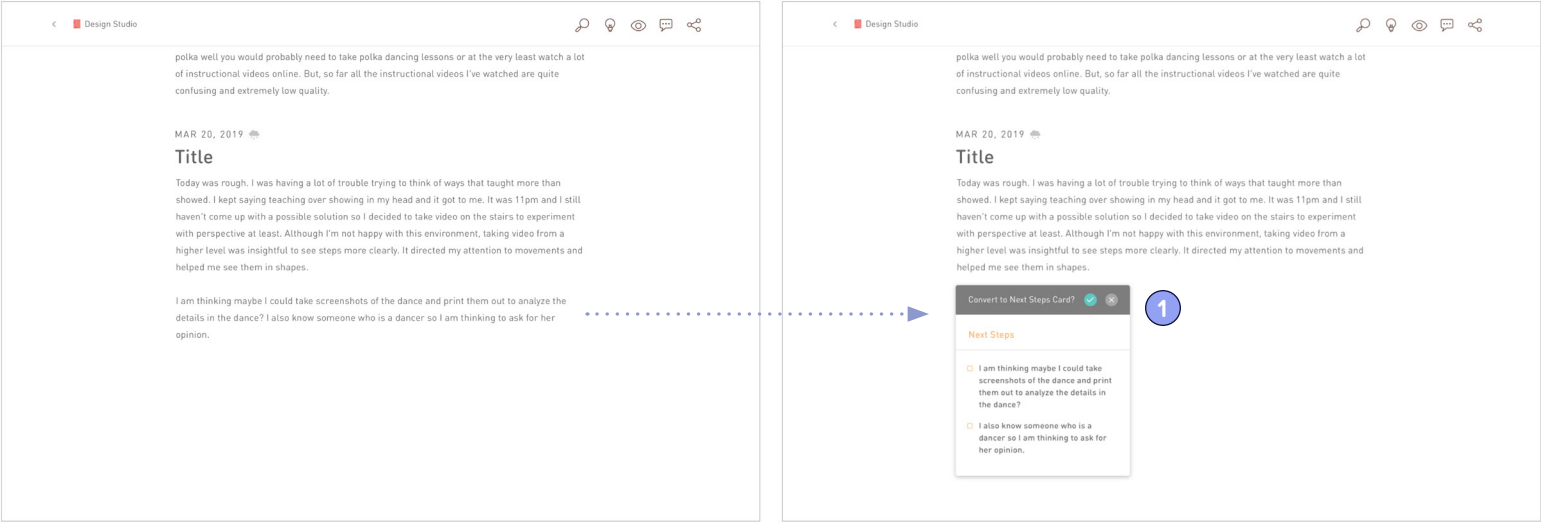


Fig. 8.5 Converting to a "next steps card"

Smart Cards

Sometimes the salient points students pinpoint can get lost in a sea of information. This tool encourages students to categorize vital information into cards so that they can retrieve the content efficiently.

1

Once the student indicates the next steps she is taking, the tool suggests converting the steps to an action card.

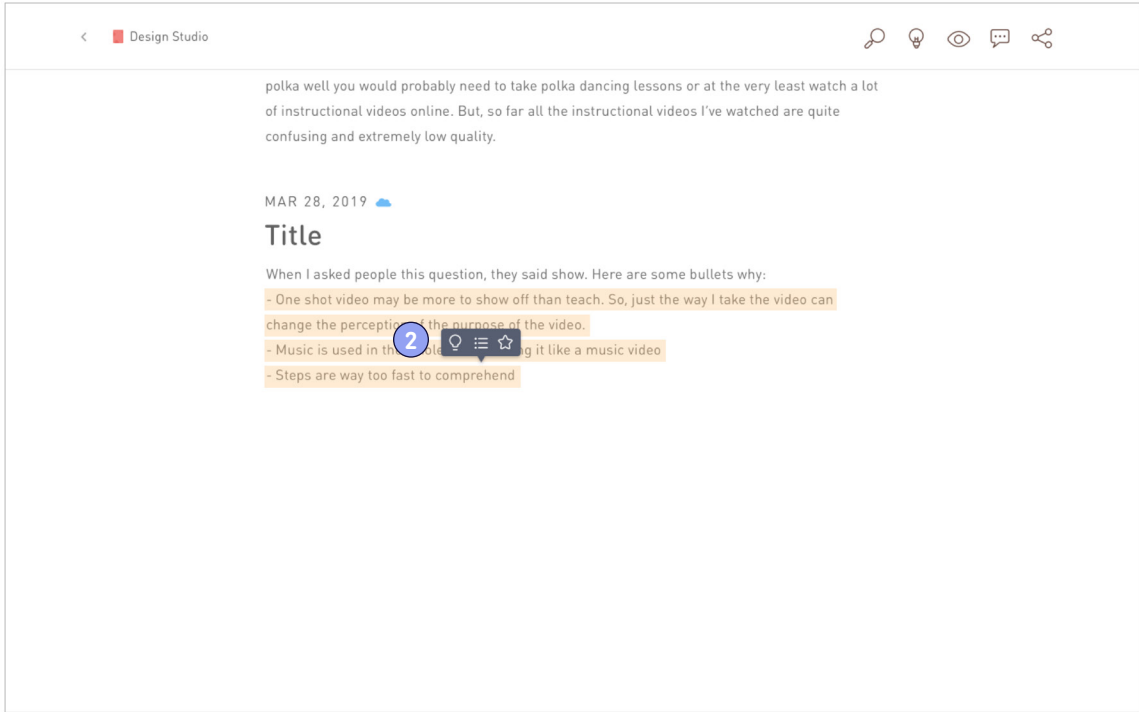


Fig. 8.6 Highlighting content to convert to a card

- As students become more familiar with the reflecting process, they are provided the opportunity to convert their reflections into project insights, next steps, or transferrable lessons.
- Insights cards highlight the salient points that are relevant to the project at hand.

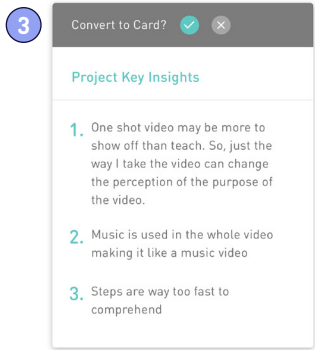


Fig. 8.7 “Project Key Insights” card

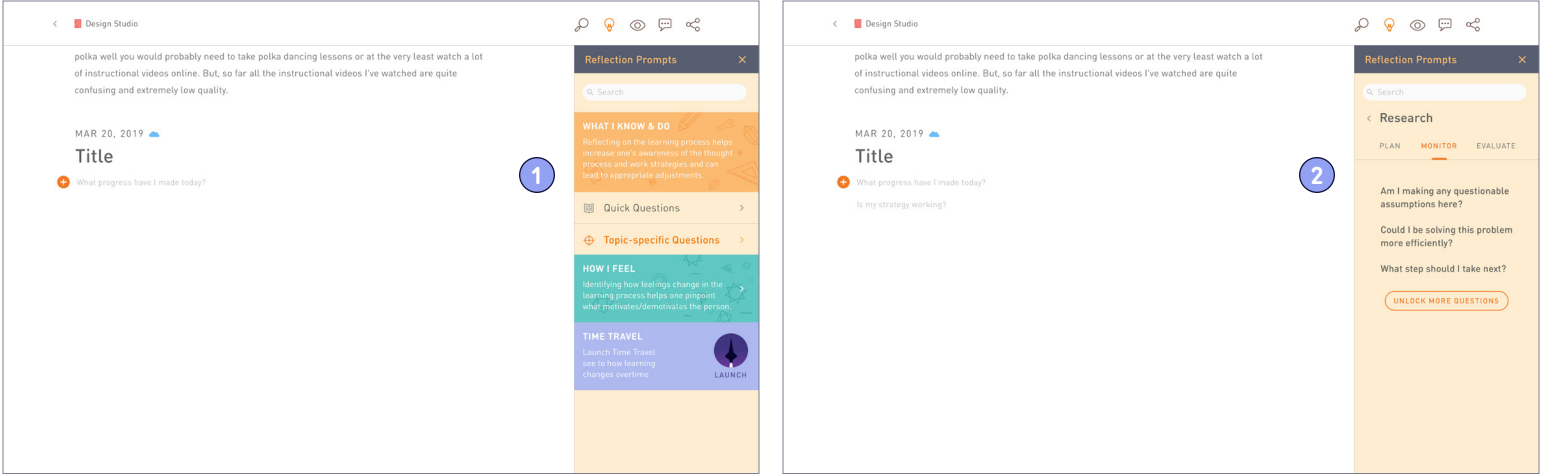


Fig. 8.8 Prompt library

Reactive Prompts

Proactive prompts evolve whereas reactive prompts stay consistent throughout the scaffolding process.

- The prompts are structured into three categories that help students reflect on what they know and do, how they feel about the projects, and their overall learning growth.
- To aid their thinking, students can choose the questions they find most relevant to their current project phase. For example, if a student decides to reflect on the research phase, he/she can select prompts that are relevant to monitoring the research process.

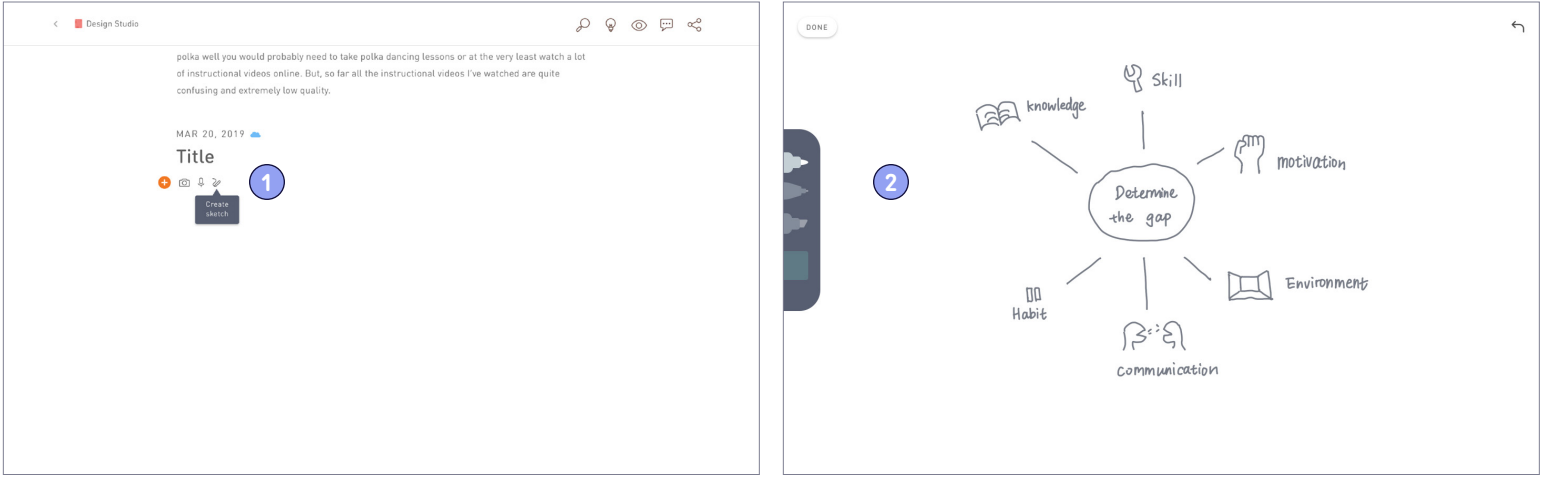


Fig. 8.9 Reflect through drawing

Various Ways to Reflect

Each student is unique. By providing various ways for students to reflect, they have the agency to choose a form of reflection that best captures their learning.

- 1 A student may choose to express his/her thoughts through images, voice, or by creating a sketch.
- 2 By selecting to create a sketch, students are taken to the built-in drawing tool.

Scaffolding Value

For students to engage in reflecting regularly and continually, not only do they need the requisite skills, but they also need to see intrinsic value in reflecting. However, through research, I learned that grades are often used to incentivize students to reflect. Therefore, it is critical for the design of reflection tool to help students see value in reflecting beyond attaining good grades. As students reflect more often and in meaningful ways, they often become more aware of their own learning behaviors and patterns. Therefore, gaining self-awareness can potentially add value to reflecting by informing the changes students make to improve their learning performance. Several of my design components explore opportunities to help students gain self-awareness. Collaboration is often a critical part of the design process. Through user research, I learned that getting constructive feedback from peers or instructors can add tremendous value to writing reflections for students. Therefore, one of the design component supports students in building positive team relationships.

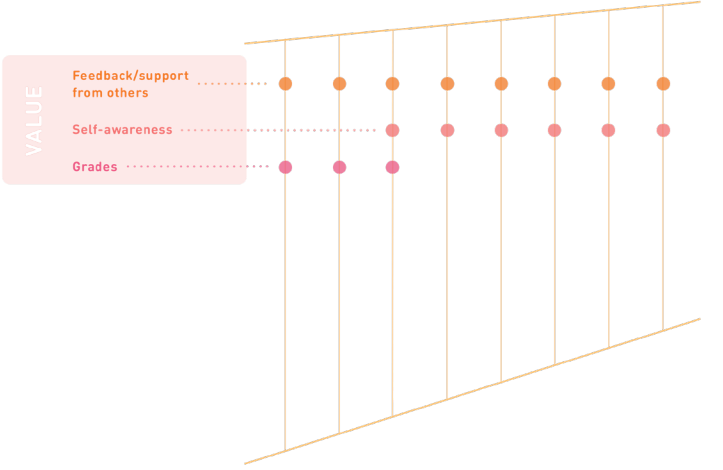


Fig. 8.10 Scaffolding value diagram

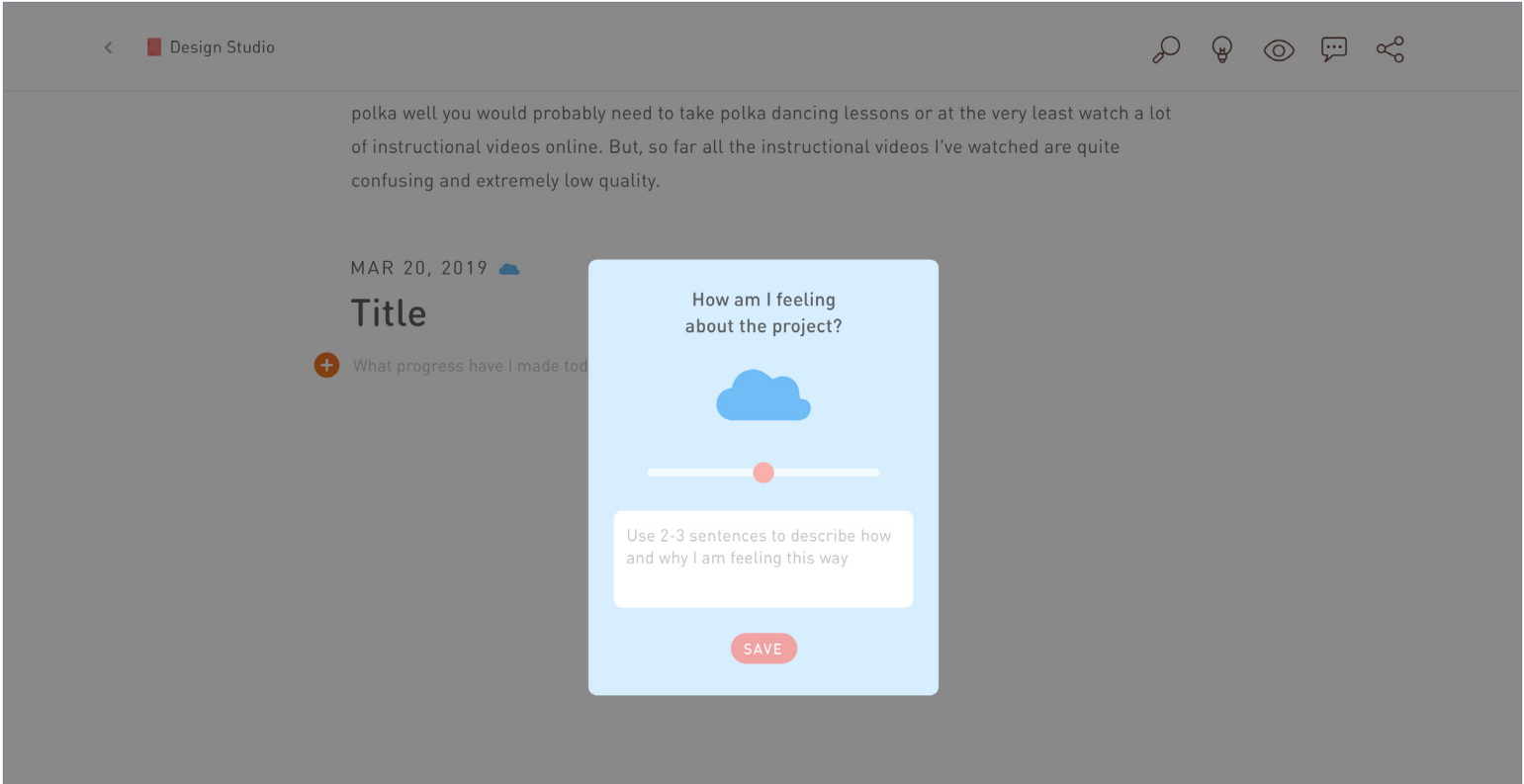


Fig. 8.11 Tracking mood

Mood Tracker

The mood tracker encourages students to monitor how they feel throughout a learning process. Many times, students reflect on what they learn but not how the learning process makes them feel or how it affects their motivation.

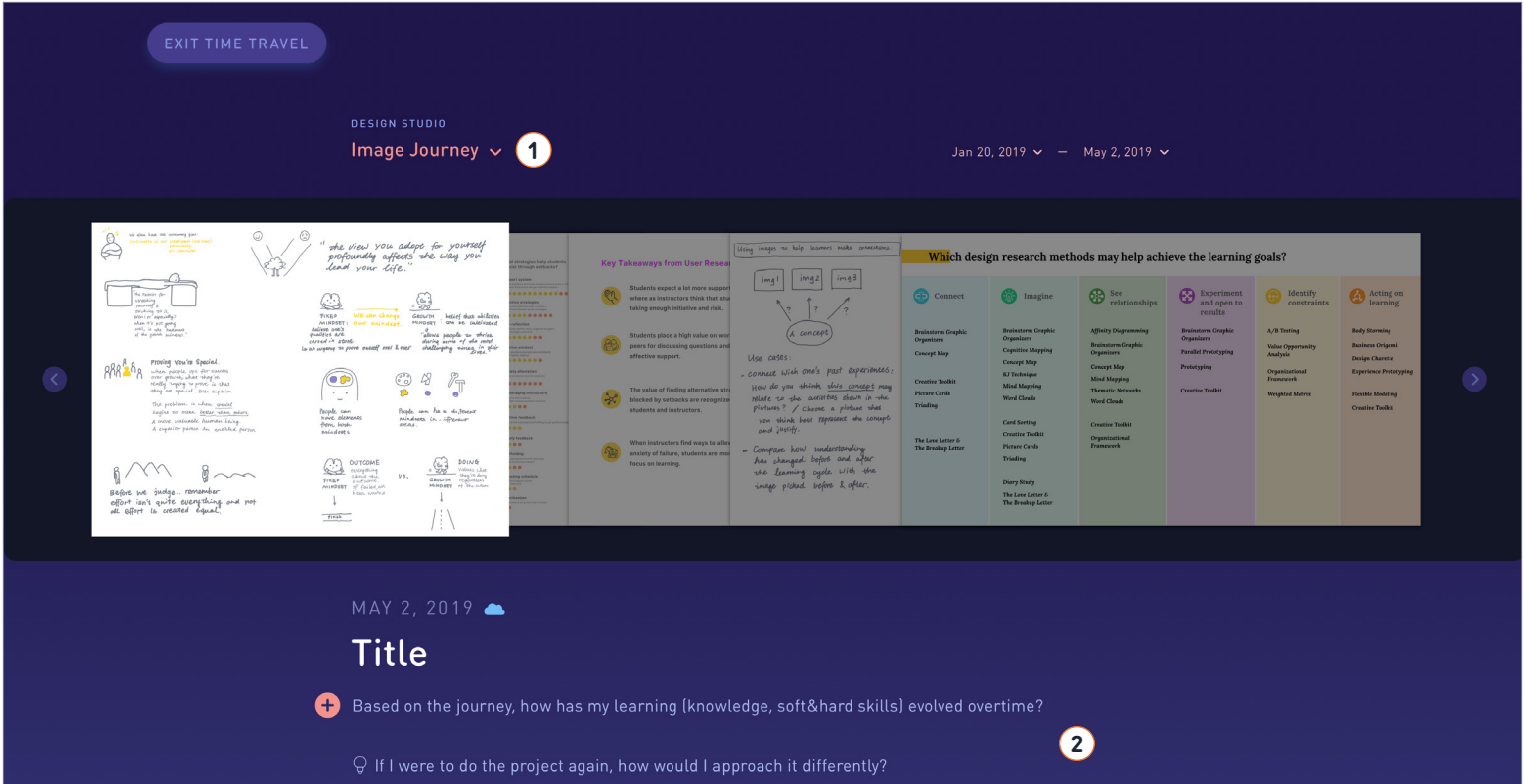


Fig. 8.12 Reflect at the end of a project

Time Travel

Time travel supports students in becoming more cognizant of their learning growth over time and helps them identify transferable knowledge.

- 1 When it's approaching the end of a semester, the tool prompts students to go through time travel. The tool curates the vital information uploaded by students in the past, in this case, it focuses on images.
- 2 The tool further prompts students to reflect on their overall learning growth and identify transferable lessons they can carry forward into their next projects or future career.

Insights Dashboard

Insights dashboard enables students to view all the key insights they made, which are categorized into various widgets, from their reflections.

- 1
- For example, students can monitor how their feelings change over time and look into a specific day to gain insights about what happened that day.
- 2
- Other widgets may include information about planned next steps, key project insights, or distractions students identified that they encountered over time.

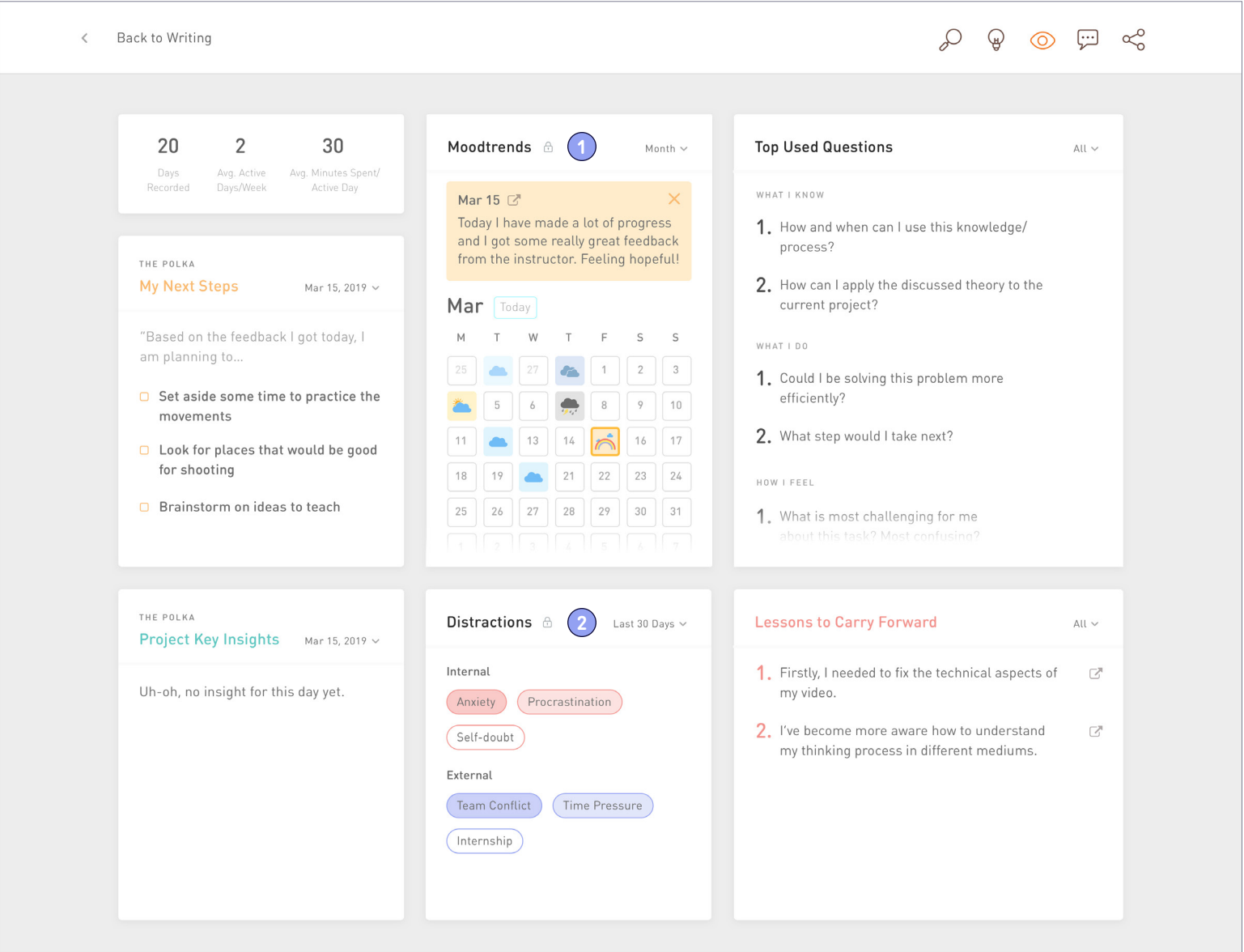


Fig. 8.13 A dashboard that shows insights over time

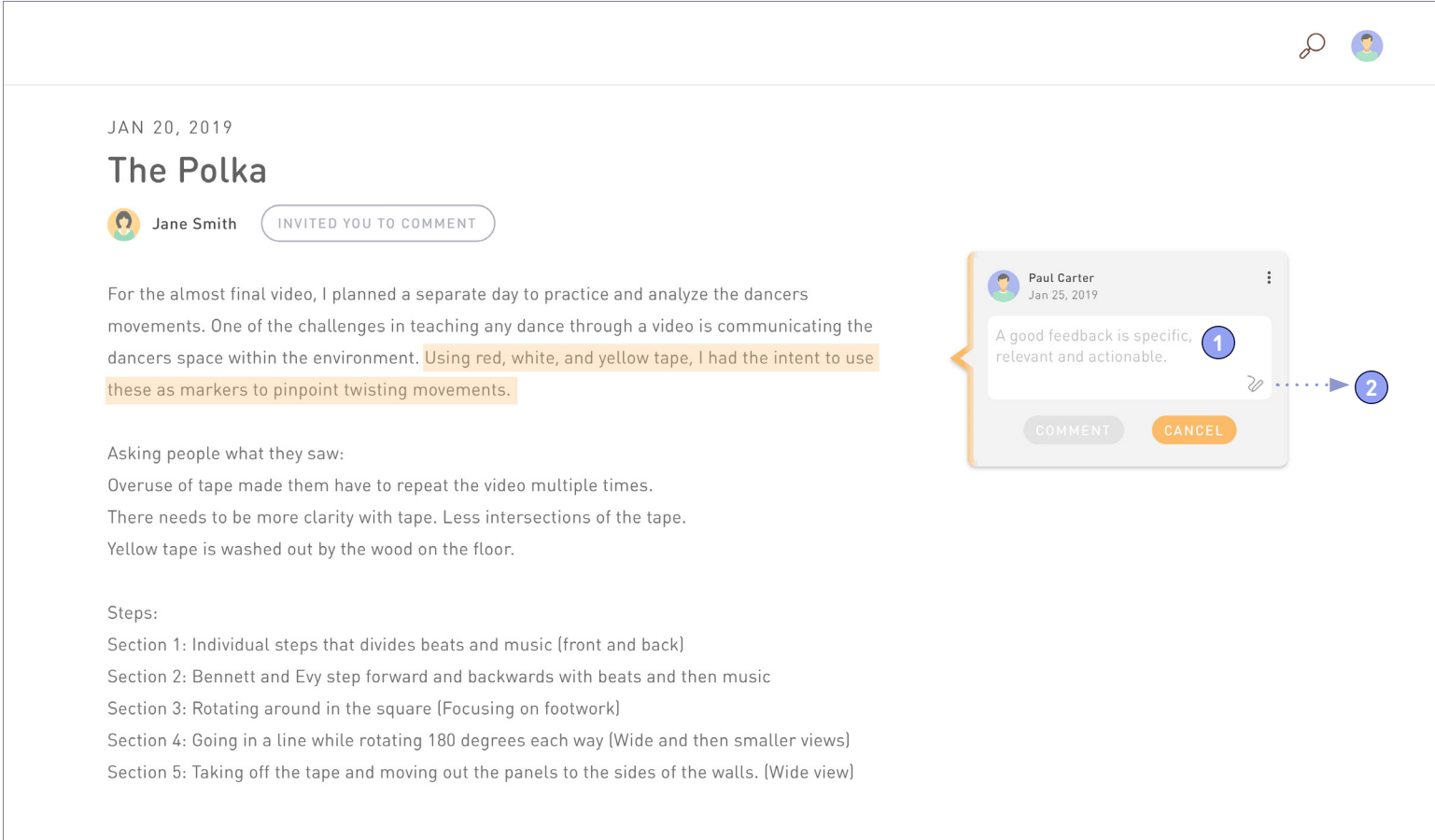


Fig. 8.14 Giving feedback to peers

Giving Feedback

When students are invited to comment on a peer’s reflection, they can highlight a specific part of the reflection and add feedback to it.

- 1 A small tip is provided to encourage constructive feedback.
- 2 Besides the regular text feedback, students can choose to leave a drawing note to show support.

Considerations

Supporting a growth mindset in college students warrants further exploration

Through literature reviews, artifact reviews, and interviews with students and instructors, it became clear that learning is typically filled with uncertainty and having a growth mindset could benefit college students not only in a demanding academic environment but also in their careers and lives after graduation. Nevertheless, most of the interventions that cultivate a growth mindset are directed at learners at a low educational level. This discovery suggests great opportunities for designers to explore ways to foster a growth mindset in learners at a high educational level, which can potentially help students reach their full potential.

Cultivating a growth mindset through encouraging metacognitive practice holds potential

Cultivating a growth mindset in students requires long-term efforts from many different parties such as schools, families, and communities, and various approaches to foster and maintain the mindset.

As design research suggests the potential significance of metacognition in students' learning process, this study focused on investigating the role that practicing metacognitive skills can have on students educational mindset and learning growth. Although more testing is warranted with the prototypes, I believe that the direction is a valid one and that it holds great potential for further investigation based on the positive feedback that I received from participants during the testing sessions.

Finding a balance between structure and individuality

Scaffolding the learning of metacognition is essential, given the challenging nature of the process. Evidence indicates that the support needs to evolve as students' needs and levels of competency change over time. By investigating various forms and amount of support that can be given to students in their learning process, this project encourages and provokes people to think about the balance between giving students enough structure and yet leaving sufficient room for their individuality. Further, it encourages people to consider the role of technology, such as artificial intelligence, can have in facilitating students' metacognitive practices.

This thesis study has been a challenging journey filled with uncertainty, and emotional ups and downs. For a long time, I was uncertain about the outcomes of the study and was fearful that the concepts would fail. There were also times when I tried to move away from the concept of growth mindset because I felt it was too vague and broad for me to handle. In a way, it is ironic that the underpinning concept for the study is growth mindset when many times my thoughts indicated the opposite. This dilemma showed me how challenging it is to attain and retain a growth mindset even if a learner is fully aware of its value. My own experience nods to Campbell et al.’s argument that there is not a “binary divide between fixed and growth mindset beliefs and behaviour, in reality they exist on a continuum” (2019). In the end, I am glad that I held on to the concept and was able to move a direction that has many opportunities. I am also grateful that I treated the experience as a reflective process where I became more cognizant of the learning behaviors, emotional states, and strategies I used that were less effective.

Following are the key takeaways from the experience that I will carry forward into my future projects, especially when I encounter setbacks:

- 1.** Reflect – Organizing my thoughts through writing and sketches whenever I felt stuck helped untangle my thoughts, put me at ease (at least momentarily), and inform my next steps.
- 2.** Talk to people – Talking to people helped me uncover ideas I overlooked, discover new strategies and methods, and persevere through emotionally difficult times.
- 3.** Come back later – Walking away from the study and coming back with fresh eyes gave me new ideas than when I forced myself to keep working even though I felt exhausted.
- 4.** Look at the bigger picture – Focusing too much on short-term gains might cause me to avoid challenges and miss opportunities for long-term learning growth. When I treated the end of my thesis project as the end of the investigation altogether, I felt pressed to create some brilliant ideas that would showcase my “solutions” to the problems. However, when I shifted my focus and treated the project as a gateway for more opportunities and meaningful questions, I felt relieved and was able to focus on exploring possibilities and evaluating what I learned.

With ever-evolving technologies and increasingly complex new challenges, students who have the mindset and skills to learn and adapt to changes continually are more likely to thrive. Supporting students in becoming self-directed learners warrants more attention and investigation in the coming years. As technologies, such as artificial intelligence, are seamlessly integrated into all aspects of our lives, it is critical for designers to explore the possibilities of leveraging these technologies to support instructors and students in developing personalized learning experiences that would celebrate students' individuality and foster a love of learning.

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