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Synthesizing personas and scenarios through participatory design to create support systems for academic success of nontraditional students in engineering

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Increasingly, nontraditional students are becoming a larger proportion of students in engineering and to better support their academic success it is essential to understand their experiences and expectations. This research paper presents the outcomes of a participatory design process conducted with nontraditional students in engineering (NTSE) to synthesize and distill different aspects of NTSE through the development of personas and scenarios. These personas and scenarios will allow stakeholders, such as faculty, advisors, and administration, to better understand how they can support these students. Based on prior preliminary research, a participatory design session (PDS) was held with seven nontraditional engineering student participants who shared their experiences related to support systems in the university. Through this process personas and scenarios were created that provide critical insights into the needs and experiences of non-traditional engineering students. These findings highlight specific areas where existing educational practices can be improved and provide actionable recommendations for enhancing support structures. This work contributes to the development of more inclusive and effective educational environments for nontraditional students in engineering.

KEYWORDS

nontraditional students in engineering, participatory design, personas, scenarios, stem education

1 Introduction

The landscape of engineering education has been evolving over the last few decades with a significant shift from wholly traditional classroom populations to an increasingly nontraditional student body. The [National Center for Education Statistics \(2015\)](#) found that between 1995 to 2012 more than 70 percent of all undergraduates had at least one nontraditional characteristic. Instead of entering college directly after high school and focusing solely on their studies, many students are faced with unique circumstances that present additional hurdles along their path to college graduation. These nontraditional students exhibit a variety of distinguishing characteristics including but not limited to having children, delayed enrollment, and/or a nonstandard high school diploma. Understanding and supporting these students is crucial not only to ensuring equal opportunities for success alongside traditional peers but also to leverage their varied experiences for the benefit of all. Addressing barriers to nontraditional students could lead to more effective educational strategies and improve retention and success rates

among this growing demographic within engineering programs. In particular, a better understanding of students' experiences and expectations, and their needs can assist higher education institutions with designing better support systems. To work towards this objective, the study presented in this paper was motivated by the following research question: *What are the current experiences of nontraditional students in engineering (NTSE) with university support systems?* In particular, in this study we focus on the needs, wants, and behaviors of nontraditional engineering undergraduates in relation to their interaction with faculty, advisors, and administration. We used a design thinking approach, specifically personas and scenarios uncovered using participatory design, to bridge the gap between theory, student needs, and design of support systems.

2 Background

2.1 Nontraditional students

There really is not a universally accepted definition of nontraditional student in the literature; therefore, this study based its definition of nontraditional students on the parameters outlined by the National Center for Education Statistics (NCES). [National Center for Education Statistics \(n.d.\)](#) defined nontraditional students as differing from traditional students in one or more of three categories: (1) enrollment patterns, (2) financial and family status, and (3) high school graduation status. The first category, enrollment patterns, refers to nontraditional students having either a delayed enrollment or part-time enrollment. The second category, financial and family status, refers to nontraditional students having financial independence, full-time employment while enrolled, dependents, and/or being single parents. The third category, high school graduation status, refers to nontraditional students receiving a nonstandard high school diploma. Altogether, these three categories encompass seven characteristics that can be applied when identifying a nontraditional student. If a student only exhibits one of the characteristics, they would be considered “minimally nontraditional.” Two or three characteristics would deem a student to be “moderately nontraditional,” while having four or more characteristics would classify them as “highly nontraditional” ([Horn, 1996](#)) ([Tables 1, 2](#)).

2.2 Personas and scenarios

To address the needs of non-traditional students, it is essential to employ methodologies that accurately capture and represent their

diverse experiences. Personas and scenarios are two such tools that have emerged from the human-centered design (HCD) and design thinking approaches ([Dahiya and Kumar, 2018](#); [Huynh et al., 2021](#); [Siricharoen, 2021](#)). Personas, which are detailed and semi-fictional representations of different user types, help in visualizing and understanding the various challenges faced by non-traditional students. Scenarios, on the other hand, provide context by depicting specific situations or challenges that a user might face.

[Cooper \(2004\)](#) defined a persona as a representation of actual users, not real people. These personas become the pretend users that are used throughout design processes. Personas have primarily been used to assist designers and programmers to focus on users' needs and requirements in product development ([Hisham, 2009](#)). Every persona has its goal, behaviors and attitudes ([Hisham, 2009](#)). Personas should feel recognizable and realistic. A complete persona typically includes a name, a photo, and a story ([Hisham, 2009](#)). [Cooper \(2004\)](#) emphasized the importance of basing the creation of personas and their goals on “initial investigation of the problem domain.” As [Guðjónsdóttir \(2010\)](#) stated, personas are meant to help us avoid our unconscious, individual biases and focus on the needs and desires of the intended users. As a design tool, personas have many benefits. They build empathy, bring focus, encourage consensus, create efficiency, and lead to better decisions ([Mulder and Yaar, 2007](#); [Hisham, 2009](#)). [Mulder and Yaar \(2007\)](#) outlined how personas enable help designers: Personas help designers walk in the users' shoes, which allows the designers to empathize as they interact with the persona. The personas help the designers define the target audience of the system/process/product so that they can focus efforts on a specific group of users. Personas identify the shared vision of their users' needs and help the designers to think about issues of users early in the process. Lastly, personas help the designers make decisions based on the users' actual needs. In summary, personas are fictitious characters that represent the needs and requirements of larger groups of users in terms of their goals and personal characteristics ([Cooper and Reimann, 2003](#); [Cooper, 1999](#); [Pruitt and Adlin, 2006](#); [Guðjónsdóttir, 2010](#)).

Scenarios, on the other hand, provide context by depicting specific situations or challenges that nontraditional students might encounter. In the context of personas, a scenario is usually a description of an activity in which the persona fulfills one of his/her goals by using a system being developed ([Cooper, 1999](#); [Pruitt and Adlin, 2006](#); [Guðjónsdóttir, 2010](#)). [Minichiello et al. \(2017\)](#) describes scenarios as “stories” of typical and significant user activities that help designers define specific product features that reflect a user focus. [Guðjónsdóttir \(2010\)](#) explains that scenarios can also be used to illustrate the present situation of the persona or a vision for the future. “Static” personas come to life when “inserted into the actions of the scenario” ([Nielsen, 2003](#); [Minichiello et al., 2017](#)). Scenarios complement the personas by illustrating in further detail how the persona's needs can be met ([Guðjónsdóttir, 2010](#)).

TABLE 1 Characteristics of Nontraditional Students.

7 Possible characteristics of nontraditional students	
Enrollment patterns	Delayed enrollment
	Part-time enrollment
Financial and family status	Financial independence
	Full-time employment
	Dependents
	Single-parent
High school graduation status	Nonstandard High School Diploma

TABLE 2 Levels of nontraditional characteristics.

Student level	Number of characteristics
Minimally nontraditional	1 NTS characteristic
Moderately nontraditional	2–3 NTS characteristics
Highly nontraditional	4 + NTS characteristics

Using personas and scenarios in tandem allows for a more nuanced approach to design and intervention, ensuring that stakeholders are able to intuitively recognize and empathize with student experiences. When “written around personas,” scenarios are more compelling because personas contain social and cultural information that help communicate the impact of proposed design features (Adlin and Pruitt, 2010; Minichiello et al., 2017). These days, both the use of personas and scenarios are common and accepted; designers may use persona and/or scenario design teams to focus on users (Minichiello et al., 2017).

2.3 Persona and scenarios for education design

Recently, STEM education scholars have started to integrate design thinking and specifically personas and scenarios across a range of activities such as design of learning technologies, curriculum development, and teaching (Fischer et al., 2011; Ozkan et al., 2019; Schmidt and Tawfik, 2022; Shé et al., 2022). For instance, Lilley et al. (2012) constructed and applied personas during the development of online learning experiences for undergraduates enrolled in a distance education computer science program and found personas to be important for understanding important pedagogical (e.g., normative peer feedback) and technological (e.g., mobile device access) needs of the distance learners in their program. Turns et al. (2015) examined the effects of disseminating engineering student personas to (a) engineering curriculum stakeholders and (b) graduate students preparing to teach an undergraduate chemical engineering course. They found personas to be flexible tools that were useful for prompting diverse audiences (e.g., teachers and students) to engage in a dialogue about their assumptions and reflect upon learning and teaching practices. Turns et al. (2015) also reported that access to “relevant,” contextually specific personas (e.g., related to student diversity, engagement, or self-regulated learning) was necessary when assisting teachers with course design and that persona development took substantial time and benefitted from a carefully considered methodological approach. Similarly, Minichiello et al. (2017) applied personas and scenarios to examine nontraditional students’ engagement and use of online forums and reported that the approach was useful. Finelli et al. (2014) and Pawley (2013) described use of personas to communicate research findings to engineering education administrators in order to promote change at higher institutional levels.

3 Method: participatory design

3.1 Participatory design

Participatory design, an approach that actively involves stakeholders in the design process, has proven to be highly effective in creating solutions that meet user needs. By engaging non-traditional students directly, participatory design helps ensure that their voices are heard and their perspectives are integrated into the final support outcomes. This approach not only enhances the relevance and usability of the solutions but also fosters a sense of ownership and empowerment among the students. In our research, participatory design is instrumental in identifying student experiences and

co-developing strategies that are impactful in addressing nontraditional student challenges. Participatory design (PD) is a user-centered design approach intended to allow the intended users of the systems under development to be deeply included in the design and development process (Bowen et al., 2020). This ensures that users’ needs, opinions, and attitudes to proposed technologies can be clearly understood and incorporated by the design team (Bowen et al., 2020). This way, the participants are actively involved in the process. Participatory design methods emphasize “creating conditions for stakeholders to participate in the design process regardless of their design skills or background” (Nicholas et al., 2012). According to Cabrero (2014), projects combining persona and participatory design tend to be “long-lasting, large-scale, western, resourceful ventures” with “extensive qualitative user-data and empirical research” developed personas. Grudin and Pruitt (2002) also reported the successful use of persona with participatory design methods and scenario-based design. Hisham (2009) implemented personas in a participatory focus group with older adults in Malaysia and explained the benefits of personas in “enhancing designers’ attention through narrative and storytelling.”

3.2 Overview of research

Minichiello and Jouffray (2018) developed a persona skeleton using ad-hoc data. They categorized student needs, wants, and behaviors, which inspired the research team working on this project to do something similar. To tie everything in with the team’s goal of understanding student experiences with university support systems, the researchers decided to focus on the NTSE’s needs, wants, and behaviors relative to feeling supported in the university setting.

The research team followed an intentional plan of data collection to understand the experiences of nontraditional students at the university. The student experience was studied through the analysis of various interviews and written feedback compiled by the researchers. The comprehensive list of data sources collected and analyzed throughout the course of this project is outlined in Table 3 below:

First, initial interviews were conducted with 12 undergraduate engineering students with nontraditional student characteristics. These initial interviews laid the groundwork for understanding the current climate for these students at the university. Then, for two semesters, the team collected a series of journal reflections from NTSE. The researchers inquired about the students’ interactions with support systems (faculty, advisor, classmates, peers, student support services, and campus events).

These responses were thematically coded to capture prevalent themes within the NTS engineering community. Subsequent follow-up interviews were scheduled with several participants from the journal reflection exercises. The goal of these follow-up interviews was to collect additional in-depth qualitative data. These responses were also coded to uncover themes.

The remaining data was collected during a participatory design session (PDS). The data was obtained through a focus group setting as well as small group breakout sessions. The procedures and methods pertaining to this portion of the data collection will be outlined in subsequent sections of this paper. Finally, draft personas were crafted by the research team by supplementing the outputs of the participatory design session with the previously collected data. The research team

TABLE 3 Data collected.

	Data Source	Description
Prior research	Initial Interviews	Interviews of 12 undergraduate engineering students with one to four NTS characteristics
	Journal Reflections	Written feedback collected weekly from NTSE students over the course of two semesters within one academic year
	Follow-up Interviews	Supplemental interviews conducted with several NTSE students selected from the pool of journal reflection participants
Current research	Participatory Design: Focus Group	Verbal feedback collected from a focus group of NTSE students within a participatory design session
	Participatory Design: Personas	Personas created by groups of NTSE students within a participatory design session
	Draft Personas	Participatory design session personas supplemented by data from previous data sources

utilized the various data sources such as previously collected journal reflections, interview transcripts, and findings from the participatory design session to triangulate the research and aim to answer the overall research question.

3.3 Participatory design

The research team hosted a participatory design session with the primary goal of developing NTSE personas with the help of actual NTSE. The team also wanted to obtain additional data to create realistic scenarios based on these personas to present to stakeholders. The previous data sources were used as background to gather the information needed to formulate the event's schedule and contents.

3.3.1 Recruitment and selection

The study targeted nontraditional students within the undergraduate engineering community at authors' university. In order to identify eligible participants, a recruitment email was sent to all undergraduate engineering students with an attached form asking the students to designate which of the seven nontraditional characteristics, if any, describe them. Students were also asked to provide basic identification such as name and major in addition to their availability for potential session dates in the upcoming weeks. Lastly, students were told about a financial incentive for their participation.

The research team reviewed the data collected via the recruitment email to compile a list of participants who should be asked to participate in the participatory design session. Subsequent emails were then sent out to these individuals asking them to confirm their ability to participate on the chosen date (i.e., the date that had the highest agreed upon availability across the participant pool). Once email confirmation was received, the team finalized the list of participants.

3.3.2 Event setup and layout

The research team arranged the session room to include desks in a U-shape for the students to sit comfortably while listening to presentations. Additionally, three smaller workstations were added for use by participants when breaking into smaller groups. Multiple recording devices were set up during the session and recorded all large group discussions excluding the breakout sessions (Figures 1, 2).

3.3.3 Materials preparation

In advance of the session, the research team prepared a slide deck presentation. In line with the team's goals, the session was sectioned into three parts: introduction of foundational research, persona development, and scenario development. The pre-prepared slide deck was developed with these sections in mind to help with pacing during

the session. The presentation contained information explaining the basis of the research, its importance, and previous findings. It also outlined the framework of this project and contained slides that prompted participants to discuss their own experiences with the group.

Draft personas were also prepared prior to the session for use by the participants while in their breakout groups. Each draft persona was presented on a large easel pad and contained an artificially generated image representing the persona, nontraditional student characteristics, and a large area for participants to fill in the needs, wants, and behaviors of their given persona. A short description was provided next to the needs, wants, and behaviors labels to clarify the type of information that should be included under each of the terms. Two extra copies of each draft persona were made as backup in case they were needed during the session.

The definitions provided to the participants for each of the terms on the persona template were as follows:

- 1 Description: short background story giving context to the persona – what their goals, characteristics, and needs are to pursue an engineering degree.
- 2 Needs: requirements necessary for the students to complete their engineering degrees.
- 3 Wants: things the students would like to see at the university to help them succeed in their pursuit of an engineering degree.
- 4 Behaviors: the way the students act in pursuit of their degrees.

3.3.4 Persona template creation

Utilizing the finalized participant list, the research team analyzed the nontraditional characteristics of each of the available students. Each student was then sorted into one of three groups with other students who exhibited similar characteristics. The first group was highly nontraditional and consisted of financially independent mothers who had delayed enrollment. The second group was moderately nontraditional and consisted of individuals who have financial independence and work full-time. The third group was minimally nontraditional and contained financially independent students. The groups served as the basis for draft persona templates that were provided to the groups during the persona development break-out time within the participatory design session. The goal was to present each group with a template each member could relate to and easily generate applicable attributes/experiences. An illustration of one of the draft persona templates can be seen below (Figure 3):

The persona templates were displayed on large pieces of paper (25" x 30"). Smaller pads of paper and writing utensils were provided to the students for use during the session.



FIGURE 1
Participatory design session layout.



FIGURE 2
Breakout session workstation.

3.3.5 Event schedule

The participatory design session was structured as follows (Figure 4):

The session began with an introduction by the entire research team and the signing of IRB consent forms by all session participants. The team leader then reviewed background research related to the study. Next, the concept of personas as applied in research was discussed in order to prime session participants with the information required to produce the desired primary output of the session: NTSE personas. Participants were then broken out into their predetermined groups and asked to fill in a persona template. At the end of the break-out session, students rejoined the larger group and shared their findings. After a short break, students returned for a briefing on scenario development in research. They then participated in a scenario development activity as a group. The session concluded with time for questions and final remarks before the students were dismissed.

3.3.6 Persona development breakout session

The main focus of the session was the persona development breakout session. The team began by explaining what personas are, how they could be used to help NTSE, and the role the participants

would play during the session to further develop the draft personas. The participants were then told they would be breaking out into smaller groups for the remainder of the activity.

For the breakout session, the participants split into three groups. Each group was presented with a persona template that corresponded to their group's shared nontraditional student characteristics. The group members worked together to fill out four sections of the template: description, needs, wants, and behaviors. Each group was provided with sticky notes and writing utensils. They brainstormed ideas on the sticky notes and stuck them under the appropriate sections on the template. Once they were done generating ideas, they grouped similar ideas by moving similar notes close together. At the end of the breakout activity, each group presented their findings to the other groups and research team, which led to subsequent follow-up questions and discussion.

3.3.7 Scenario development group discussion

The final portion of the session consisted of scenario development. In vein with the previous activity, the team presented conceptual background and explained what scenarios are and why they are important. Instead of breaking up into smaller groups, questions were discussed as a single large group. One of the researchers posed a series of questions related to student experience with faculty, advisors, and administration. The students were prompted to share positive as well as negative experiences under each of these categories. Participants were given a few minutes to write down their individual responses and then elaborate verbally. Students who shared with the group at large were prompted for clarity by the research team. For many questions, elaboration by one student would cause other students to share additional information.

3.4 Participatory design participants

There were seven participants in total who attended the participatory design session (Table 4).

4 Data analysis

The primary data analyzed for this study was gathered during the participatory design session. Student feedback throughout the session was recorded, transcribed, and later analyzed to develop themes. In the session, students worked together to develop personas to reflect their experiences in a way that could be presented to stakeholders to foster understanding and further support. The responses that were collected during the scenario development portion of the session were merged with secondary data sources to develop finalized scenarios to support the personas when presented to stakeholders (Figure 5).

4.1 Analysis of participatory design session data

The participatory design session was recorded on a primary device and a secondary back-up device. Following the session, transcriptions were made from the audio captured in the recordings. Once the transcriptions were finished, the research team applied

- Behaviors:** the way the students act in pursuit of their degrees

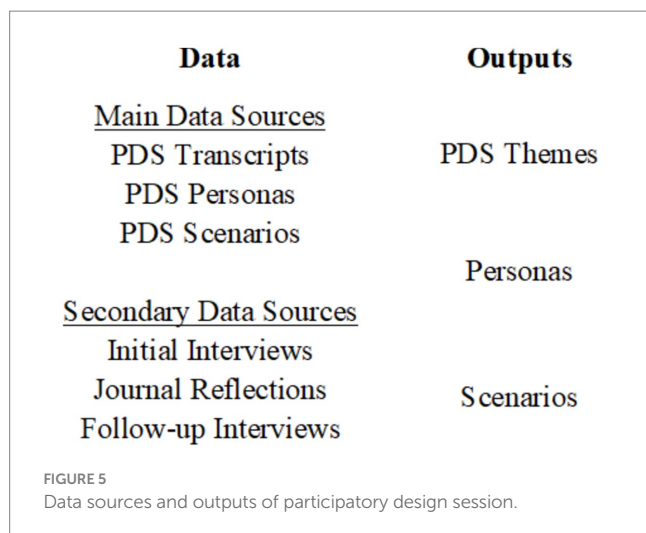
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graph LR
    A[Introductions / IRB Consent] --> B[Background on Research Study]
    B --> C[Introduce Personas]
    C --> D[Breakout Session]
    D --> E[Findings Presentations]
    E --> F[Scenarios]
    F --> G[Final Remarks / Thanks]
  
```

TABLE 4 Participatory design session—list of participants and their NTS characteristics.

Participant	Number of NTS characteristics	NTS characteristics
1	3	Delayed enrollment, financial independence, full-time employment
2	2	Full-time employment, financial independence
3	1	Financial independence
4	4	Delayed enrollment, financial independence, dependents, single parent
5	1	Full-time employment
6	3	Delayed enrollment (12 years), financial independence, dependents
7	1	Financial independence

The persona analysis was conducted by the students who participated in the participatory design session. The group members worked together to generate descriptions, needs, wants, and behaviors for their assigned template persona in relation to their own experiences. The students analyzed the generated ideas by grouping



the single ideas together based on common themes. They used the themes to construct the finalized personas.

4.3 Analysis of scenario data

Thematic analysis was utilized to examine the qualitative data collected from the scenario development activity in the participatory design session. The research team began by transcribing the participant's responses that had been written on individual sticky notes. Initial codes, brief descriptive phrases, were then assigned to each of the individual recorded responses. The purpose of these initial codes was to identify distinct elements of the data that could be grouped together based on commonalities. After the codes were sorted according to their similar characteristics, the groupings were labeled with higher level codes. These secondary codes allowed the team to identify the prevailing subthemes within the data, ultimately leading to the formation of overall themes. The themes were then incorporated into illustrative scenarios for presentation to stakeholders.

In addition to the identified themes, scenarios were developed with the assistance of previous data sources (follow-up interviews and journal reflections). The team first drafted an outline using the themes that were found to tell a representative story of the NTSE experience. Interactions between students and the three main stakeholders – faculty, advisor, and administration – were the focus of these scenarios.

Once the team had finished drafting the scenarios, they were emailed to the participants from the participatory design session to get their feedback. The students were asked to fill out a form evaluating the scenario that related to their associated persona. They had the option to rank the scenario on a scale of 1 to 5 and then comment additional feedback. The resulting finalized scenarios are included in Section 4.2 below.

5 Findings

5.1 Themes from participatory design

This study identified potential opportunities for the support of nontraditional students in the undergraduate engineering community

at universities. Support, or lack of support, can come from various sources. This study focused on areas related to faculty, advisor, and administrative contact with the students and how these interactions lead to both positive and negative outcomes.

Throughout the initial stages of data collection and the participatory design session, faculty impact emerged as a prevalent theme. Students shared positive interactions in which professors understood their unique needs as nontraditional scholars and made accommodations to alleviate stress and facilitate learning. One student shared a story about missing a paper deadline due to personal circumstances. This student was extremely worried about the impact on her grade and emailed the professor to explain the situation and plead for an extension. The professor was sympathetic to her situation and worked with her to accept the late submission. In reflecting on the experience, the student said, "It was just the kindest response I've ever gotten for being so stressed out." This example is one of many that illustrate how an empathetic approach from a member of faculty helped students to feel supported.

Conversely, students shared how they can be negatively impacted by faculty interaction. They talked about instances when professors called attention to personal shortcomings in front of their classmates, discouraged them in their studies, or did not exert any effort to help them. The students also talked about struggling to access office hours due to professors having restricted open hours and appointment-only policies.

One common sentiment expressed by all the female participants in the participatory design session was gender bias exhibited by male professors toward female students. One student said, "I was in office hours. I had a question, I got insulted... I'm seeing that it's not happening to any of the guys." Another described reaching out to a professor via email to ask for clarification on a topic covered in class. In reflecting on the experience, the student said, "he thought I did not understand the concept at all. Meanwhile I had already given him all of the details. The way he behaves with the male students in our class, I feel as though if someone else had asked that question, he would have gone a little further in depth and assumed that they understood." Every female participant believed they have received different treatment than their male counterparts, and oftentimes the interactions have negative outcomes.

Regarding administrative interactions, student feedback was overwhelmingly positive. Almost all had utilized on campus math tutoring services and thought that this resource was both beneficial for their studies and a productive way to meet other students. One student was particularly positive about this form of support in relation to his delayed enrolment stating that math tutoring helped him refresh concepts he had long forgotten.

Several students also regularly use accessibility services for test-taking accommodations and supplemental academic resources. The individuals who have used these services were grateful for this form of support. They were especially appreciative when faculty members worked with them to coordinate the exchange of materials between the classroom and accessibility services.

When discussing advisor interactions, students had mixed feedback. Some were very positive about their experiences saying their advisors' knowledge and guidance were invaluable assets in building their class schedules. All the students prioritized timely graduation and especially appreciated it when their advisors were able to help them create 4-year plans to reach their graduation goals. Conversely,

students were frustrated when their advisors gave them incorrect information that jeopardized their ability to pursue their planned graduation timelines. Moreover, some students believed mandatory advisement meetings are a burden and expressed a preference for email communications with their advisors.

A theme that was found across students from all nontraditional areas was time management. Nontraditional students highly value time management as a method for balancing their schoolwork with their various extracurricular responsibilities. One student shared, “It’s hard because a lot of times I leave school, I go to work, I get home at like 5 a.m., I sleep till noon, and then I have school. So it can make it hard to leave time for study or time for myself.” In support of this point, another student said, “I’m financially independent and the impact is definitely noticeable because I definitely have to plan more for time management things, especially with the high level of commitment engineering is. I really have to balance my time with how I work.”

5.2 Personas

The primary outputs of the participatory design session were three fully developed personas: Lucy May, Kate West, and Josh Tall. Students were separated into groups according to their nontraditional characteristics. Each of the groups was assigned to work on a draft persona whose NTS characteristics aligned with the group members’ NTS characteristics. They were asked to develop descriptions for their assigned persona as well as details regarding their needs, wants, and behaviors. The results of this portion of the session are shown below:

5.2.1 Persona 1—Lucy May

Group 1 was assigned Lucy May, a financially independent mother with delayed enrollment. This group described Lucy as a mother of two children, pursuing an engineering degree, with a high grade-point average, and a long daily commute. They discussed her needs for organization, study time, childcare, and financial support. They said she wants access to study spaces, office hours, tutoring, daycare, and community. The group believed Lucy would have established priorities and seek support services when needed (Figure 6).

5.2.2 Persona 2—Kate West

Group 2 was assigned Kate West, a financially independent student with a full-time job. The group described Kate as being hardworking, prioritizing her responsibilities, and having minimal personal support. They said she requires support at school, adequate rest, and financial resources. Kate is said to want flexibility in her class options, academic support, and access to scholarships. Lastly, the group said Kate stays organized while being rushed between classes and work (Figure 7).

5.2.3 Persona 3—Josh Tall

Group 3 was assigned Josh Tall, a financially independent student. Josh was described as a relatively young nontraditional student who is involved on-campus and works part-time. They described Josh as needing financial support, strong support systems, and an adaptable schedule. The group said Josh’s wants include scheduling options, financial information, and career-oriented development. Josh was said to pursue development opportunities, access support, and work hard while still making time to connect with his peers (Figure 8).

5.3 Scenarios

The research team drafted three scenarios, one for each persona, using the information the participants shared during the participatory design session. This data was supplemented by the initial data sources (journal reflections and follow-up interviews) used in the preparation for the session (Figure 9).

The goal was to highlight the three primary interactions with university support systems (i.e., the interaction between students/faculty, students/advisors, and students/administration) to illustrate students’ identity as well as needs, wants, and behaviors to stakeholders. The scenarios are meant to be read as “A day in the life of...” each of the developed personas. The scenarios were set in the middle of the academic semester, during exam time and scheduling season, to illustrate the support interactions in context.

5.3.1 A day in the life of Lucy May

Lucy wakes up to her alarm at 5:30 a.m., feeling tired after another late night studying for an exam she has later this week. She prepares breakfast and packs lunch for her son Lucas. Lucas has a stomachache this morning and is taking longer than usual to finish his food. Lucy must take extra time to ensure he is okay before leaving, making her 10 min late to her first class of the day. As she walks into the classroom, her professor rolls his eyes and makes a comment to the class about how he is going to start taking points off of their grades for tardiness and missed attendance. Lucy feels disheartened because she needs to do well in this class and is worried about how her tardiness might affect her grade.

In her second class, Lucy struggles to keep up with the lecture, feeling overwhelmed by the material. The professor notices her struggling and stops her after class, taking an extra 15 min to explain some of the topics she was confused about. Lucy thanks the professor for helping her gain a more solid understanding of the concepts, then she rushes to the accessibility support office during her short break between classes to arrange accommodations for her upcoming exam. Even though she was supposed to schedule the testing room several days ago, the office assistant understands the situation and helps her get the test scheduled anyway.

Since registration will begin next week, Lucy is relieved that she scheduled a meeting with her advisor for this afternoon. During her advising appointment, her advisor helps her review her four-year plan, making sure that she is still on track to graduate as soon as possible. When the meeting is over, Lucy rushes to pick Lucas up from daycare before it closes. On the drive home, she thinks about how she overheard some resident students talking about an on-campus event happening tomorrow night. She wishes that she had time to attend and get involved on campus. She also wishes that she had a better way to connect with other students who could relate to her situation.

When she gets home, Lucy starts a load of laundry, unloads the dishwasher, and starts preparing dinner. She spends time playing with Lucas and reads him a story before getting him into bed for the night. Once she knows her son is settled, Lucy begins completing homework assignments and studying for her upcoming exam. Despite feeling exhausted, she’s determined to stay on top of her studies and succeed in her classes. Around 1 a.m., Lucy finishes her work for the night, but before bed she makes sure to check her emails, not wanting to miss any important information. As she drifts off to sleep, Lucy reflects on the challenges and triumphs of her day. Despite the obstacles she faces as a non-traditional engineering student, she remains committed to pursuing a better life for herself and Lucas.

Name: Lucy May

NTS Characteristics

- Delayed Enrollment
- Financially Independent
- Have Dependents



photo generated by hotpot.ai

Description

- Has 1 infant and 1 preschooler
- Pursuing an engineering degree and trying to graduate in 4 years (as a full-time student to be done sooner)
- 3.5 GPA
- 45 minutes commute time due to children's schedules

Needs

- To be organized
- Have study time
- Childcare and financial support
 - Being able to attend classes or study without family system available at any hour of the day
 - Financial support for this care with multiple children needing watched & transported to/from their school
- Have to have a set schedule with study time available to be successful in life and in classes

Wants

- Library open or study space available past 5pm with child play area (ex: room in library)
- Flexible office hours that do not interfere with other class times
- Tutoring available later/keep online tutoring
- Flexible emergency daycare if child's regular daycare closes, have option to use daycare services on campus
- Nontraditional students community

Behaviors

- Highly motivated with high level of seriousness and clear sense of priority
 - Other people are depending on you
 - Understands a career in the "real world"
 - Has bills to pay
- Organized and on-time
 - Has a planner that's color-coded for studying/classes
 - Has another planner for life/bills schedule
- Asks for help and accepts support
- Takes advantage of services offered

FIGURE 6
Persona 1: Lucy May.

5.3.2 A day in the life of Kate West

Kate's alarm goes off at noon, interrupting her few hours of sleep after working a double shift last night. She groggily gets ready and drags herself to her afternoon classes. During class, her mind wanders as she struggles to focus and take notes. Kate reflects on her packed schedule, feeling overwhelmed by the constant cycle of work, then

school, then homework, then maybe some sleep. With a deep sigh, she wonders how long she can sustain this lifestyle. She wishes she had more time and energy left to participate in extracurricular activities or to make some friends in her program. If only there was some sort of community of students who could relate to her situation, commiserate with her, and offer encouragement. She thinks about her

Name: Kate West

NTS Characteristics

- Full-Time Job
- Financially Independent



Description

- Minimal family/friend support
- Want to graduating debt-free
- Hard-working
- Good time-management skills
- Consistently prioritizing responsibilities over wants
- Multitasking

Needs

- School support
- Emotional & mental support
- Professors who are willing to help
- Hybrid classes/online videos
- Time to take care of herself
- Decent amount of sleep
- Money (loans, grants, scholarships)

Wants

- More opportunities to meet fellow classmates
- More class options (at different times)
- More scholarship opportunities for nontraditional students
- Tutoring hours (MAC) to extend into the evenings
- Time for herself & time to breathe
- Nontraditional student community
 - Organization to meet other students

Behaviors

- Hoping to pass all her classes by doing work as much as possible
- Doing schoolwork during work, relax time, and all available free time
- Responsible
 - By limiting time with friends and fun activities
- She is rushed from going from class to meetings straight to work, then homework, then to sleep
- Organized
 - Make folders for all classes on computer to keep track of assignments, download videos and save previous exams, assignments, homework
 - Takes nice notes in class

FIGURE 7
Persona 2: Kate West.

advising appointment scheduled after this class and is worried about trying to fit her classes around her work schedule.

At her advisement meeting, Kate's advisor recommends that she retake the math placement exam to potentially test out of some prerequisite classes. Kate is grateful for this guidance because it will help her save valuable time and money while keeping her on track to

graduate. After advisement, Kate stops by her math professor's office hours. The professor has his office door closed and says he does not have time to help, so Kate seeks help at the math tutoring center where she receives guidance on some homework problems she could not understand. She really appreciates the time the tutor takes to answer her questions and help her work through her problems.

Name: Josh Tall

NTS Characteristics

- Financial Independence



photo generated by helipet.ai

Description

- Recent high school graduate
- 1st year engineering student in college
- 18-19 years old
- Need to maintain financial stability
- Trying to gather friends in similar groups
- Finish in 4 years
- Maintain mental health & stability
 - Get involved in groups or activities to destress
- Part-time job on-campus

Needs

- Financial support and knowledge of aid
- Strong support systems personally & professionally
 - To help manage working and studying
- Good working relationship with faculty/classmates/campus groups
- Robust & adaptable school schedule

Wants

- Better scheduling options/flexibility for classes & work
- Financial support seminars & access to institutions that offer support
- Built-in co-ops/internships
- Resume building & professional development
- Better sense of understanding or empathy from faculty
- As many grants or scholarships as possible

Behaviors

- Going to office hours
- Building peer relationships
- Seeking out academic development support
- Attending career fairs/professional development
- Sits in the front of the class and is very attentive during/after class
- Is hardworking and always studying
- Is tired
- Building social community with peers (group chats)

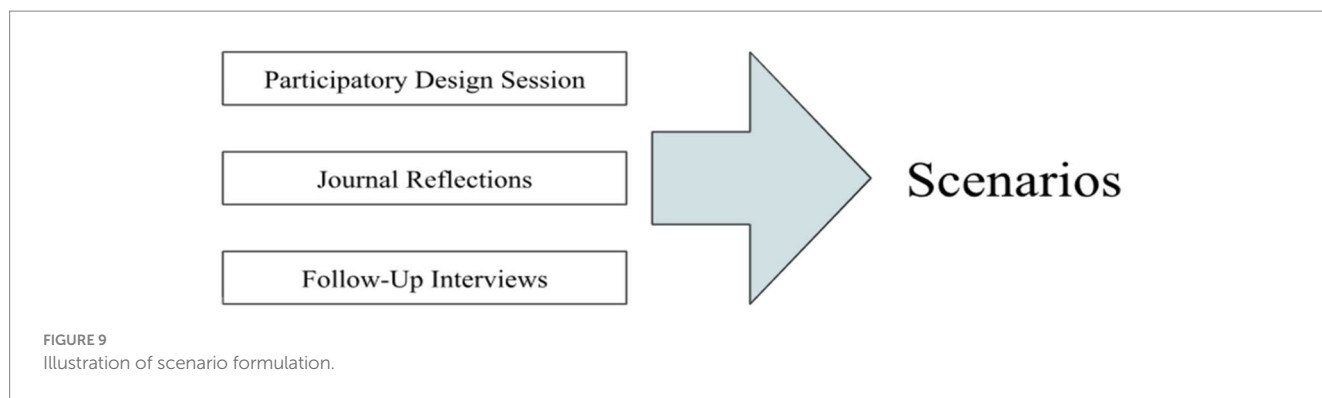
FIGURE 8
Persona 3: Josh Tall.

After a few hours at the tutoring center, Kate rushes home to have dinner before heading back to work for another 12-h shift. While eating, she opens her laptop and tries to search for scholarships to alleviate her financial burden. However, she feels lost and unsure where to begin, overwhelmed by not knowing what resources are available. Kate then checks her student portal and winces at the sight of several accumulated late fees. She was not able to pay off her total bill for the semester yet and is stressed about the growing financial

burden. Even though she is worried about how she will cover her costs, Kate feels determined to finish her degree, graduate debt-free, and start a career as an engineer.

5.3.3 A day in the life of Josh Tall

Josh wakes up early and gets ready for the day ahead. Arriving at his first class, Josh's heart sinks as he realizes he mixed up the due date of an important assignment. Panicking, he approaches the professor,



who thankfully understands his honest mistake and extends the submission period by 1 day. During his lunch break, Josh heads to the gym to join his club basketball team. He really enjoys connecting with other students and getting to de-stress through physical activity.

Josh then gets ready for his advising appointment. He frustratedly recalls when his freshman advisor misinformed him about a pre-requisite class and jeopardized his four-year graduation plan. Josh is thankful that his new advisor has a good understanding of the courses he needs to take to graduate on time, and he feels more confident about registering for the right classes next week. After meeting with his advisor, Josh goes to his on-campus job. He appreciates the job because it includes a scholarship for on-campus housing. Without the job, he is not sure where he would be living. His minimal income makes it very hard to afford rent in the area and though he applies for as many scholarships as possible, it is still challenging to be financially independent.

Shaking his head, Josh remembers when he first started college and how he thought he could maintain a full-time job while being a full-time engineering student. Very quickly, he realized that he was in over his head. His grades were suffering, and he was struggling with his mental health. He made the difficult decision to reduce his work hours and dropped to part-time to preserve his mental health.

When he gets off work, Josh grabs dinner at the dining hall and gets some studying done at the library with his friends. Before bed, Josh reflects on the challenges he has overcome and his resilience during his years in college. Sometimes he struggles with the comparisons between himself and other students who have more resources. He is nervous about seeking an internship and wishes there were programs that would help pair him up with a company. Regardless, Josh is excited for his remaining time in school and looks forward to graduating with his degree.

6 Discussion

This study aimed to answer the research question: What are the experiences of nontraditional students in engineering (NTSE) with university support systems? The goal was to understand the current student experience in order to identify areas that require additional support. The findings provide details of how NTSE interact with and perceive these support systems, highlighting their personal challenges and needs. The results also corroborate and expand upon existing research regarding nontraditional students (Brozina et al., 2023; Brozina and Johri, 2022). As previously noted, nontraditional

students differ from their traditional counterparts in several key ways, including their enrollment patterns, financial needs, and family responsibilities. By implementing personas and scenarios, the research team was able to represent these differences concretely and examine how they affect students. This approach aligned with the literature's emphasis on the utility of these tools in capturing diverse user experiences and needs.

Participatory design emerged as a particularly effective method for engaging NTSE. By involving these students directly in the design process, the team was able to gather valuable input on the students' experiences and challenges. This high level of engagement not only validated the theoretical benefits of participatory design but also provided actionable insights into how support systems can be improved to better serve NTSE.

The personas and scenarios that were developed using data collected during the participatory design session were instrumental in illustrating the unique circumstances that NTSE face. These tools allowed the researchers to create realistic profiles and representative situations that capture the complexity of NTSE experiences. For example, the scenarios highlighted challenges such as balancing academic responsibilities with work or family obligations. This detailed understanding underscores the literature's focus on the importance of empathy and user-centered design in developing effective support systems.

The insights from this study have practical implications for university faculty, advisors, and administrators. For example, administration could consider offering more flexible class schedules and allocating funds to develop resources specifically for those balancing work, family, and education. Advisors could take note of nontraditional students' sensitivity to time management and ensure timely graduation is a top priority when creating course schedules. Faculty could endeavor to apply a more empathetic approach in their instruction, taking the time to account for the unique life events that affect their students outside of the classroom.

6.1 Limitations

The main limitation in this project was the nontraditional student characteristics that were studied. The seven possible measures of a nontraditional student are: delayed enrollment, part-time enrollment, financial independence, full-time employment while enrolled, having dependents, single parenthood, and/or having a nonstandard high school diploma. The issue arose in comparing students who did not possess the same set of nontraditional markers. In the participatory design session, this complication was especially evident as the students worked to relate to their assigned personas. Some of the students could closely relate to the

characteristics of their persona while other students only had one characteristic in common. For example, the group assigned the persona of Lucy May (financially independent mother with delayed enrollment), consisted of two financially independent mothers with delayed enrollment, but one individual is a single parent while the other is married.

Another limitation in the participatory design session was the ratio of male to female participants. Out of the seven participants in attendance, only two of the students were male. As significant differences were observed in the shared experiences of male versus female students, it may have been beneficial to have more individuals speaking from the male perspective.

7 Conclusion

This paper aims to provide an understanding of the experiences of nontraditional students in engineering. By integrating personas, scenarios, and participatory design, the research team has worked toward gaining a clearer view of the specific challenges nontraditional students in engineering face and how current support systems can be improved. The positive feedback and high level of engagement from students during the participatory design sessions affirm the effectiveness of this approach and its potential for creating meaningful, user-centered solutions in the future. Moving forward, it would be beneficial for faculty, advisors, and administrations to apply these insights to develop more inclusive and effective support systems. By doing so, they can better meet the needs of nontraditional students, ultimately enhancing their academic success and overall experience in school.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Youngstown State University IRB. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

CB: Conceptualization, Formal analysis, Funding acquisition, Methodology, Project administration, Resources, Supervision, Validation, Writing – original draft, Writing – review & editing. AC: Data curation, Formal analysis, Investigation, Methodology,

Visualization, Writing – original draft. SB: Formal analysis, Methodology, Writing – original draft. AJ: Funding acquisition, Investigation, Methodology, Supervision, Validation, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The authors declare that Gen AI was used in the creation of this manuscript. Hotpot was used to create the pictures of the 3 personas.

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