RESEARCH PAPER

Listening to students: Understanding how new-majority students engage with degree planning technologies

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Executive summary

This paper examines how current degree progress and tracking tools fall short of meeting the needs of Black, Latinx, Indigenous and low-income (BLI/LI) students. These tools aim to provide the information and resources students require along the degree planning process. However, the tools haven't bolstered success for BLI/LI students. We explore one possible explanation, namely, that current degree progress and tracking tools are inadequate to support BLI/LI students because, like higher education overall, these tools were not designed with them in mind. The overarching goals of this paper are to identify the needs of BLI/LI students in the degree planning process, and to improve degree progress and tracking tools so they better serve the students in most need of support.

To assess our hypothesis, we conducted focus groups with 24 BLI/LI students from 2 institutions. During the focus groups, students were guided through a "process-mapping" exercise whose goal was to represent the steps that students take when planning and registering for a semester. After the process mapping, we asked focus group participants to reflect on the exercise, and the degree progress and tracking tools provided to them. To supplement the dataset from the focus groups, we spoke with 14 advisors and 13 back-end personnel across both colleges.

The findings from the "process-mapping" exercise part of the focus group depicted the cognitive complexity that semester planning requires. One key finding was that, in order to create a schedule for even a single semester, students consider, on average, 4.5 items, do 3.7 things, and consult 3.8 resources. Furthermore, we noted 28 mentions of considerations related to graduation requirements, compared to 60 mentions of considerations that weren't directly related to graduation requirements–emphasizing the extent to which student planning encompasses much more than taking the correct courses.

The interview part of the focus group revealed four common pain points that students face in using these tools: they are hard to navigate, they are hard to interpret, they use overly complicated language, and they don't give students all the information they need to make informed decisions. Students were also asked to suggest improvements and specific product modifications. These fell into two broad categories: **fewer and clearer tools** and **more information**. The first suggestion category includes stronger tool integration, improved navigation and interpretability, and streamlined in-tool communication with advisors and other support staff. The second suggestion category calls for information that has financial implications, indicates the quality of the instructors, and reduces choice overload by providing course suggestions.

To put in context our findings and uncover the barriers to address them, we also interviewed back-end users and advisors at both colleges. Many described sizable and various constraints in bringing about these improvements. These included challenges around complex data streams and integrations, data definitions and data points, lack of bandwidth or personnel, curriculum updates, and the quality of vendor services.

The upshot of this paper is to provide vendors a deeper understanding of the needs of BLI/LI students around degree planning, such that they will more robustly consider those needs in the design and development process. We offer concrete suggestions for product improvements that are drawn directly from student testimony: refine the user-experience, pay close attention to language, and present new, non-requirement related information.

Since these improvements are contingent on constraints at the institution level, we offer 3 recommendations for how vendors can make product improvements in a way that

aligns with these constraints: **(1) ensure all data elements have a clear and consistent definition, (2) align the data refresh process with the underlying business process at the university,** and **(3) offer additional resources to support the institution's evolution of its planning/scheduling/advising software.**

Our final suggestion for vendors is that they incorporate BLI/LI voices into their processes, that is, by making BLI/LI students a fundamental and ongoing part of product design and development. We suggest they can do this by co-designing and user-testing their products with input from BLI/LI students, and by establishing early access/beta phases to refine their solutions before bringing them to the market.

Understanding how new-majority students engage with degree planning technologies

Al[1] is a college student in Ohio. He's from a low-income family, and is an emancipated minor. Like most college students today, he uses degree planning and scheduling tools to help him select, enroll in, and keep track of the classes he needs to take on his way to graduation. But despite his understanding of these tools, he calls course planning and registration "headache inducing." He's had trouble registering for the right courses at the right times, and his graduation has been delayed.

Al isn't unique. Colleges around the country have adopted various tools for academic planning. These tools aim to help students seamlessly identify the courses they need to graduate, and avoid courses that won't count as a requirement. They may also help students build multi-semester plans so that they can have a clear "roadmap" to completion; help advisors communicate with their students; or serve as a degree audit to ensure graduation requirements are met. And usually, they help students select not just the courses they need to take, but the sections and schedules that are available to them, so that they can easily move from planning to registering and enrolling.

The growth in planning and scheduling tools comes, in part, from research that shows that student progression and completion is hindered by inaccurate degree planning (see, for example, Bailye, Jenkins, & Jaggars, 2015; Zeidenberg, 2012). These tools have been developed and launched under the assumption that by providing accurate, easily accessible degree information, technology solutions can reduce excess credit-taking while enabling advisors to identify and proactively intervene with students who are off the path to graduation. And, by simplifying the planning and registration process, these products are assumed to enable more effective "self advisement" by students, thereby reducing the burden on over-capacity advising teams.

And yet, as Al's story shows, these products haven't yet lived up to their promise. This is particularly true for students, like Al, who are the "new majority" in higher education–Black, Latinx, Indigenous, and low-income students for whom college was not designed. These groups of students historically have been excluded from higher education and therefore complete college at lower rates than their whiter, wealthier peers. In fact, a recent study of broad access community colleges and universities using degree planning software found minimal impact on completion rates (Velasco, Hughes, & Barnett, 2020).

There are many possible reasons why program planning tools don't support Black, Latinx, Indigenous, and low-income (hereafter referred to as "BLI/LI") student success. Perhaps students don't actually use the tools. Or perhaps program planning isn't the root cause of low graduation rates. It's possible that even the most perfect tool has muted impact when used in under-resourced institutions with clunky advising systems.

In this paper, we hypothesize another possible reason: that, like higher education overall, **planning and scheduling tools were not designed for BLI/LI students, and therefore don't effectively meet their needs.** In doing so, we acknowledge that usage patterns and the institutional systems in which planning and scheduling tools are embedded are critical aspects to

1 All student and advisor names in this paper are pseudonyms.

their success–worthy of interrogation and reform because tools are only as good as the systems within which they are used[2]. But we start from a recognition that the products themselves may be problematic, and that this is a challenge vendors and solution providers can directly address. Moreover, by examining whether or not current planning and scheduling products meet the needs of Black, Latinx, Indigenous, and low-income students, we put the needs of these students–who make up the majority of college students in the United States–in the driver's seat. And we begin to overcome the reality that most technology products were not designed by, for, or with input from the students most in need of their support.

In other words, we put today's students at the center of our inquiry and argue that, if planning and advising tools are to be more effective, they need to be designed with new-majority students in mind. This paper provides technology designers and vendors with a deeper understanding of what BLI/LI students directly tell us they need to make informed decisions around program planning and scheduling in order to stay on track to graduation. It also uses the voices of personnel at broad-access institutions to frame the constraints they face in launching, using, and supporting planning and scheduling tools, and that need to be taken into account in any future technology feature set. We conclude with concrete suggestions for next-generation product features that can better-support new-majority students by taking their needs as a starting point.

2 Research from the Community College Research Center, Advising Student Success Network, and Phase Two Advisory–among others–explore challenges with advising in broad access institutions more generally (see, for example, Karp & Lyons, 2022; Tyton Partners, 2022; Fried & McDaniel, 2022; Pellegrino, Lopez Salazar, & Kalamkarian, 2021)

Approach

This paper draws on a robust dataset drawn from two broad-access, four-year public institutions.[3] One institution was located in the midwest, and enrolls approximately 11,000 students, 24 percent of whom identify as racially-minoritized, and 41% of whom are Pell-eligible. The other institution was located in a northeast urban center, and is part of a multi-institution system. It enrolls approximately 15,000 students, 85% of whom identify as racially-minoritized and 52% of whom are Pell-eligible. **Appendix A** provides additional information about the two institutions.

We designed our study to emphasize the experiences and needs of BLI/LI students, with a secondary aim of understanding the experiences of and institutional constraints faced by advisors and back-end support staff tasked with supporting students and technology. The research questions guiding the study, therefore, asked:

1

How do end-users (students and advisors) engage with and experience current degree planning and audit tools?

2

What pain points do end-users encounter with current tools and what implications do those pain points have for student persistence and completion?

3

What constraints do back-end users (e.g. IT, registrar, curriculum chairs) encounter when trying to address the identified pain points?

4

How can technology tools, technology-related processes, and campus cultures be refined to better meet student needs while being attentive to broad-access institutions' constraints?

Our primary data are drawn from virtual focus groups conducted with students at both institutions during the spring of 2022.[4] Representatives from each college helped us identify and recruit students who identified as Black, Latinx, Indigenous, and/or low-income. They were offered a $50 gift card to participate in the focus group.

3 A full description of the methodology is available from the authors. This study was approved by the IRB at both institutions included in the dataset. For all of our data collection procedures, we were careful to ensure participant confidentiality and voluntary participation. We were particularly cognizant of the fact that we (a) were asking students to discuss potentially-uncomfortable questions around race and class and (b) for advisors and staff, we were asking them about their places of employment. Strategies used to mitigate these risks are available from the researchers.

4 Although we had planned to conduct these focus groups in person, the ongoing COVID-19 pandemic prompted us to switch to virtual format to ensure the health and safety of our participants. It should be noted that our response rates were lower and our no-show rates were higher than we had hoped for–a phenomenon experienced by many qualitative higher education researchers during the same time period. Readers should note that our sample may not include students most negatively impacted by the pandemic or who have the greatest caregiving and work responsibilities, as well as those with inconsistent access to technology. As such, our findings may actually underestimate the extent to which non-academic considerations play into students' planning and registration processes.

We spoke with 24 students across the two institutions.[5] Seventeen students self-identified as Black or Latinx; 15 self-identified as low-income.[6] Twelve students identified as female and eight identified as male. Nine students indicated they are first-generation college goers; eight work full or part-time; at least one student was undocumented and illegible for financial aid; and one student was a runaway/emancipated minor.

The focus group itself had two parts, leading to two different types of data. During the first section, we guided our participants through a process mapping exercise. Process mapping is widely used in business to visually represent the steps individuals take while completing a task or series of steps. It is typically used to identify breakdowns or inefficiencies in a business process (Dietz, King, & Smith, 2008).

We adapted this process to collect visual representations of students' experiences and practices when planning and registering for classes. Using Google Slides, focus group participants were asked to map the steps they take when planning their schedules; we guided them through the process by asking them to identify what they think about, what they do, and what resources they rely upon to remain on track to graduation. We then asked them to array those steps into a visual that represents their planning and registration process. We also asked them to "annotate" their maps, identifying the aspects that were easiest and most challenging. **Appendix B** illustrates these maps, including the map created by Al, the student you met in the introduction to this paper.

We were able to analyze these maps to identify when and how students use advising and planning tools; the things they think about, do, and use while creating course plans; their perceptions of advising and planning tools; and the challenges they face when using those tools.

During the second half of the focus group, we used a semi-structured interview protocol to ask the students to reflect upon the mapping experience, their planning processes, and the tools available to them. We took detailed notes during these discussions, which were analyzed to supplement the map findings and clarify the types of product features students say they rely on or would like to rely on.

To supplement our student dataset, we spoke virtually with advisors at both colleges in the study. We also spoke to representatives from offices that engage with planning and scheduling products, such as the registrar, Institutional Research, and IT. Our college contacts helped us identify these personnel, but all interviews were scheduled and conducted by external members of the research team in order to preserve confidentiality.

In total, we spoke with 14 advisors and 13 back-end personnel. These interviews used a semi-structured protocol, and we took notes during the discussion. Advisor interviews focused on their use of planning and scheduling tools, perception of the tools and their usefulness for BLI/LI students, and suggested improvements of the tools. These interviews also provided context for the broader advising structure within which the tools are used. Staff interviews focused on the constraints faced by broad-access institutions when implementing and deploying advising products like planning and scheduling tools, as well as suggestions for improvement.

We analyzed the interview notes thematically, using them to triangulate on what we heard from students and to supplement our understanding of institutional constraints that could influence available product developments in the future.

5 A few additional students joined the focus groups but opted not to participate once they learned more about the study, or were unable to participate due to technology constraints. These students are not represented in the dataset.

6 In order to allow for student agency and choice, we gave them the option to share their race, income, gender, language, and work status, and to share the identifiers that mattered most to them. Therefore, these numbers may under-represent the BLI/LI students in the dataset.

Student engagement with advising and planning technologies

In general, students engage with advising and planning tools when it is time to register for classes or check their graduation status. By and large, they don't use the tools to create long-term academic plans or communicate with advisors about their academic progress. Instead, they log in to check the classes they need, when they're offered, and whether or not a given course meets their requirements.

Students find that the tools are adequate for these purposes. This was particularly true once they had used the tools for more than one semester. For example, Mariamu–a Black, first-generation student who does not speak English at home–said,

> "I feel like as the years go, you get better at using different tools and know what you have to do."

In other words, students engage with planning tools in ways that are task-oriented and generally productive with regards to the narrow purpose for which the tools were designed.

However, perhaps the most important thing we learned from the students in our study is how complex the course planning, scheduling, and registration process is–and how existing tools address only a small part of that complexity. Jesus, a Latinx male who speaks Spanish at home and is an adult student, summed it up by saying that when he logs into his planning tool, the first thing he thinks is, "Where do I even start?"

In analyzing the process maps, we found that, on average, students need to think about 4.25 things just to create a course plan for a single semester. Some students listed as many as nine. Students thought about obvious planning and scheduling concerns, such as whether or not a course meets their requirements. But they also thought about things seemingly unrelated to degree progression–including the quality of teaching in a given section, their work and family obligations, unexpected fees and costs, and whether or not they find a class interesting or relevant to their interests.

In fact, 21 of 24 of our participating students thought about graduation requirements. But 14 students also thought about their personal or work schedules; 11 thought about course timing–usually in relationship to other obligations; and 10 thought about their courseload. Overall, there were 28 mentions of graduation requirement-related "thinkings," but 60 mentions of things that students think about, but aren't directly related to graduation requirements.

The cognitive complexity of program planning is further reflected in the number of steps students take (3.7, on average) and tools and information sources they access (3.8–with some students relying on as many as 7). Notably, most of these tools are **not** program planning tools, indicating that the tools as they currently exist do not provide functionality to meet all of the cognitive and logistical demands faced by students during the course planning process.

All but two students indicated using a degree planning tool. However, nearly as many (all but 4) students indicated that they use friends, family, advisors, or college staff to identify the classes they need to stay on track for graduation. Moreover, students indicate that they need to supplement campus-based advising tools with external tools–notably the website ratemyprofessors.com

(8 students) and pencil and paper (7 students). **Appendix C** provides a full list of things that students thought about, did, and accessed in their maps.

The complexity of the program planning and scheduling is evident in both students' maps and their reflections on the mapping processes. Al, the student we met at the beginning of this paper, described his map by saying,

> "I made mine messy as an artistic statement. I find the process very confusing and frustrating and a lot of going back-and-forth between different documents... I was surprised at how much thinking goes into registering that we don't think about..."

If we look at his map, we can see how there are multiple paths to registering for courses, and the number of considerations that have nothing to do with graduation requirements. These include personal interest in courses, potential conflicts with work, commuting time, and financial aid requirements. Moreover, we see (in bright red) that Al missed out on courses he needed when they conflicted with out-of-school demands.

Valeria, a Chicana student who is undocumented and therefore ineligible for financial aid, reiterated the point that each step in the planning process requires cognitive complexity. (Her map is also shared in **Appendix B**). She said,

> "My process is kind of a step by step process but each step requires a lot of thinking and going over multiple times so I can choose the best options."

She noted that the available tools were useful since they showed what courses had been completed and "what to focus on next," but also implied that there were many considerations outside of what was provided by those tools. In her map, she notes having to drop a class due to unexpected/unstated course fees, reaching out to professors to get additional information about courses, and using ratemyprofessors.com and speaking to others who have taken classes. These aspects of planning indicate that she needs information about the classes themselves–not just the requirements–to build an academic plan and schedule that will work for her.

It is clear that, for students, "staying on track to a degree" includes far more than picking the right classes. They need to consider external factors, notably work, family, and financial demands. Available tools generally do not include that information. Therefore, their engagement with college-provided tools is limited to relatively narrow circumstances–checking on progress towards a degree and scheduling–and supplemented with other information sources to create a complex yet comprehensive planning and scheduling experience for students.

Because we were keen to center the experiences of BLI/LI students, we also analyzed the data with an eye towards differences across racial and income groups. Students report engaging with technology similarly across groups. Most also indicated that tools are race-neutral, in that their experiences do not vary based on their race or ethnicity (both in terms of what they report and with regards to answers when explicitly asked if race influences their technology engagement).

However, students did indicate that class substantially influences their engagement with advising and planning technology tools. Students report that the reliance on technology disadvantages low-income students, particularly because these students are less likely to have consistent internet access and this creates barriers to timely registration. This might seem like a small challenge, but when contextualized with the constraints discussed earlier, it is substantial.

Students are careful to plan course schedules that enable them to balance work and school; if they are unable to register on time, and the class sections they need are filled, it is often impossible for them to select an alternative. Instead, they have to wait until a later semester to take the classes they need.

Sireana, a low-income, first-generation college student who works full time to support her family of four, explained that she tries to build a draft schedule as soon as courses are released.

> "I figure out my schedule months ahead of time, as soon as the mock schedules come out I have to start planning for what my semesters will look like so I can work around it."

Her map is also included in **Appendix B**.

Al, whom we have also already met, is in a similar situation and explained that he has trouble leveraging his priority registration status to get the classes he needs because his internet goes down. His graduation was delayed as a result. He said,

> "[We all] register at the same time and people with consistent internet are prioritized just by the fact that it's first come first served."

Technology pain points, from the student perspective

The students in our study generally indicated that the advising and planning products to which they had access were adequate for the purposes for which they were used. They felt like the tools did what they were supposed to do–give them insight into the classes they had taken and what they needed to take, and provide an avenue for registering for the next semester. When explicitly asked how they felt about the planning tools at their disposal, 11 students made comments that were explicitly positive, while only five gave negative comments (the remainder had no opinion).

That said, when probed, students indicated that the tools have room for improvement and that the available technology, while adequate, can create pain points or challenges. This is particularly true when we look at the tools through the lens of race and class. It should also be noted that when we triangulate these student findings with advisor perceptions, we find that both groups of stakeholders identify similar pain points and potential negative consequences.[7]

We identified four categories of pain points.

1. "Clunky" technology tools.

Ten students noted that the tools often lack key information, take a long time to navigate, don't connect to other tools or information sources, or take a long time to access and use. Octavia, a Black, first-generation college student who works full time as part of a single-parent household, described using a course scheduling tool by saying that the "whole website bugs out… The page won't work, it sends you back two pages, go back to the class. You have to make sure you press to modify the search or it will redo the whole search."

2. The tools are hard to interpret.

Eight students indicated that the tools, or parts of them, are difficult to interpret. Interpretation difficulties stem from information that is hidden (for example on a second tab), the use of course numbers rather than course names, and the visual appearance of the tools. Teddy, a Black male student, described his frustration by saying that the tool "is a pie chart. A lot was green so I thought I was done. But if you click something else, there are major requirements. And that was a lot of red." As a result of misinterpretation, a number of students ended up making scheduling and registration mistakes that cost them time or money; others indicate that the confusion leads them to use other information sources or resources.

7 We also remind readers that while significant process and advising-related pain points exist for students, this paper focuses solely on challenges created by technology tools and data infrastructure.

3. The tools use language that is overly complicated, or unfamiliar to BLI/LI students.

As part of the process-mapping exercise, we asked students to list words they encounter during planning, registration, and scheduling that were confusing or made it difficult to make good choices. Students listed 25 different "trouble" words, many of which are used in the tools themselves but are not explained to or defined for students. The most common of these were: co-requisite, prerequisite, asynchronous, and Writing Intensive. A full list of these words can be found in **Appendix D**.

4. Tools don't give students the information they need.

As discussed in the previous section, students take a robust set of considerations into account when planning and scheduling their courses. Much of this information is not available in the institution-provided tools. Students frequently note that they had trouble finding out if courses were online or in person; accessing information about additional fees; if course sections have already been filled; or specifics regarding the instructor and course expectations. Some students, like Nika, a Black student who works, noted that information is often outdated.

These pain points are problematic on their own, but become more so when we intersect them with the things that BLI/LI students consider and prioritize when engaging in program planning and scheduling. As the first section of this paper made clear, building a course schedule is, for many BLI/LI students, a complicated puzzle in which they need to fit together academic requirements, work demands, family obligations, and financial realities. Any delay in access to a course schedule or registration opportunity, or any missing piece of information, can create a cascading impact that results in excess stress, delayed graduation, or additional costs.

We already learned that Al had to delay graduation when his irregular internet access prevented him from registering for classes he needed. Valeria, whom we met earlier, explained that she enrolled in a course only to find out that the materials cost extra–and she had to drop it as a result.

Jennifer, a Latina first-generation student who took a break from college and has now returned, explained how tools that were difficult to interpret created undue stress and almost waylaid her graduation. She relies heavily on a degree planning and audit tool, but did not see a section of the tool that indicated she needed additional courses. She did not find out that she was missing required courses until she applied for graduation–at which point, she had to scramble to find an "alternative credit option" that would enable her to stay on track. With great emotion, she described how–even though she ultimately worked it out–the situation was "stressful." She emphasized that using the tools is not difficult but

> "What's difficult is to know what I do not know.... I didn't know [what was missing or what alternative credits were.] I'm first gen. I don't have anyone to tell me it's all right."

As these examples illustrate, technology pain points were particularly salient for low-income and first-generation college students.[8] The students in our study were clear that the technology tools they were expected to use assumed a base level of knowledge that they did not have. Even supposedly-simple things, like knowing when to register or what higher education terminology meant, were not simple for those who did not have family or friends to guide them. Mariaumu summed up this point by saying, "You have to know what you're looking at. [The technology] assumes you know things."

8 Our study did not explicitly explore first-generation college students' experiences. However, and as we have noted, many students self-identified as first-generation and this status–which often intersects with race and class–was salient in many of their maps and reflective interviews. Thus, we highlight it here as another important consideration when thinking about ways to foreground the needs of BLI/LI students.

Technology improvements, from the student's point of view

After students spoke about their technology pain points, we pivoted the conversation and asked them for suggestions on improving the technology tools focused on advising, degree planning, and progress tracking so those tools could more effectively assist them in achieving their educational goals. Their suggestions can be broadly grouped into two categories: Fewer and clearer tools, and different information. Within each category, they had specific ideas for product modifications that would be useful.

Students suggested making existing tools more user-friendly in design and interface and consolidating. As noted in the pain points, although existing tools are helpful, they are still difficult for students to navigate, interpret, and understand. Thus, one-third of the suggested features or improvements focused on making products more usable from the perspective of BLI/LI students included in this study. In some cases, aspects of the tools that are viewed as well-designed by product developers, such as multi-layered, multi-colored "donuts" tracking course progress, are not actually easily-interpreted by the BLI/LI students in our study.

Suggestions to broadly improve integration and design came in the form of comments like these, from two different students:

> "A website that has all the things we need, versus having some information on one website and another."

> "Sometimes I just think, ... the college's front page could be streamlined. A lot of links that send you to a million different places... I don't think it has to be rocket science to be able to traverse the website. It can be really hard to find something. Directories to find staff but they have so many different departments. I don't know, for a person coming in, it's overwhelming."

The students with whom we spoke provided insight into specific things they believe would be more helpful than the current tools.

1

Stronger tool integration. Students mentioned having to use a degree audit system to understand their course options to satisfy their remaining requirements and a separate tool to build a course schedule and a third system to ultimately go and register for classes. They often jump back and forth writing down course options and rekeying them into a course scheduling tool due to classes being full. The student's desire was to have these be the same tool or real-time data integration to ease the back-and-forth frustrations.

2

Students suggested that the degree audit tools could **improve their navigation, give the full picture, and enhance search** and **usability** by more clearly pulling back courses for key requirements (e.g, 'take 1 History course from the following list'). Students commented that often, they would believe their degree audit indicated that they had completed requirements, but they had misread it or not seen the entirety of their progress. They also wished that, when their audit indicated they needed additional courses, they could immediately see what those courses were and when they would be offered.

3

Streamline communication and enable **real-time digital conversations** with their advisor and other offices, within the planning tools. Students want to supplement digital information with personalized information, but find that meeting face-to-face can be intimidating, and time-consuming. They often also have to wait for answers when they reach out via email. Thus, they suggest in-tool texting or chat capabilities which would reduce the time required to get answers while also making personalized support more accessible.

The second broad category of suggestion is related to the information included in the digital tools. As we have seen, BLI/LI students consider a wide range of things when planning their course taking–not just graduation requirements. We have already noted that students rely on external products, like ratemyprofessors.com, because planning tools do not provide them with the information they need. They do this even though they recognize that such external products are imperfect.

As one student said,

> "If I'm going to take a class with a new professor I've never heard of, I want to make sure that they are a good professor and they have a good work ethic or whatever. And I do find it [ratemyprofessors.com] a bit hard to trust... it's difficult to find recent ratings."

As a result, they suggest adding additional information to digital planning products so that they can make informed decisions about their next steps.

4

Reduce choice overload by providing course suggestions aligned with the degree audit and scheduler. Students indicate they would like products that tell them which courses they should take next, given their major and progress toward a degree. This is in contrast to most tools currently in use, which provide a long list of courses that meet requirements–but do not tailor the list to students' majors, course-taking patterns, or preferences.

5

Provide institutional transparency on **instructor quality**. Students want to understand what will be expected of them in a given course section–and the type of teaching instructors engage in. They are aware that not all instructors are equally effective, and that some instructors are better-suited to their learning preferences than others. Providing access to course evaluations, student ratings, and course expectations (e.g. writing and reading load) would help them craft course schedules that will maximize their learning.

6

In addition to instructor ratings, when using an online course catalog to learn about a course, students said it'd be helpful to have **additional information that has financial implications** like books, cost of books, or lab fees. Students in our study were clear that these unexpected costs can lead them to drop courses for which they have enrolled; understanding the financial implications of their course choices–and enabling them to plan for any lab fees they might incur in later semesters–will help them make college financially feasible.

Institutional constraints and enablers that will influence how vendors can address students' needs

Overall, students are asking for more integrated tools to make planning and scheduling easier, additional information to help their decisions, and a more intuitive user experience. To meet these needs, vendors will need to refine their products. But, they'll also have to take into account institutional constraints and challenges. Our back-end end-user interviews clarified the types of parameters and considerations vendors and developers need to be mindful of as they work to address BLI/LI students' needs.

To reduce or consolidate the number of tools, back-end users need resources and expertise not only on the technical and IT sides but also with a strong understanding of the underlying business processes and current features in use. Mary, who oversees many of these systems from an IT perspective, observes:

> "I wish we could reduce the number of systems, technology, and data integrations; fewer sub-systems and few integrations. What we have is a lot! The challenge is finding similar features in fewer systems."

To better integrate tools for students, institutions need to invest in resources to understand their existing systems, and their features to design new integrated solutions.

Our two partner institutions have an array of complex systems and tools ranging from 15 to 20 "point" solutions (specialized in select tasks like degree auditing for example) to facilitate degree planning, course scheduling, and academic advising. Several of these solutions have been around for many years and may not have the most modern architecture. The end result is a complex web of systems, somewhat integrated, that requires specialized staff to operate and eventually simplify.

If a vendor were to provide an integrated tool, the college IT team would still need to retire some systems, and change existing data integrations. But that takes time and manpower they don't have. We discovered that some teams are left operating in a "keep the lights on" mode, often fueled by staff retention issues and restrictions in accessing the resources needed to attract new, qualified talents. Gerald from a service unit explained:

> "Staff turnover, retirements. Keeping the lights on. Make sure stuff doesn't break - that is what we do. We are not about making things better. 80-90% loss of staff. So many retirements."

With large numbers of systems to operate, often coming from different 3rd party vendors, all of the work required for the existing infrastructure can leave very little room for innovation.

In addition to that, the expertise and know-how to transform their IT landscape depend on the institutional knowledge of the existing systems and integrations. This can be a challenge too as we heard from Carol, involved with software application management:

> "There has been a lot of customization of the student information system. The self-service interface has been customized a lot. Not so much the data itself. The lack of documentation about customization can affect/slow down the team; we need to pause and assess/analyze some areas if not well documented."

The students in our study also want new information related to courses and ways to take into account their constraints - for example, their work calendar. This would require sourcing, connecting, and surfacing new data points, potentially from new systems. Students need the data to be up-to-date, accurate, and able to flow from its source to the tools they use. While adding a new system is problematic, as we've seen, adding new data streams also presents a number of constraints for back-end users.

Jessica, who is a heavy user of institutional data, runs into issues with data definition and mapping:

> "We are seeing slightly different definitions of an active student between the advising management system and the student information system. We have not been able to resolve how it is being defined."

The challenges she faces get exacerbated when new data feeds are established. Solid data governance and data hygiene processes are therefore a necessity, to ensure that data flows from and into different systems are correctly understood. For example, ratings from ratemyprofessors.com appear to be a popular resource among students. In order to bring over the data in an existing tool, like the course scheduling software, it would be important to ensure that course numbers and faculty members are matched between the 2 systems. Otherwise, students could make decisions based on the wrong rating. Imagine the challenge to align internal data definitions with the numerous 3rd party vendors involved.

Another consideration for adding new data, like students are asking, is how the data source would be integrated. We mean by that the mechanism by which the data gets from one system (internal or external to the institution) into another (internal and used by students). The type and means chosen can affect both the accuracy and "freshness" of the data. Some teams are faced with manual data entry, prone to mistakes and lengthy processing time. Hakim who works in a service unit has seen, for example, issues with how curriculum information discrepancies can percolate into the tools involved with degree planning and scheduling: "It is difficult to get curriculum changes - for example, adding a new section. It can take up to 3 days. The department would get a spreadsheet "proof" from the registrar office to review and make changes. Then it is sent to the registrar. (...). Too many people making changes and it can lead to course conflicts.". In this example, a change in the curriculum decided by the faculty senate may not be properly or timely coded in the degree audit system. The students may not see the correct list of requirements and associated courses to take from the system. Going back to our example of ratemyprofessors.com, students will expect timely and precise information to guide their decisions. The way the data would be connected and exchanged can impact their experience and trust in the new information.

There are a plethora of possibilities to integrate data streams, depending on the underlying systems. But IT/Integration teams can be constrained by legacy software, which may not have modern data exchange capabilities, like APIs.[9] They may rely on daily flat file exchanges or other types of middleware. These added layers or older technologies are more prone to failure which could affect the data delivered to students. Subject matter expertise and 3rd party vendor support are key to overcoming these issues.

9 Application Programming Interfaces are standardized ways for two or more computer programs to communicate with each other; source: Wikipedia.com https://en.wikipedia.org/wiki/API

In addition to the transfer protocols, we also found that the frequency at which the data is exchanged can severely affect the business processes supported by the application. For example, overnight or longer lead times to transfer data between two systems can affect the student experience with registration or create confusion for the student. Here we found several examples where the student experience is already affected by asynchronous data transfers. Julie detailed for us one use case:

> "The data between the student information system and the degree audit is not always refreshed overnight. It can take 3 or 4 days even. Sometimes students declare their major on the same day they are being advised. They declare it in the SIS system but the degree audit is not updated. It is showing students as undeclared and their courses are not populated properly in the degree audit system."

In this example, students are meeting their advisors but the tools needed for them and their advisors to collaborate on a plan are not up-to-date. Considering the complexity of the curriculum, the advisors would miss an important tool to confirm the list of requirements and courses to take. An advising appointment that was scheduled weeks in advance because of the large student-to-advisor ratio would be significantly degraded because of the delay in the data refresh process. Similarly, we can extrapolate this example in the case of using ratings about courses. If vendors are not implementing an appropriate refresh cadence, or if it is unclear to the users when the data was updated last, students may not have all the information they need when planning and scheduling their next semester. When adding new data streams for the students, back-end users and vendors must address several existing constraints related to data integration.

Finally, students in our study viewed some of the technology tools not as simple to use or intuitive as they'd like. Improving the overall student digital experience plays an important role in supporting their degree planning and progress.

Back-users think that students want tools that work well with their equipment (mobile devices, computers, internet access) and that are intuitive. But this is not always the case. We found that back-end users can be aware of these issues but are depending on 3rd party vendors to fix them. Miranda, who leads a student-facing service unit, explained that

> "Some of the systems are not intuitive or not mobile friendly. There are a lot of pop-up windows that do not work on students' phones. Most if not all students are using their phones and workflows are not designed for mobile. It frustrates them and they need help to complete the tasks on a computer"

To make matters worse, students are doing a lot more tasks on their mobile devices than on their desktop or laptop computers. Compatibility and technical glitches can also get in the way as another staff member suggests: "We receive emails every day complaining that our version of the degree audit systems does not load on their institution-issued laptops. 3 weeks wait time to see an advisor and they cannot open the degree audit. They are asked to use another browser". To address these issues, institutional teams are often depending on the software providers to make a fix, which can take some time.

Beyond "the basics" of interface design and technical compatibility, curriculum design and course availability can affect the student experience in other ways.

Curriculums designed by academic departments ultimately need to be rendered in the various degree

management tools clearly and unambiguously. If not, students will not be able to understand the courses to plan and schedule for. This can be a challenge as Mike offered:

> "Faculty sits in a room and make complex thoughts of their curriculum, and may or may not think about operationalizing it. Systems might be an afterthought."

To achieve this alignment between curriculum and tools, some departments found it useful to involve a subject matter expert for the tools used by students and solicit feedback in the design.

Students also need to find enough courses available to complete their degrees in a timely fashion. But in some cases, departments and administration don't have the tools to make better-informed decisions:

> "[...] routinely, departments will reach out during registration to say they can open new sections and ask how many students would register, but we don't have a mechanism to proactively project the number of seats needed for a given course. A degree planner would help to see the seats needed for a given semester."

said Anne who is involved with advising. In this example, back-end users will need to make the most of the data they already have or generate new information, in order to refine their course schedule and better support their students.

Conclusions and recommendations

Students like Al and the others in our research rely on planning and scheduling tools to help them register for the right courses at the right time and stay on track to a degree. Technology providers have designed these tools intended to meet this purpose, and help students achieve their educational goals. And yet, research to-date shows that current advising, planning and scheduling products have not improved student progression and completion rates.

We undertook this study to understand why this might be the case. We hypothesized that these tools were not designed for today's students--particularly Black, Latinx, and low-income students who heavily rely upon them. We spoke to students from these groups to understand how they use these tools and what they say they need from them.

What we found confirms our hypothesis--and indicates that one possible explanation for the low impact of planning and scheduling tools is that they do not provide BLI/LI students with the information they need, nor do they reduce the complexity of the planning and registration process. In short, our findings indicate that these tools need substantial refinement in order to meet the needs of today's new-majority students.

Given these findings, we see a variety of opportunities for the technology provider and product design community to listen to students and improve their digital experience. We would argue that, given what we know, it is in fact our obligation to take students' voices seriously and act now on their feedback.

While some of our findings have implications for institutions, such as investment in professional learning for advisors or validation of the cross-functional business processes supported by the planning tools, our goal is to improve the suite of product features designed by vendors.

Specifically, there are five areas we would recommend vendors to consider and focus on when designing advising, planning and scheduling solutions:

1. Improve user experience

Students want software that is easy to use, intuitive, fast and have a consistent visual design, especially when they roam from one tool to another. Vendors should adopt UX design standards and allow for some level of interface customization to build a cohesive digital experience. They should also employ modern design techniques that include user testing to ensure tools are understood by learners. Low-Income students have also shown us that their access to technology can be limited. Vendors need to design their software for cross-platform compatibility and access (mobile, desktop, multi-browsers, etc).

2. Attention to language

Vendors should stop using jargon or generic language. We heard from students a long list of words they do not understand clearly. Product designers need to build product features such that the copy on screen, feature labels and terms are the ones used by the specific institutional partner licensing the product. To remove ambiguity, the software could have features to provide more context or resources for specific terms/names (like bubble tips, etc).

3. Surface new information

to inform decisions (holistically). Students have told us tools are not giving them all the information they need. Vendors will want to offer more functionalities for students to import/connect their personal schedules. They should also consider sourcing and integrating new information, like course ratings. New data should be presented in the user interface in a way that is intuitive to understand and timely to make the right decision.

4. Involve BLI/LI students

in product design. We validated our hypothesis by talking to BLI/LI students in this research. But these students should be an integral, ongoing part of the product design to make sure that vendors understand and address their needs. During development, vendors can engage in a co-design process with BLI/LI students and do user testing to verify their design. To further learn and refine, vendors could set up early access/beta phases to polish their solutions for planning and scheduling before mass-market adoption.

We recognize that, as shared by our advisors and back-end interviewees, these vendor improvements will need to be aligned with constraints at the colleges. Therefore, vendors should also think about how they intersect with colleges. We have 3 recommendations to make their products more usable in the open-access college context.

1. Data definitions

Ensure that the data elements being exchanged in and out of the system have a clear and consistent definition. Vendors need to provide detailed documentation and be transparent about what a data element means and how it is used to avoid discrepancies at the institution's ecosystem level.

2. Data integration

Align the data refresh process and cadence with the underlying business process. Students who are finalizing their semester degree plans are often using multiple systems which may need real-time data exchange to be accurate. It may involve more complexity to allow for real-time data exchange.

3. Professional services

Offer additional resources to support the institution's evolution of its planning/scheduling/advising software. Institutions are facing a shortage of resources - not only limited funding but also a shortage of qualified staff. Institutions are interested in add-on services from vendors to augment their staff and bring the expertise needed to improve their systems, business process and data flows.

The designers, developers, and operators of these planning, scheduling, and advising solutions have an important role to play, as well as new opportunities to ensure that the needs of the BLI/LI student population are better met.

Appendix A: Institutional partners profiles

INSTITUTION 1

Midwest Region

Regional 4yr Public

11,000 students

~25% minority students

~20% first-gen

Over **40%** Pell eligible

~40% part-time

~43% 6-yr grad rate

INSTITUTION 2

Northeast Region

Regional 4yr Public, Integrated in a large system

15,000 students

85% minority students

Over **50%** first-gen

~55% Pell-eligible

Over **35%** part-time

~53% 6-yr grad rate

Appendix B: Student process maps

AI

Gender Identity: Male
Ethnicity: Caucasian
Sexual Orientation: Heterosexual
Financial Status: Extreme Poverty

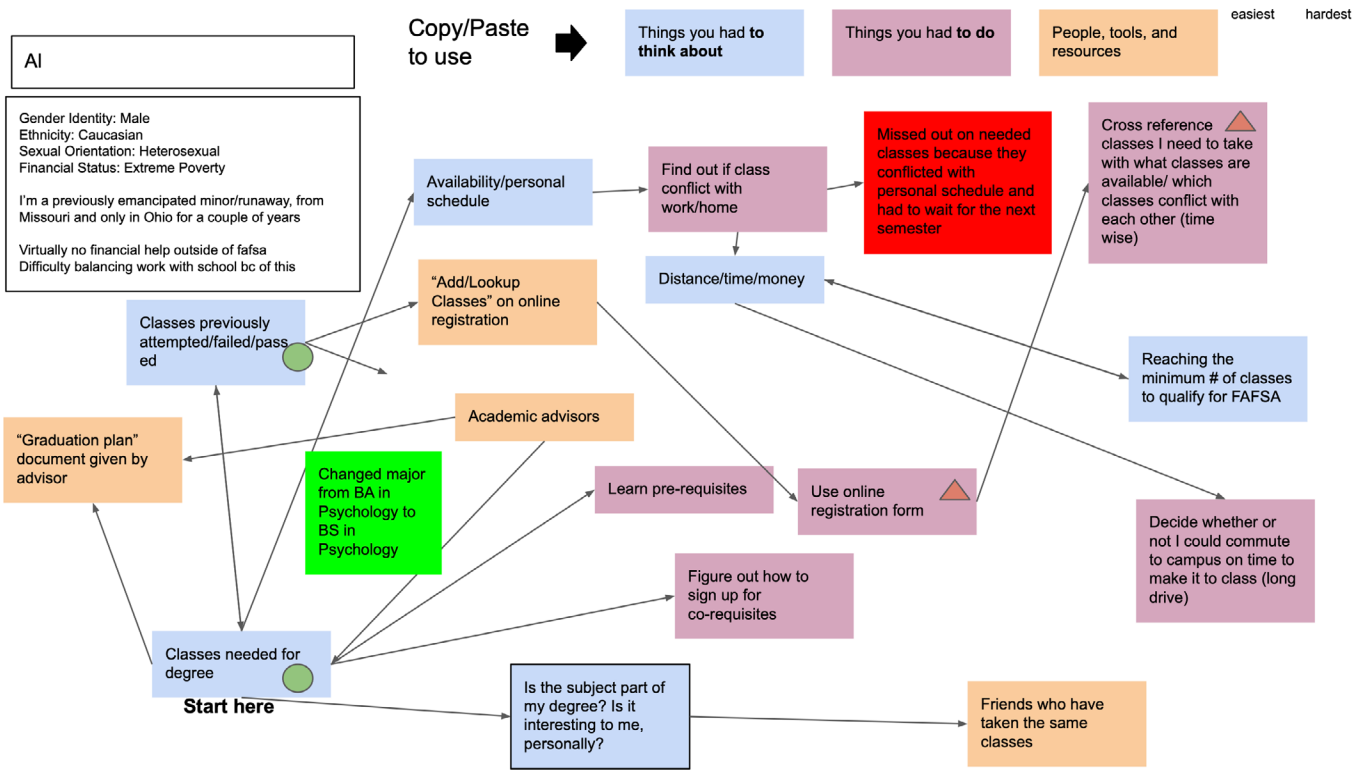
I'm a previously emancipated minor/runaway, from Missouri and only in Ohio for a couple of years

Virtually no financial help outside of FAFSA

Difficulty balancing work with school bc of this

Changed major from BA in Psychology to BS in Psychology

Here is how this student drew their map.



Appendix B: Student process maps

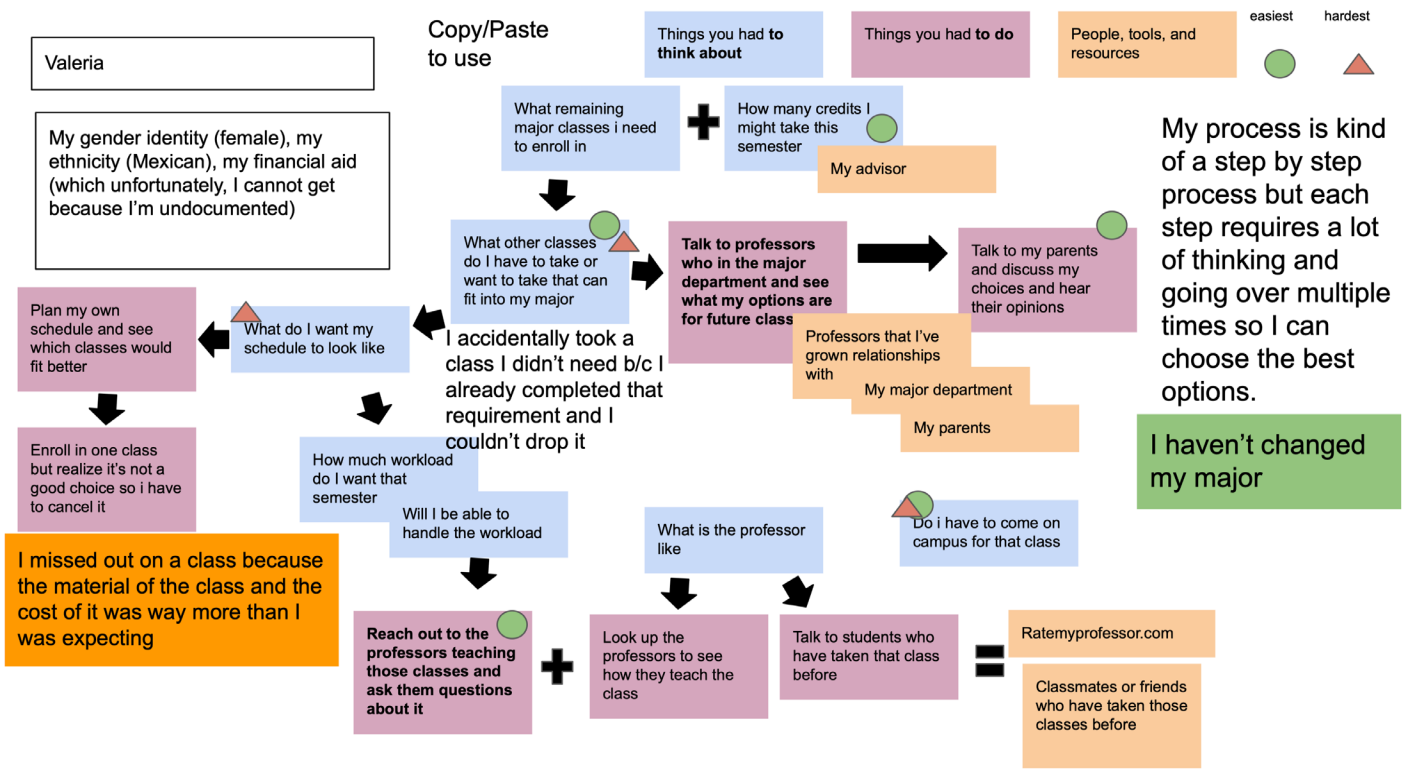
Valeria

Gender Identity: Female
Ethnicity: Mexican
Financial status: Financial aid (which unfortunately, I cannot get because I'm undocumented)

My process is kind of a step by step process but each step requires a lot of thinking and going over multiple times so I can choose the best options.

I haven't changed my major

Here is how this student drew their map.



Appendix B: Student process maps

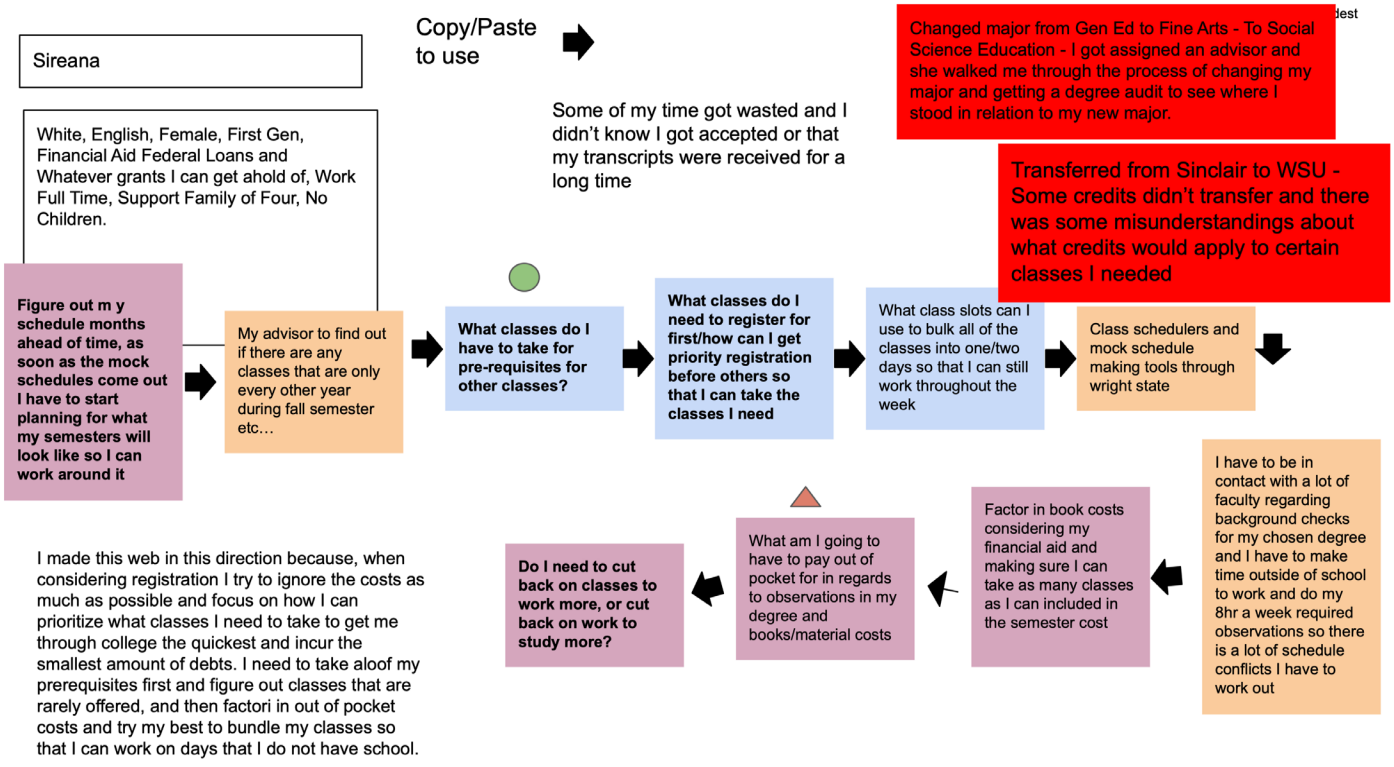
Sireana

Gender Identity: Female
Ethnicity: White / English/ First Gen
Financial aid Federal Loans and Whatever grants I can get ahold of, **Work** Full Time, **Support** Family of Four, No Children.

Some of my time got wasted and I didn't know I got accepted or that my transcripts were received for a long time

I made this web in this direction because, when considering registration I try to ignore the costs as much as possible and focus on how I can prioritize what classes I need to take to get me through college the quickest and incur the smallest amount of debts. I need to take aloof my prerequisites first and figure out classes that are rarely offered, and then factori in out of pocket costs and try my best to bundle my classes so that I can work on days that I do not have school.

Here is how this student drew their map.



Appendix C: Summarized student process map results

Things students had to think about AVG: **4.25**

Things students had to do AVG: **3.7**

People, Tools, & Resources students needed AVG: **3.8**

Things students had to think about	Things students had to do	People, Tools, & Resources students needed
Grad requirements	Make an appt with advisor	Course Catalog
Personal/Work Schedule	Create a chart	Degree Audit
Course Timing	Draw out a schedule	Advisor
Class Difficulty	Check emails	Friends
Modality	Look up time options	Schedule Planner
Instructor Quality (RMP)	Locate Degree Audit	Hand-made schedule
Course Load	Identify conflicts	Google Doc of classes
Aid/Payment/FAFSA/FT	Learn about pre-reqs	Registration
Commute time	Find alternatives if course not avail	My Boss
Pre-Req	Can I commute to campus in time	Dept chair - get permission
Relevant to my career path	Meet with dept for permission	RateMyProfessor
Credits Remaining	Register	Graduation Plan advisor gave me
Need Books?	Talk to classmates about profs	Transfer coach
Available seats?	Rearrange my work schedule	Pen/Paper
	Find Login information for diff tools	Chatbot

Appendix D: “Trouble” words

Corequisite

“There was this word that basically meant you had to take both classes and I didn’t understand that”

Prerequisite

Audit

Bursar

General education

Hybrid

Major courses

Not eligible

Writing intensive

Acronyms

BA, BS/MS

LAB

Asynchronous

Synchronous-online class

Matriculated

Requirement designation

Regular non-liberal arts

HEO

REF

RFP

Electives

Hold

Registrar