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Reflect, Assess, Visualize: Cultivating Skill Development in User Experience Education

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Abstract

In the field of user experience (UX), there is a wide range of skills that practitioners are expected to acquire and demonstrate as a competitive candidate for a job. Previous research identified three main skill categories of UX practitioners: technical skills, human skills, and dispositions. However, as educators, we have found that students often struggle to understand and incorporate the breadth of the skills they need into their learning and development. To help students identify, assess, and cultivate their skill sets, we designed a pedagogical intervention in the form of an 'advance organizer' that asks students to reflect on their initial and changing skill sets while enrolled in a UX-focused course. In this article, we present the basis of the intervention, including background on learning theories that supported its design. The intervention asks students to read and reflect on an academic article about the desired skills of aspiring UX practitioners, conduct an inventory of their existing and desired skill sets, and design a visualization to represent their current and future skill levels. We report on how the intervention was implemented in three different programs related to UX (one undergraduate, and two graduate programs). An analysis of the resulting assignments suggests the intervention was effective and valuable and helped give students a better sense of the range of skills required in industry. We conclude with considerations for implementing the intervention.

Keywords

user experience, UX, skills, reflection

Introduction

The field of user experience (UX) has grown and changed a great deal over the past 40 years and is projected to continue to grow at an even brisker pace over the next 30 years (Nielsen, 2017). As a result, the market and interest in UX education have also blossomed. UX is taught in a variety of interdisciplinary academic programs and disciplines in design, computing, and the humanities. There is also a plethora of online programs that include self-study and for-profit boot camps. The demand to learn about UX has never been higher; however, the field itself is in flux, shifting, and changing (MacDonald et al., 2022).

As instructors in academic programs, we see how students struggle to understand where they might fit in the broad and multifaceted field of UX. In our research, we have conducted several studies to better understand the UX industry, how it is changing, and what kinds of skills aspiring UX professionals might need to be successful. Based on our research, we designed a classroom intervention to help students inventory and reflect on their skill sets related to UX. In this paper, we explain and assess how the intervention worked across three different academic

programs that prepare students for careers in UX. The key contribution of this paper is to bring together industry research and educational theory to help students gain more understanding and agency about their individual learning within the large and complex interdisciplinary field of UX.

In a 2020 paper, we reported the results of this research that demonstrated the disparate skills that UX practitioners are expected to acquire and demonstrate competency (Rose, et al., 2020). The study included interviews with 71 senior UX practitioners. We identified three main categories of skills professionals need to succeed in UX: technical skills, human skills, and dispositions. We defined technical skills as observable, standard skills a person is expected to perform on the job and include research, design, process thinking, and information architecture, to name a few. We described human skills as those demonstrable when a person must directly engage with others to achieve goals. Human skills include approaching problems, communicating, collaborating, and storytelling. The third category is dispositions, which we defined as character traits that define a person's internal motivations to act or behave in certain ways. Examples of dispositions include independence, flexibility, curiosity, and passion. These last two categories, human skills and dispositions, are seen as differentiators by employers and are more highly valued than technical skills (Rose, et al., 2020). Our participants emphasized human skills and dispositions as particularly important in UX because practitioners are expected to engage in sophisticated and nuanced communication practices on the job and communicate for a variety of purposes and in a variety of ways.

While it is helpful to understand the broad swath of skills needed to be successful in UX, we have found that our students often feel overwhelmed by how much they need to learn. To help students identify, assess, and cultivate their skill sets, we designed a pedagogical intervention that asks students to reflect on their initial and changing skill sets while enrolled in a UX-focused course. In this paper, we report on the intervention and its impact on students in three different degree programs focused on UX. This was an exploratory study to assess the effectiveness of the intervention across multiple contexts. The article is structured as follows: first, we discuss metacognitive strategies, namely reflection and 'advance organizers' that prompted the intervention, and the relevant learning theories that guided the design of the intervention. Next, we describe our intervention in which students assessed their existing skill set at the start and end of a term. The intervention included reading an academic article, conducting a skill inventory, visualizing their existing skill set, and reflecting on areas they would like to continue to work on. We then discuss the findings, which include gaining a deeper awareness of industry expectations and the importance of human skills, in addition to heightened awareness of their personal growth. We conclude by presenting the implications of the study by describing the impact of the assignment, its effectiveness, and suggestions for additional improvements or changes.

Background: Creating the opportunity for reflection

In this section, we highlight literature from educational theory that situates the aims and goals of the designed intervention. We first drew from Argyris's and Schön's theories on learning and reflection.

A key component of learning is the ability to detect and correct errors by differentiating between single and double loop learning (Argyris 2002, Argyris 2003). Single loop learning is

described as “when a mismatch is detected and corrected without changing the underlying values and status quo that govern the behaviour” (Argyris 2003, p. 1178). In contrast, double loop learning occurs when those underlying values are corrected. A key feature of double double loop learning is that “understanding, insight, and explanations are connected with action” (Argyris 2003, p. 1178). Taking action and simultaneously reflecting on that action, according to Argyris and Schön, is a prerequisite for learning and similar to learning a skill (1974). Both theories emphasize that “it is essential to practice, to develop and draw on tacit knowledge, and to be in a learning situation that permits a reinforcing cycle of feeling and performance" (Argyris and Schön 1974, p. 14).

For Schön, the idea of professional competence is always shifting, and how to learn “requires developing one's own continuing theory of practice under real-time conditions" (Schön 1983, p. 157). Both Argyris and Schön agree that cultivating awareness of what a person does not know and reflecting on that awareness provides the opportunity for growth.

Further, Schön’s theory of reflection emphasizes that the knowledge that professionals display is “knowing-in-action” (1983) which is tacit and routinized to the point where it cannot be fully articulated or explained. It is when something out of the ordinary, or “stimulated by surprise” that this implicit knowledge is brought to the surface. As he states,

> *Usually reflection on knowing-in-action goes together with reflection on the stuff at hand. There is some puzzling, or troubling, or interesting phenomenon with which the individual is trying to deal. As he tries to make sense of it, he also reflects on the understandings which have been implicit in his action, understandings which he surfaces, criti-cizes, restructures, and embodies in further action.” (p 50).*

Together, both Schön and Argyris assert that it is this combination of doing, encountering new circumstances and messy problems, and then reflecting on one’s experiences, is when learning and growth happen. In order to spur our students to experience this combination of doing, struggling, and reflecting, we wanted to explore how to create these circumstances in our UX classes.

Broadly speaking, the goal of our intervention was to help students improve their awareness or assumptions of what they do and do not know when it comes to UX skills through cultivating metacognitive processes. Metacognition can be thought of as an awareness of cognitive processes (see Brown, et al. 1983; Flavell, 1979; Zimmerman, 2002) and is connected to students’ ability to transfer their learning across contexts (Bransford, et al., 2000). Our intervention included two metacognitive strategies: an advance organizer and reflection. Both are described briefly below.

Advance organizers are pedagogical tools with roots in schema-based learning, which itself is informed by schema theory, a cognitive theory of human and artificial learning (Pirnay-Dummer & Seel, 2017). A schema can be described as a framework, i.e., when a learner is confronted with new knowledge, they will apply a previous knowledge framework (if available). As such, they can be seen as a recognition device to aid in the assimilation of new knowledge. Piaget (1937) characterized a schema as a means for a learner to organize concepts and their relationships. According to Anderson, “without a schema to which an event can be assimilated, learning is slow and uncertain” (1984, p. 5). Ausubel (1968) introduced the concept of advance

organizers as part of his theory of 'meaningful verbal learning' as a way to activate schemas to scaffold learning. Thus, the role of 'advance organizers' is to help learners bridge a gap between what they know and what they need to know.

The concept of advance organizers is not entirely new to the field of UX or to human-computer interaction (HCI), its closest related academic discipline. As explained by Blackwell (2006), after exploring the role of advance organizers in helping people learn programming languages throughout the 1960s and 1970s, the term instead "became common as an empirically justified formalization of the 'user model' or 'mental model'" (p. 505). When the graphical user interfaces (GUI) were first developed, the 'desktop metaphor' was viewed as an impactful (and lasting) advance organizer for helping novice users learn about and use computers effectively (Carroll et al., 1988; Mynatt & Macfarlane, 1987). From an academic perspective, advance organizers have been evaluated for teaching students programming (Macfarlane & Mynatt, 1988), but we found no examples of advance organizers used in the context of teaching UX or HCI.

The use of student reflection is a common pedagogical practice where students are asked to think about and articulate what they have learned. Reflection dates back to education theorist Dewey (1910, 1916, 1933) and is synonymous with thinking and learning. Dewey's conceptualization of reflectivity has four key criteria, as read by Rodgers (2002). First, reflection is a continuous meaning-making process, a means to "essentially moral ends" which is connected to the purpose of education, which is to educate not just an individual but in support and evolution of a democratic society. These educational experiences happen not at the individual level but during interactions with others and are continuous. As Rodgers states, "we make sense of each new experience based on the meaning gleaned from our own past experiences, as well as other prior knowledge we have about the world—what we have heard and read of others' experiences and ideas" (Rodgers, 2002, p. 846). Second, reflection is systematic and rigorous and is a cyclical process that includes an experience, a description of the experience, an analysis of that experience, and intelligent action and experimentation. Third, reflection happens in the community and with interaction with others, which "serve as a testing group for an individual's understanding as it moves from the realm of the person to the private" (Rodgers, 2002, p. 857). Finally, reflection is a set of attitudes that value the growth of oneself and others. In sum, reflection is key to metacognition which is an awareness of how to learn and awareness of oneself as a learner.

Designing and Evaluating an Intervention for UX Skill Reflection

Given the variety of skills that UX practitioners need to be successful in their jobs, we designed an advance organizer that could be used as a reflection tool at the beginning and/or end of a course related to UX. In this section, we will describe the intervention and the three settings where we implemented it.

Three learning contexts

We each implemented the intervention examples presented in this paper in classes in either 2020 or 2021. It should be noted that these courses were disrupted, as most things were, due to the COVID-19 pandemic. We opportunistically chose these three settings because they were the classes we were teaching. As instructors teaching UX, we wanted to explore in this study how the intervention could support students' self-assessment and reflection.

1. Undergraduate course: This is an upper-level undergraduate Design studio course in an Interdisciplinary Innovation and Design minor. Before this class, students have taken a prerequisite course that introduces them to user-centered design. The goal of this course is to work on a specific design project in groups, and the projects can be for community partners. The course is capped at 20 and meets for ten weeks. Students come from different majors and enroll in the minor to add design expertise to their disciplinary focus. The class typically is a hybrid course, but met completely online due to COVID-19. In this class, the intervention was an assignment embedded in the course and students completed it in the first week of class and the last week of the class.
2. Graduate course: This is an introductory design course required for students studying User Experience Design, who typically take it in their first semester. The goal of this course is to introduce students to user-centered design methods through a semester-long responsive website redesign project. Relevant topics include user research, information architecture, sketching and wireframing, prototyping, and formative usability testing. The course typically enrolls 15-18 students (capped at 18) and meets for 15 weeks. It is offered entirely in person.
3. Graduate course: This is the advanced design course required in a Human-Computer Interaction program. Prerequisites include an introductory design course and an HTML/CSS course; both prerequisites can be waived. The bulk of the course work is dedicated to building a mini-design system of a website of their choice (most choose to focus on their portfolio). Other topics include typography, color theory, logo design, animation principles, and an introduction to information visualization. The course typically has 30-36 students enrolled (capped at 36). Post-COVID, the class is taught using a mixed model, in which all lectures are recorded with weekly synchronous meetings for discussion, workshops, and design critique. The synchronous meetings are held using a mix of in-person and remotely (using Zoom); all are recorded for those students who choose to watch the meetings asynchronously. The course meets for 11 weeks (quarter system).

Details about the intervention

While advance organizers can be presented in multiple ways (UNIT 2008), we adapted our advance organizer from a 'KWL (Know, Want, Learned) Chart' (Ogle, 1986). In a typical KWL chart exercise, learners are introduced to a new topic and expected to reflect on what they **Know** about the topic, what they **Want** to know about the topic, and then what they **Learned** about the topic.

During week 1, students were given a recent academic article about desired skills for aspiring UX professionals and the following directions:

Initial inventory, visualization, and reflection

1. Read the article on Preparing UX Professionals posted on the course website.
2. Define the three types of skills and conduct an inventory of your current skill sets and what areas you would continue to grow.
3. Draw a visualization of your skill sets. You can use the metaphor of the T-shaped skills or find another way to show the relationships between what you know and what you hope to learn.

4. Reflect by writing a short paragraph on what this exercise has helped to show you by answering the following questions:
    - What have you learned from reading the article and doing this exercise?
    - What, if anything, is surprising or eye-opening?
    - What questions do you have?

They were also given a slide template to complete that walked them through the four steps above.

Final reflection

At the end of the term, students in the first two academic contexts were asked to do the reflection and visualization a second time with the following prompt:

1. What have you learned from reading the article and doing this exercise?
2. What, if anything, is surprising or eye-opening?
3. What questions do you have?

In the third academic context students were not required to redraw the visualization but were asked to respond to the following prompt:

1. How was this self-reflection exercise AND the article I had you read at the beginning of the quarter helpful or not helpful in defining your UX aspirations?

Assessing the intervention

While the initial goal of this project was to explore the possible intervention as an educational tool, we decided to pursue the possibility of examining student assignments to assess its effectiveness. After consultation with the University of Washington's Institutional Review Board, this research project was deemed to not qualify as research as defined by federal and state regulations (STUDY00012513). To assess how the intervention worked, we anonymized all the assignment submissions and imported the written reflections into a qualitative coding tool (Atlas.ti) and the visualizations into a visual whiteboarding tool (Miro). The three authors then iteratively coded and categorized the data. As a group, we negotiated differences in codes to reach agreement.

Results of the student reflections

In this section, we present findings based on our analysis of the anonymized assignments to examine the value of using this assignment. First, we describe the impact of the initial reflections (reading the article, doing a skill inventory, and drawing a visualization of their skills). Next, we summarize the different types of visualizations students created as part of their skill inventory. Finally, we discuss how the students reflected on the totality of their experience based on their responses to the second assignment, submitted at the end of the term.

Initial reflections

In the initial assignment, students were instructed to (a) read the article on UX skills, (b) conduct a skill inventory of those skills by evaluating where they were currently and where they wanted to go in the future, (c) draw a visualization of their current skills, and (d) answer some brief questions reflecting on what they learned from the entire activity. We examined 71

student responses to the reflection questions (four students did not provide any answers) and categorized the themes as either outward-facing (i.e., focused on the UX industry and professional community) or inward-facing (i.e., focused on the self).

Outward: General awareness of industry expectations (n = 52; 73.2%)

The most common response among our students was gaining a better understanding of what the UX industry is looking for in new hires. For many students, it was helpful to hear directly from UX professionals about what they are looking for when evaluating job candidates because they found that information difficult to find. As one student explained:

> *"The article provides great insight into the skills needed as a UX student. I never really found the skillset so comprehensively laid out and explained with references in any other place. Furthermore, the most convincing aspect to the article is the fact that research was done with existing industry professionals who provided updated and current information." (P48)*

Other students described the article as "really insightful" (P15) and "an eye-opener" (P24), while another appreciated how the article "demystifies the UX field" (P12). Other students mentioned picking up specific pieces of information about the UX industry, with one saying "they did not know the concept of disposition" (P69) before the activity and another noting it was "the first time [they] have heard of T-shaped skills" (P45).

Outward: Importance of human skills and dispositions (n = 42; 59.2%)

The second most common response among our students was learning specifically that human skills and dispositions were so highly valued by the industry. Several students explained how the exercise challenged their assumptions about UX being a highly technical field by showing the importance of being collaborative, communicative, and empathetic. As instructors, we were encouraged to see that this realization was a comfort to many of our students as it helped reduce their anxiety about their lack of technical skills by highlighting other types of skills. Here is how one student reflected on this experience:

> *"I found it surprising that people who recruit employees in the field of UX design also hold equal weightage to people's dispositions and are willing to take time out to teach those who are passionate and yet lack the skillset. I found that finding to be extremely motivating and heartwarming." (P18)*

Other students described this experience as "reassuring" (P61) and "a confidence boost" (P63), while another said they were "relieved" (P65) to learn that soft skills were so valued.

Inward: Self-awareness and personal growth (n = 34; 47.9%)

Finally, students valued the opportunity to reflect on their own skills and dispositions. From doing a skills inventory to helping them create individualized learning goals, students felt that the exercise helped them discover where they were lacking and where they needed to improve. As P4 explained:

> *"This assignment really helped me evaluate my previous experience with and thoughts on UX and the design process. It made me analyze myself and the skills I have learned through my time at [university], particularly in relation to the aforementioned subjects.*

> *Perhaps one of the more important aspects of this assignment was identifying which areas of my knowledge and myself I wanted to improve by the end of this course." (P4)*

Other students described the activity as "really helpful" (P75), "kind of eye opening" (P43), and "a great guide for reflecting on my own skills" (P27). As a whole, students felt that the exercise was an opportunity to gain a better understanding of not just who they currently were but who they wanted to be in the future.

Initial visualizations of skills

Our instructions stated that students could "use the metaphor of the T-shaped skills or find another way to show the relationships between what you know and what you hope to learn." Students were not given any other guidance or suggestions about other formats for their visualization. They could use hand-drawn or computer-generated visuals and were encouraged to be creative.

We collected a total of 73 visualizations from students' initial submissions across the three courses (two students did not include visualizations with their submissions). We imported all the visualizations into an online whiteboard and grouped them into ten categories. Below, we briefly describe and provide visual examples of each category.

T-Shape (n = 36; 49%)

Roughly half of the visualizations (49%; 36 of 73) used the t-shape metaphor, though within this category, we noted two variations: simple and enhanced. Simple t-shape visuals were typically abstract and included minimal text and few, if any, visual flourishes (e.g., color). Many of these visuals were hand-drawn (Figure 1), though some were created digitally.

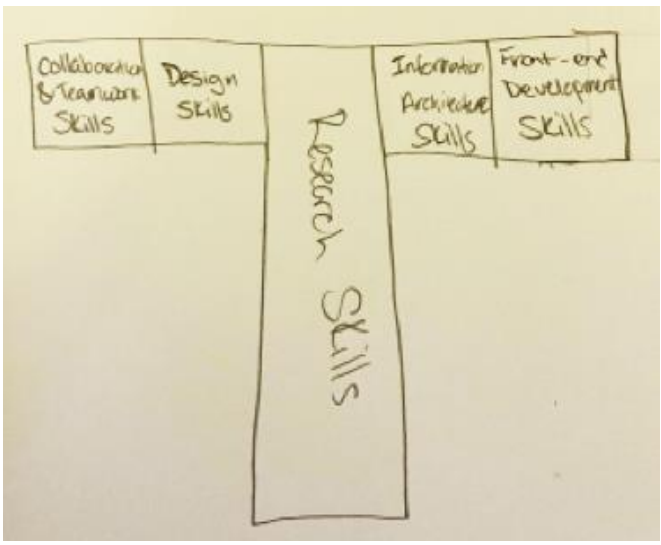


Figure 1. Examples of simple t-shape visuals (P40)

Enhanced t-shape visuals added additional layers of visual complexity to the t-shape. For example, P19 (Figure 2) used a modified t-shape ("pi-shape") and added bubbles of different colors to indicate skill type (technical vs. human/dispositions) and different sizes to indicate their current skill level. We categorized half of the t-shape visuals (47%; 17 of 36) as enhanced.

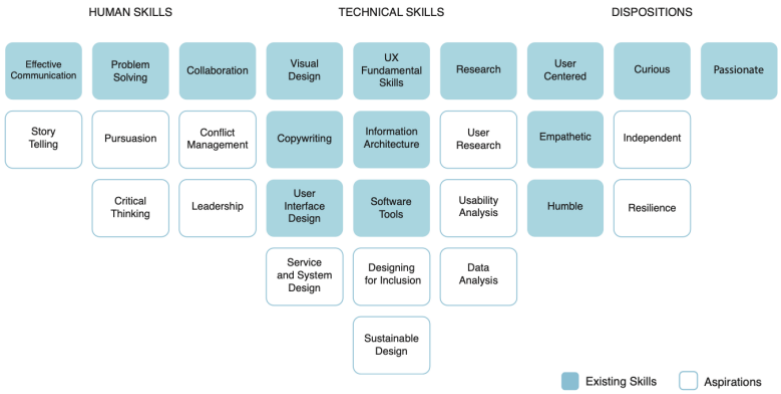


Figure 2. Example of an enhanced t-shape visual (P20)

Table (n = 8; 11%)

Visualizations in the table category were primarily text-based and had few, if any, visual elements. For example, in Figure 3 below, P34 created a table with the three skill categories as columns (human skills, technical skills, dispositions) and their skill level as rows (current standing vs. where to improve).

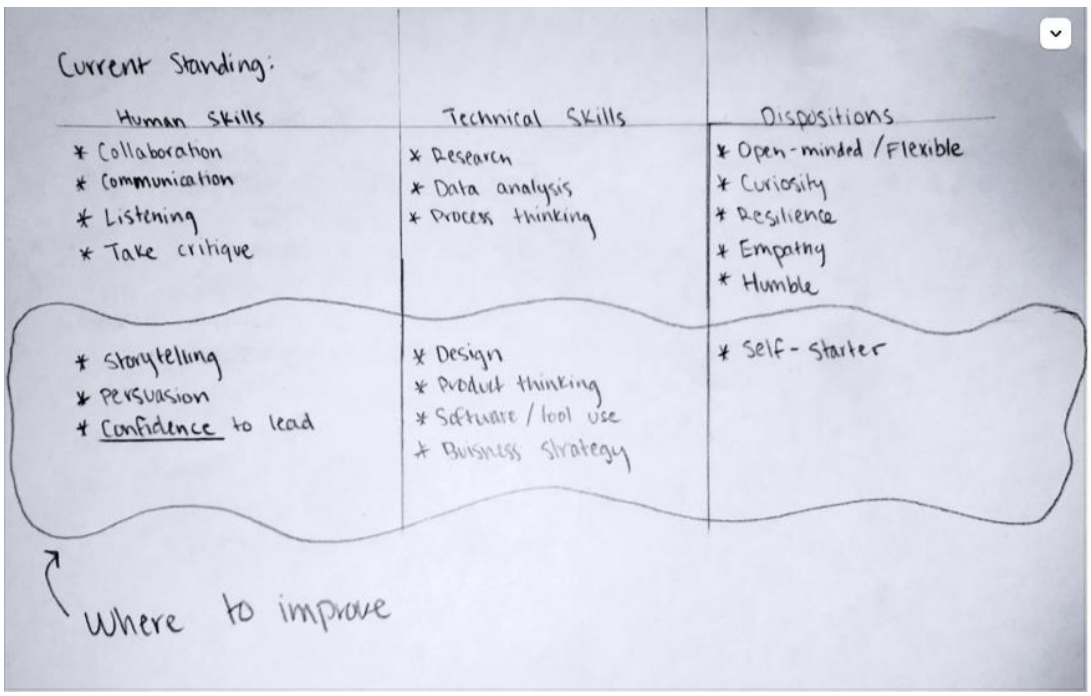


Figure 3. Example of a table visual (P34)

Bar Graph (n = 7; 10%)

Several students visualized their skills using a bar graph. For visuals in this category, most students used color to differentiate between different skills, and the size of each bar indicated their current or desired skill level. As one example, P53 (Figure 5) created a dotted line to indicate “where I want to be” and colored bars to show how far away they were from that line in each skill.

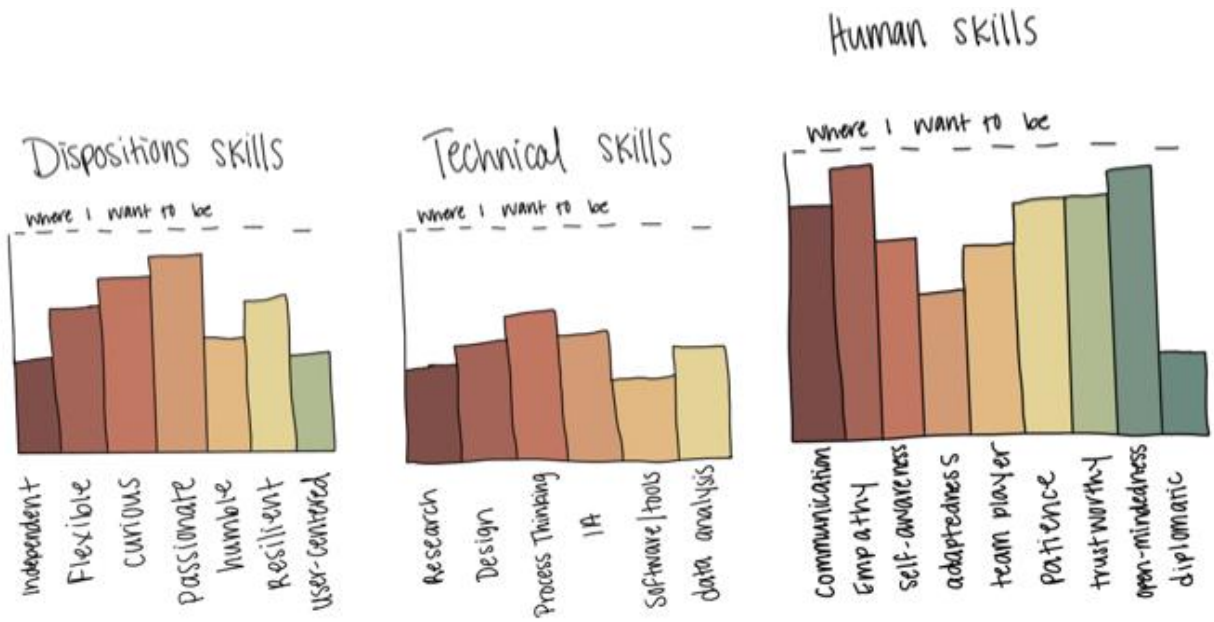


Figure 5. Example of a bar graph visual (P53)

Spider Graph (n = 5; 7%)

Some students used a spider graph to visualize their skills. In these visuals, students showed their skill level by mapping them on a radial axis; the higher the level of skill, the further it is plotted away from the center. Some visuals in this category included a single spider graph; others, like the example from P26 (Figure 6), created three spider graphs, one for each skill category.

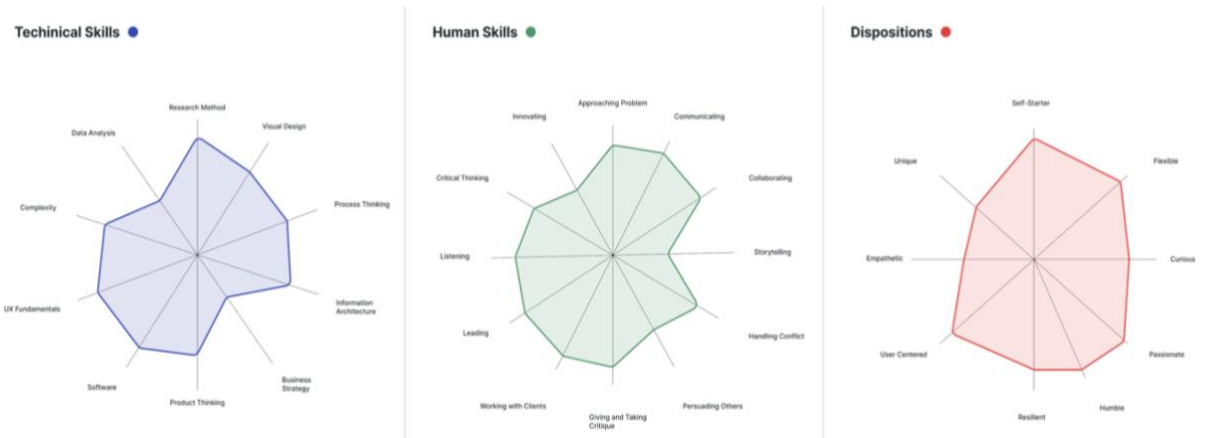


Figure 6. Example of a spider graph visual (P26)

Illustration (n = 4; 5%)

Illustration-style visuals were metaphorical and abstract drawings. These visuals included a scale representing a balance between technical and human skills, an apple orchard growing over time (where each apple represents a different skill), and a puzzle in which each piece is a different skill. In one of the more elaborate illustrations, P63 (Figure 7) used their drawing skills to create a gardening scene. In the scene, the "skills I know" are depicted as indoor houseplants, and the "skills I hope to grow" are depicted as an outdoor garden visible through the window.

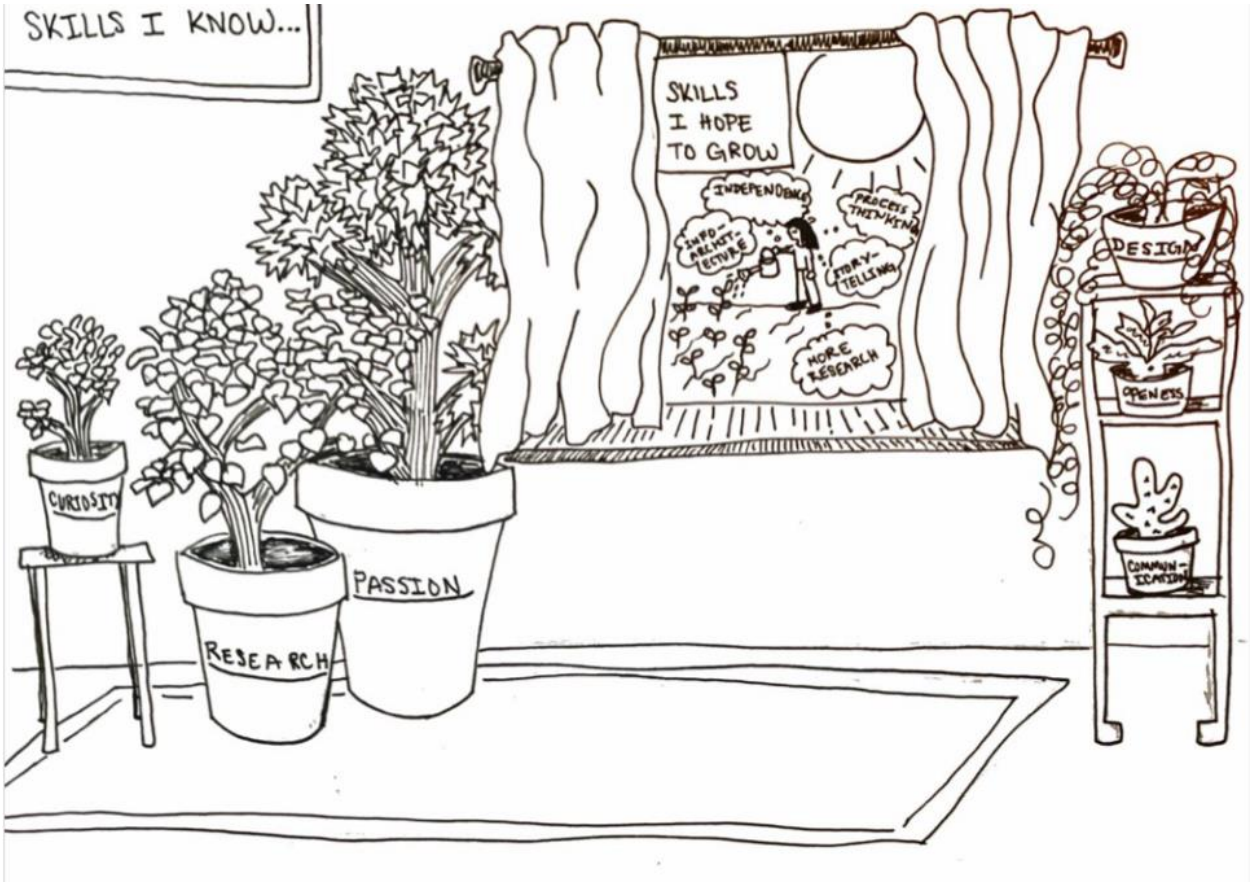


Figure 7. Example of an illustration visual (P63)

Bubble Chart (n = 3; 4%)

In the bubble chart style visual, students presented their skill levels by placing them inside filled circles ("bubbles") that varied in size according to their skill level, where larger circles indicated stronger skills and smaller circles indicated weaker skills. Some students also used color to represent either skill types or skill levels. For example, P24 (Figure 8) used color to differentiate skills by their current status ("what I know" vs. "what I hope to learn more") and created one bubble chart for each skill category.

Figure 8. Example of a bubble chart visual (P24)

Cartoon (n = 3; 4%)

Some visualizations took the form of a cartoon. In these visuals, students depicted themselves as a character going through some form of growth. For example, P57 (Figure 9) created a storyboard showing three different scenarios, one for each skill type. In each scenario, the first scene depicts their current self (marked "N" on the cartoon) expressing a desire to learn and the second scene depicts their future self (marked "F" on the cartoon) after they've made progress.

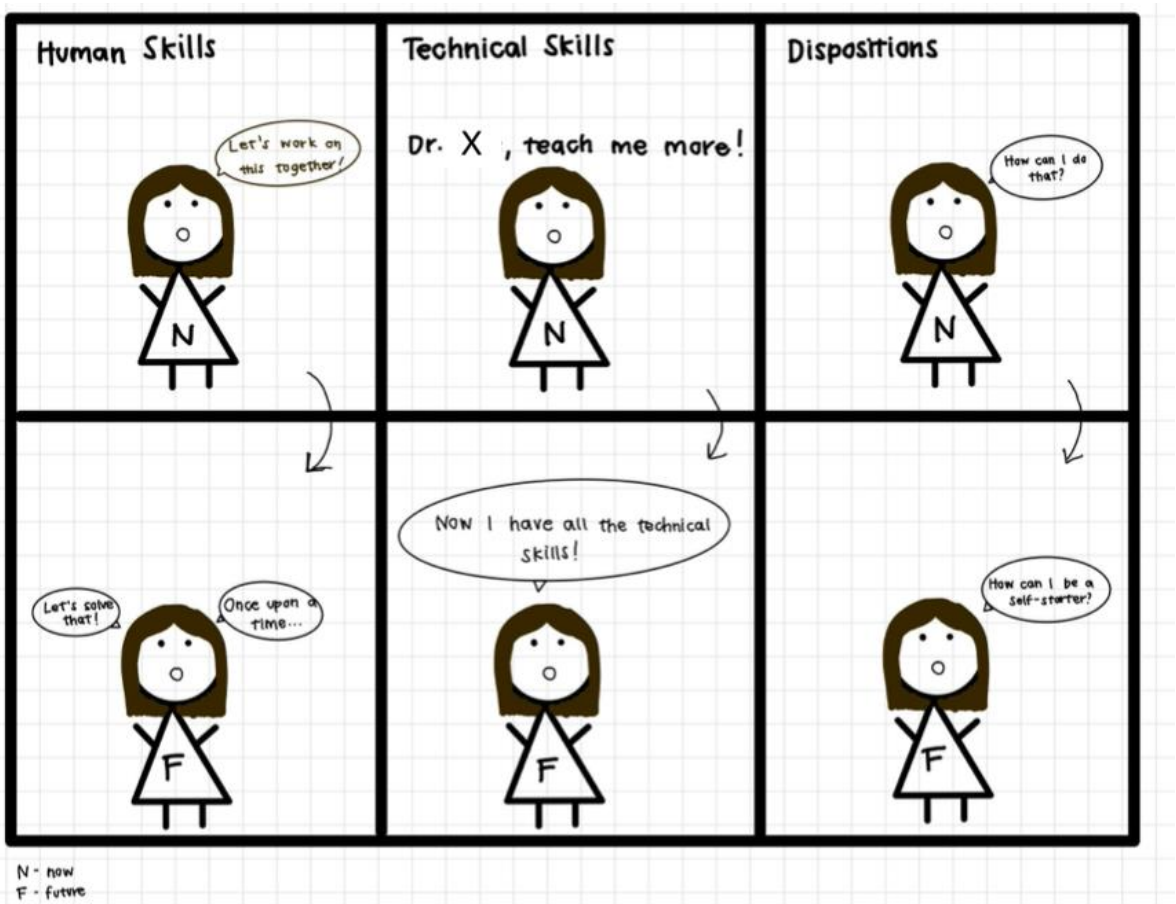


Figure 9. Example of a cartoon visual (P57)

Steps (n = 2; 3%)

Steps visualizations were a type of illustration that specifically used the metaphor of steps or a staircase to show learning. For example, P14 (Figure 10) depicts a 4-step process that starts with acquiring skills and ends with skills they hope to "constantly work towards even after graduation." Skills are highlighted in different colors based on the type (human, technical, and disposition) and the visual includes a cartoon depiction of the student at their current step.

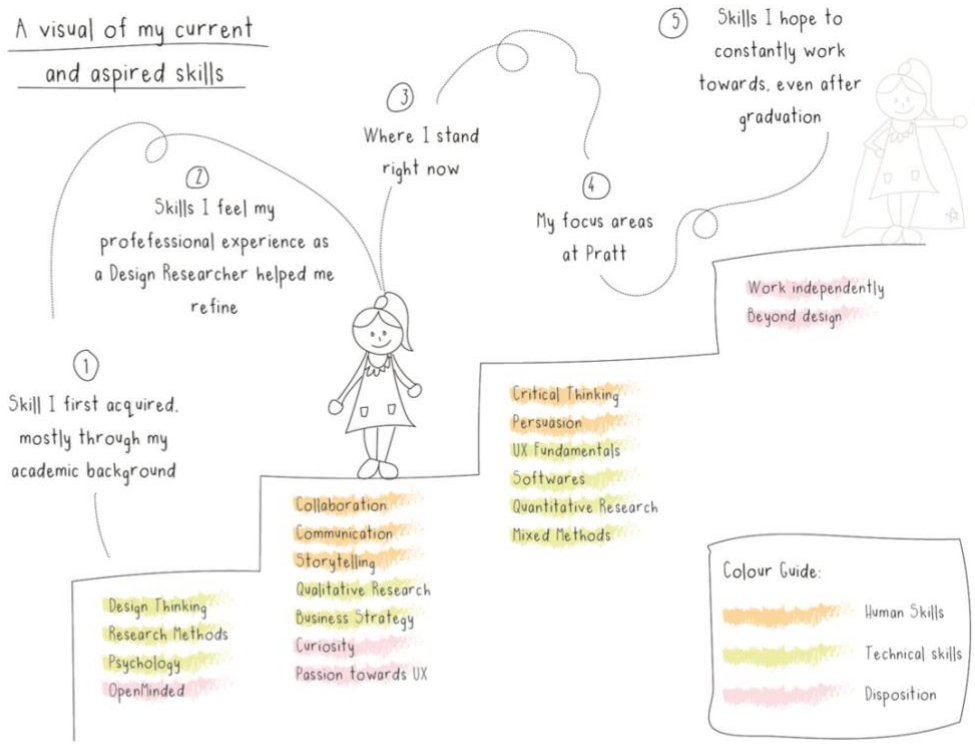


Figure 10. Example of a steps visual (P14)

Scale (n = 2; 3%)

Scale visualizations plotted the students' current skill levels on an abstract scale of expertise. Among the three visuals in this category, one student used a numerical scale from 1-10 and also summed all their ratings together into a summative score. Another student created a simple scale from Novice to Expert. On the scale below (Figure 11), P9 created a scale anchored by Expertise (E) on the left and Want to Learn (L) on the right, with Proficient (P) in the middle. They then plotted their technical skills, human skills, and dispositions on the scale.

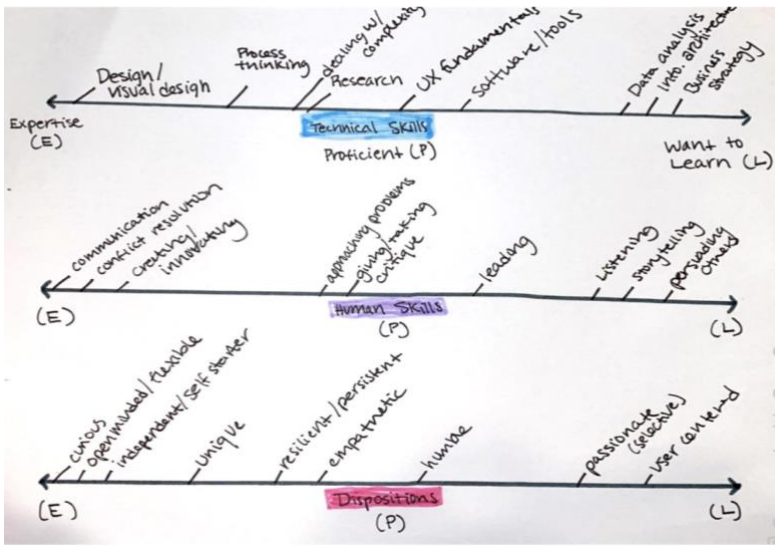


Figure 11. Example of a scale visual (P9)

Other (n = 3; 4%)

We grouped the remaining visuals into an "other" category as each one was unique. One visual showed a set of "skill cards" fanning out from a "UX" center, another was a Venn diagram with overlapping circles for each skill category, and the last showed two sets of nested circles (Figure 12), one representing "Where I am Today" and the other "Where I Want to be Tomorrow." In each set of circles, technical skills are the outer layer, human skills are the inner layer, and dispositions are nested in the center.

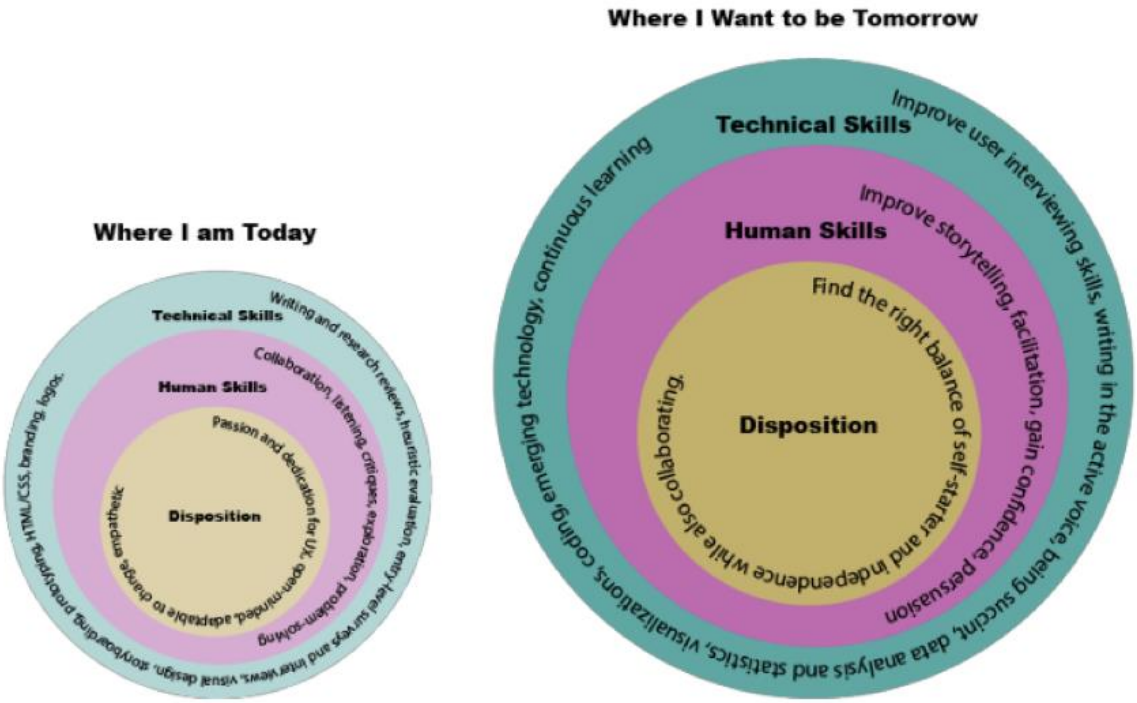


Figure 12. Example of an "other" visual (P51)

Follow-up reflections

At the end of the term, students were asked to revisit their initial submission and write a brief reflection on what they had learned. We again examined student responses and identified two common themes: a growth or change in their skill sets and reflections on the helpfulness of the intervention.

Growth or change in skills

Most students pondered their growth at the end of the term using the language of the article, i.e., specifically framing growth in their human and technical skills. Reported growth in human skills included communication (n = 12; 16%), collaboration (n = 12; 16%), storytelling (n = 7; 9%), critical thinking (n = 3; 4%), and problem-solving (n = 3; 4%). For example, P27 focused on collaboration in their reflection:

> *"I learned many important lessons about teamwork skills. I learned how to truly 'collaborate' with others, delivering my opinions to my teammates and receiving their critiques. I will try my best to be a better collaborator by listening to others opinions and being humble."*

Similarly, P50's reflected on growth in storytelling and communication:

> *"I was able to gain more experience and training in storytelling and communications skills through preparing presentations…It helped me think of how I'm going to elaborate detailed information through visuals and speaking."*

Many students also reflected on their growth in technical skills which included design (n = 24; 32%), software acquisition (n = 22; 29%), and research skills (n = 8; 11%). Technical skill growth was (obviously) related directly to the specific course assignments. For example, in the second context, where students conducted user research, learned new software, and designed an artifact, it was common for students to mention all three common areas of technical skill growth; P12 submitted:

> *"I believe that over the course of the semester, I have picked up several skills from all these areas of study – including research skills, from our user interviews, card sorting and tree testing activities, technical skills from our bout with Optimal Workshop and prototyping skills from our design process on Figma. I have even picked up finer design skills – something I believed I already had a good skill set in, from my teammates and classmates through the process of constructive criticism and iterative designing."*

Assessing the Helpfulness of the Intervention

Recall, in the third institutional setting (n = 45) we asked how the article was helpful (or not). Most students (n = 12; 27%) focused on how the article provided a framework by which to inventory and assess their strengths and weaknesses at the end of the term. In an example, P49 wrote:

> *"I think the most helpful aspect about these self-reflections/the article we read in the beginning was that it forced us (well, it at least forced me) to think about how and where we stand as designers at least compared to how and where we think we should be at. In my opinion, the first step to improving is understanding your limitations in the first place so that you can place focus on improving those weak parts."*

Students (n=11; 24%) also reported that the article and assignment were helpful in assessing their progress and growth; P67 wrote:

> *"I feel this is helpful in being able to do a progress check-in. It's very easy to get caught up in feeling like there is still a lot to learn, but this is a great reminder of all the growth I have had in just one quarter."*

Finally, there were four responses (9%) that mentioned how the article gave them more context for the UX field, which helped them better understand where they saw themselves in that context. In an example in which the student encouraged us to continue the assignment, P73 wrote:

> *"I think both reflections were helpful. It's hard for me to stop and recap my experiences during my education. Being a student is really a constant journey that slams you with task after task, so it's nice to stop and think about the fruits of my labor. The article was also helpful because it had good insights into the job market and made me think more*

about the soon to be future where I'll really need to sell myself for a job. Overall, a great exercise that we don't get to do in any other classes, so I suggest keeping it for other students."

Follow up visualizations

In addition to the reflection questions, students in the first two academic contexts (n = 29) were also asked to create a new visualization of their skills as part of the follow-up assignment. Of the students who created a second visualization, all but three students chose the same style as their initial submission. When examining these follow-up visuals, we identified two themes: enhancing their skills and recalibrating their understanding of their current skills.

Enhancing skills

For the majority of students, the follow-up visuals show a mild-to-moderate enhancement of their UX-related skills. For some students, the final visuals showed an increase in the number of skills they possessed. For example, participant P5 used the exact same "t-shape" visual from their initial submission but added four new skills: leadership, self-starter, persistence, and "deal with complexity."

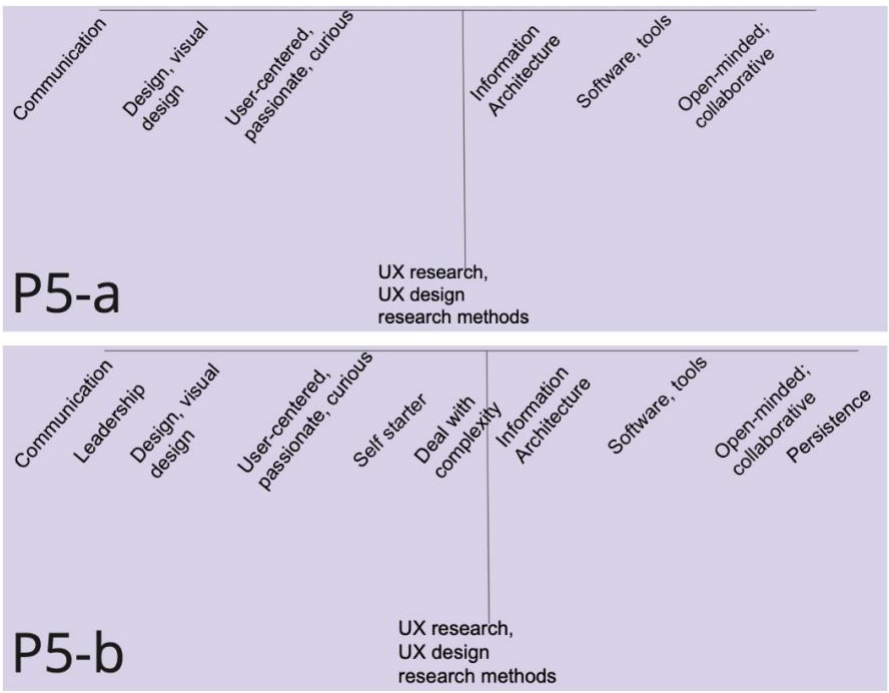


Figure 13. Initial (a) and follow-up (b) visuals from participant P5 showing an increase in the number of skills they possessed

For other students, the final visuals showed growth in their existing skills rather than the addition of wholly new skills. For example, P19 (Figure 14) used a series of different-sized bubbles on their "enhanced t-shape" visual to demonstrate growth and improvement.

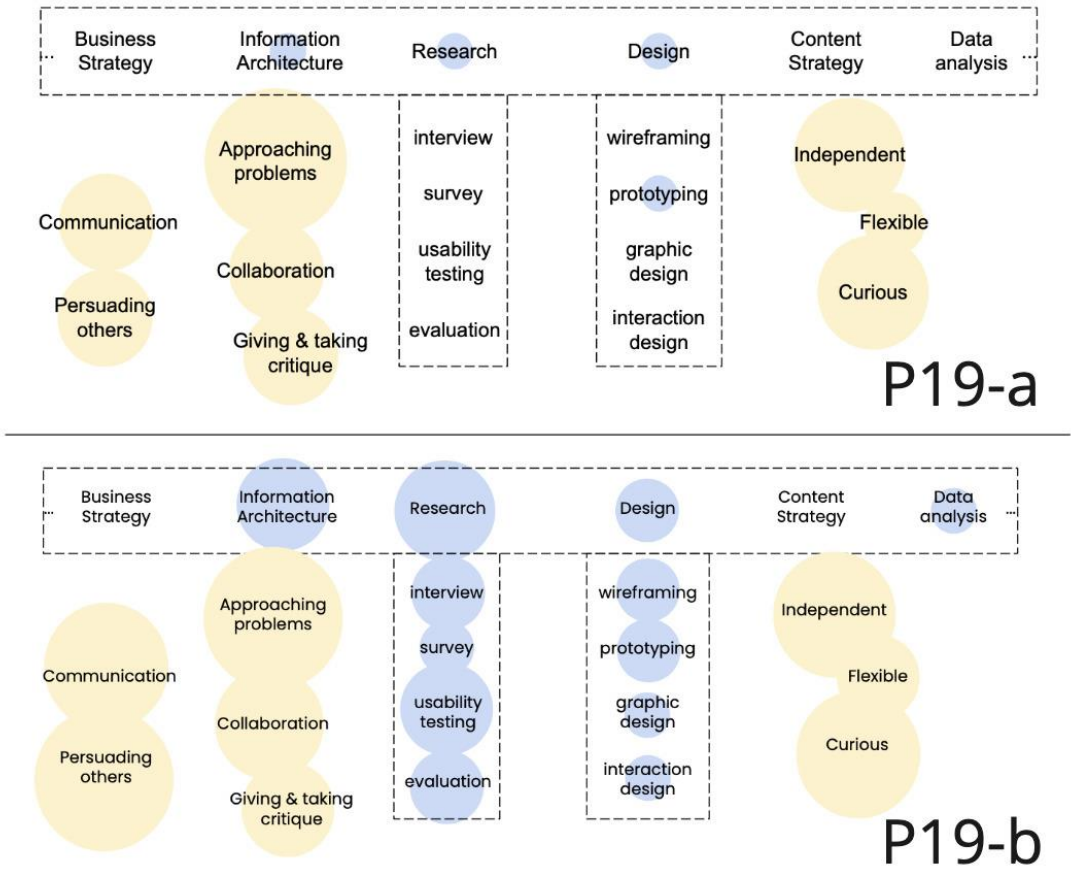
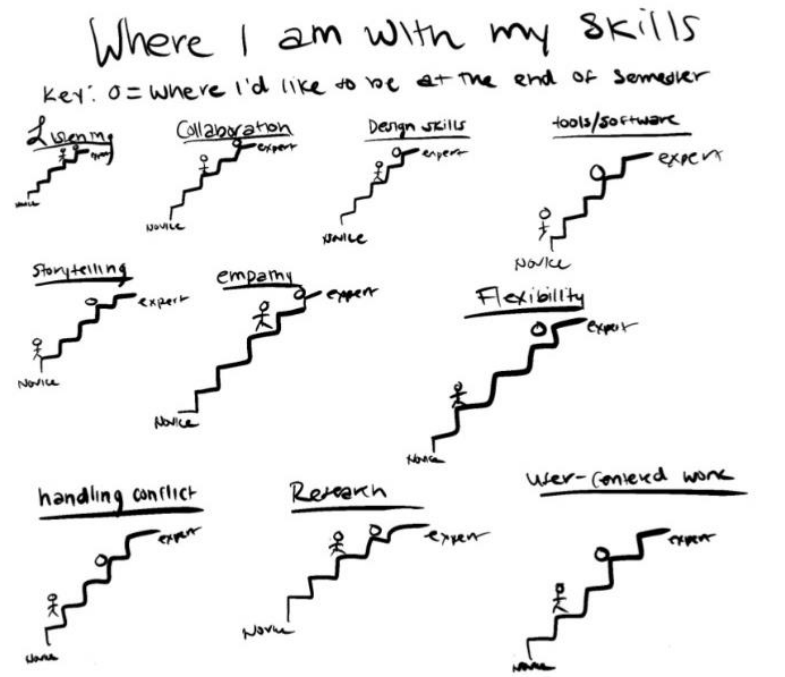


Figure 14. Initial (a) and follow-up (b) visuals from participant P19 showing how they improved several skills

Recalibrating their skills

For some students, the final visuals seemed to encourage a recalibration and appreciation for the effort required to develop new skills. For example, participant P15 used the "steps" metaphor to indicate their current and desired skill levels on both the initial and follow-up visual. However, on the follow-up, they depicted themselves on a lower step on several skills (listening, collaboration, empathy, and flexibility) compared to the initial visual.



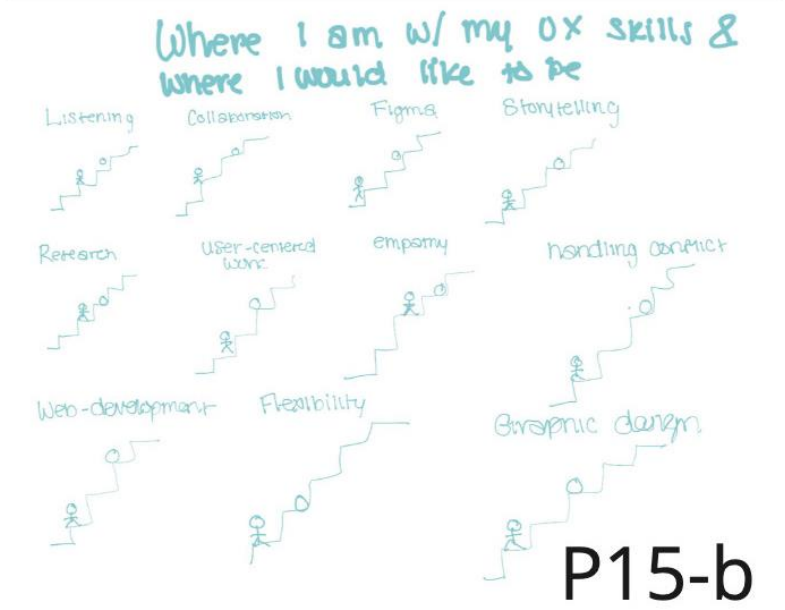


Figure 15. Initial (a) and follow-up (b) visuals from participant P15 showing a recalibration of their self-assessed skills

This example shows that growth was not simply progressive in terms of students seeing their skills increase. Instead, some students' appreciation for what a skill might entail and their perceived strengths in a particular area changed over time. The following student, in their final reflection, spoke to how their perception of their skills changed over time and how they recalibrated that perception.

> *"At the start of the semester, I graded my skills at a very high level but over time I realized that I'm falling short in some areas of the skill set. As the semester went on I tried to push myself to bridge the gap. Sometimes the result came in quickly but other time it took more time then expected." (P26)*

This evidence points to how the intervention is a helpful tool for self-reflection and can complicate students' understanding of the skills themselves and their growth in relation to those skills.

Implications and Implementation

In this section, we discuss the implications of the findings presented through our analysis and provide recommendations for others interested in implementing the intervention in their own classes.

A helpful intervention

Based on the data shared in the previous section, we have concluded that the reflection intervention was helpful for students enrolled in UX courses for several reasons.

First, the intervention scaffolded a double-loop learning (Argyis 2003) opportunity for students to make assumptions about their understanding of what the skill sets were and how they assessed their existing knowledge. Students then reflected on these skill sets that they were asked to engage in throughout the term, to see how their initial understanding changed and evolved. They were asked to demonstrate these skills while also reflecting on how they were learning and how they were executing these skills, a form of reflection-in-action (Schön 1983).

Second, the intervention helped break down and demystify the skills that UX professionals need to be successful in the workplace. Students were able to learn about these skills, not just through their classes but through reading an article based on evidence from practitioners who identified these skills as critical.

Third, the intervention not only helped students appreciate the breadth of skills in UX but provided them with a way to scaffold their own existing and emerging skill sets, so they could strategically know what to strengthen or work on based on their individual goals. We concluded that this activity was a helpful example of an advance organizer. Additionally, our findings suggested that the KWL (Know, Want, Learned) format (Ogle, 1986) was a beneficial way to help students become aware of their existing skills and it also provided a way to set goals and assess what they had learned.

Fourth, we see that this intervention helped to disrupt the false notion that technical skills are the priority in UX. Students expressed a sense of relief that the skills were not solely technical. It helped broaden the idea of what it takes to be successful in UX.

Finally, given the different types of programs that we piloted this intervention in, both undergraduate and graduate, and in design, computing, and technical writing, we concluded that this intervention can be implemented in other UX-related fields at different levels.

A skill-building exercise itself

In addition to being a helpful tool to help inventory skill sets and set goals, there is evidence that the intervention itself is an activity that helps to strengthen UX skills. First, the act of doing an inventory of one's skills can be seen as a type of research exercise where students are searching inwardly through reflection to identify, catalog, and assess their own skills. Second, creating the visualization is a type of design exercise in which students have to consider how to create a visual design that represents both their existing strengths and where they wish to improve. Given very little description of how to do so, we see students demonstrate a variety of different ways to represent their own skill sets and where they might need to grow. This range of options demonstrates some creativity on their part to think through a design exercise with little direction, which is not unlike the experience they will find themselves in when they are on the job.

Considerations for implementation

Given the flexibility of the intervention, we believe it is a suitable exercise and activity for a variety of classes where students are learning about UX. While the data presented here are from the first implementation of the exercise, we have continued to implement and refine it in subsequent classes. Given our experience implementing the activity for over three years, in three different courses, in three institutions, we have identified additional considerations for implementation.

Pre and post

It is helpful to have the implementation act as both a pre-assessment of student skills and also post-assessment. Students can be asked to repeat the visualization they created at the start of the course and reproduce, iterate, or create a completely different visualization of their skills. Alternatively, instead of reproducing a visual, students could be asked to respond to a series of prompts that asks them to describe how their skills have changed.

Peer sharing and review

When we ask students to share these visualizations with each other, they also get to appreciate how there is no one way to design based on a prompt and there are many possible conceptualizations of their skill sets. To do so, we recommend making sure that students first submit their assignment and then share them with students, either in small groups or through an online peer review process. Providing a peer review or sharing process can make the exercise social and collaborative. If implementing group work in a course, this activity may also be a helpful way to identify teams with a mix of skill sets.

Examples and instructions

The original research article that the students read (Rose, et al., 2020) had industry professionals use the term "T-shape" (Brown, 2005) to describe the breadth and depth of skills. Therefore in the initial instructions, we told students "to use the metaphor of the T-shaped skills or find another way to show the relationships between what you know and what you hope to learn." As a result, the T-shape was the most common visualization that occurs in student submissions. However, when students chose a different visualization, the results were richer and more creative. Therefore, in future implementations of the exercise we have either omitted the instructions to use a T-shape as the metaphor or have explicitly instructed students to not use the T-shape. In addition, we sometimes show examples of previous students either

before or after students have submitted their assignments. Providing examples can be helpful to show the different ways to approach the visualization but it can also prompt students to replicate those existing examples. In either case, in our instructions, we encourage students to be creative and attempt to design something that is unique to them.

Course integration

We continue to think about how individual student assessments can be integrated into the courses. For example, one skill that we saw repeatedly that students felt like they wanted to learn more about was storytelling and information architecture. This was both seen in the pre- and post. Given this interest, we are considering how to elevate or draw attention to these specific components in the class as they occur. For example, within assignments, it would be helpful to specifically point out which skills a student might be able to demonstrate within the specific assignment. Alternatively, the KWL chart could be used as a self-assessment tool for each assignment where the student can connect the skills they are learning to their original goals.

Program integration

In each of the examples from our work, we have integrated the skill assessment into a single course. However, the assessment could also be integrated into a program where we ask students to take part in the intervention at the beginning or end of a specific gateway course and again at the end of a program. Having multiple iterations can assess how students' perceptions of their skills are shifting over time. It can also be used to assess where a program might need to strengthen or make improvements.

Limitations and future work

While we believe that the intervention we designed is successful, we also acknowledge the limitations of this work. Our assessment of this intervention was exploratory and not intended as a controlled experiment. A strength of the intervention is that we were able to implement it in three unique classrooms in three programs in three settings with a range of students. The audiences were all slightly different and included undergraduate students and graduate students. However, our enthusiasm for this intervention may be impacted by the fact that we both designed and evaluated the intervention and therefore were invested in its success, which may have introduced bias into the evaluation. We believe this initial data indicates it is successful, but encourage and invite other instructors to implement and evaluate it in other classroom settings.

Part of understanding the impact of this intervention was to see if students saw value in it. Students mentioned both in class and on course evaluations that they saw value in this exercise. Additionally, we have continued to successfully use this intervention in our classes and students see value. We have also shared this intervention with colleagues who have also implemented it in their classrooms. To examine its impact more fully, it would be helpful to do additional research and design a controlled experiment to evaluate its effectiveness in a variety of settings.

In conclusion, having students attempt to engage in double loop learning (Argyris 20003) and reflection-in-action (Schön 1983) and assess their skills through a Know, Want, Learned (KWL) advance organizer was a successful intervention that helped students cultivate awareness of

industry expectations, the importance of human skills, and to assess their own self-awareness and personal growth. We believe that due to its successful implementation in three different programs with different student populations, it is an effective pedagogical tool to support student learning and inform course design for students studying UX.

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