The Value of Participating in the Grand Challenges Scholars Program: Students' Perceptions Across Three Years

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Abstract

This work seeks to understand students' perceived value of their participation in a multi-year co-curricular program, the Grand Challenges Scholars Program (GCSP), at Arizona State University (ASU) and explore how these perceptions vary between students at different class levels. Students in the GCSP engage in multidisciplinary, entrepreneurial, multicultural, research, and service learning activities throughout their undergraduate collegiate career, in order to gain diverse perspectives about global challenges related to a Grand Challenges theme (Health, Joy of Living, Security or Sustainability). At ASU, GCSP students are also encouraged to connect with their peers, faculty, and staff in the GCSP community through events and courses. There is interest in learning more about why students engage in the program, and what keeps them motivated to continue the program throughout their entire academic career to graduate as a Grand Challenges Scholar. According to Eccles' Expectancy Value Theory, people are motivated to participate in and persist in a program or activity by a combination of their expectations for success and their perceived value of the activity or program (subjective task value). Motivated by this belief that students will participate and persist in programs or tasks that they believe bring value to them, a brief digital whiteboard activity was integrated into first, second, and third year GCSP courses to ask students about their perceived value of GCSP. The data collected from the digital white board activities is analyzed qualitatively using thematic analysis. Resulting themes are reported and also compared between student class levels. Results indicate that the perceived usefulness of participation in the program and becoming a Grand Challenges Scholar (utility value), motivation and access to participate in research and other extracurricular activities to achieve their personal goals, connections with members of the GCSP community, faculty, and industry professionals, and developing multidisciplinary global perspectives are common themes of students' perceived value of GCSP. Implications of this work and findings related to students' perceived value and success in multidisciplinary multi-year co-curricular programs such as the GCSP will also be discussed.

Introduction and Motivation

Undergraduate engineering students face many options in their education today, all of which can shape their academic pathway and influence their persistence in their degree program and future career plans [1]. But what is it that motivates or influences a student to decide to participate in one program or activity versus another? And what influences a student's decision to continue to engage (or not) in that program or activity? Several studies have been conducted to assess the impact of students' participation in various types of activities outside of the classroom on students' skill development, professional development, identity formation, and professional success [2-5]. Although these studies provide valuable information about the impact of

participation in extracurricular and co-curricular activities on student learning and development, there is interest in learning more about what motivates students to participate in these activities. Learning more about what motivates students to continue and persist in an activity outside of the classroom is particularly important for multi-year co-curricular programs, which often face challenges with sustained engagement.

This work is focused on understanding why students continue to engage in a specific multi-year co-curricular program, the Grand Challenges Scholars Program (GCSP). The GCSP is a program designed to enhance undergraduate engineering students' skillset and broaden their mindset to prepare them to create value for society through addressing global challenges. In this program, each student develops a unique portfolio of courses and experiences to achieve five competencies or outcomes upon graduation: Talent (research/creative project experience), Multidisciplinary (interdisciplinary perspective), Viable Business/Entrepreneurship (entrepreneurial mindset), Multicultural (global perspective, multicultural awareness), and Social Consciousness (service learning experience). Each student chooses the courses and/or experiences they want to pursue to achieve those outcomes focused on a Grand Challenges theme (i.e. Health, Security, Sustainability, or Joy of Living) or specific Grand Challenges, in accordance with the requirements of their institution's GCSP. There are currently approximately 100 universities around the world with an established GCSP, each with its own specific requirements and structure to support students in achieving the five competencies[6, 7]. The specific courses and experiences students pursue towards achieving the five program competencies, when they complete them, and in what order they complete them varies between individual students and across institutions. Each GCSP aims to support students' personalized journeys and progress towards achieving the program outcomes, but the level of support and ways in which the program engages students varies between institutions. The engagement opportunities and support provided to GCSP students at each institution may include community events, GCSP-specific courses, various forms of mentorship, funding for research or travel, organized service trips, a GCSP specific advisor, or others[6, 8, 9]. At Arizona State University (ASU), students participate in GCSP specific courses to support their progress in the program, through which they receive mentorship from GCSP faculty Directors. To support students and encourage them to build a supportive peer community, ASU's GCSP provides opportunities for funding to support travel and research, and hosts several community events each year with opportunities for students to connect with their peers, faculty, staff, and alumni. After several years of GCSP implementation at ASU, there is interest in learning more about what influences students' motivation and persistence in this program.

Understanding students' motivation has been the focus of several engineering education research studies, though the studies typically focus on students' motivation to pursue an engineering degree and/or persist in an engineering degree program [10]. According to Eccles' expectancy value theory, students' motivation to participate in and persist in a program/activity is influenced by both their perceived value of the program/activity (subjective task value) and their

expectancies for success. Subjective task values incentivize individuals to engage in tasks and/or activities due to their alignment with the individual's personal values, goals, and needs [10-12]. Eccles defines four categories of subjective task values: Attainment value (consistency with sense of self), Interest value (enjoyment), Utility value (future usefulness), and relative cost (time and effort) [10]. Motivated by this theory that students are more likely to engage in activities that they perceive as valuable to them and the desire to better understand why students engage in GCSP, this work focuses on understanding what students perceive as valuable about their participation in the GCSP.

Research Aims

This research aims to understand students' perceived value of participation in the GCSP. Specifically this work aims to address the following research questions:

1. How do students describe their perceived value of participating in GCSP?
2. How do students' perceptions about the value of GCSP vary between students in different class levels (specifically first year, second year, and third year)?

Methods

Data Collection

The anonymous data used for this study was collected as part of an activity GCSP students at ASU completed in the first week of their required GCSP courses. The activity asked students to anonymously add sticky notes to a digital whiteboard with their thoughts in response to various prompts. The prompts for second and third year students asked them how they believe their participation in GCSP has been valuable to them thus far in their academic career, and how they believe their participation in GCSP will be valuable to them in the future. First year students responded to the same prompts, but altered slightly to their first year status (i.e. what is the value of GCSP to you? What do you hope or expect to gain from GCSP?)

Data Sources

The data in this study was collected from a total of 321 students, including 124 in their first year in GCSP, 119 in their second year, and 78 in their third year. Data was collected from second and third year students enrolled in the required second and third year courses, respectively, during the Fall 2022, Spring 2023, Fall 2023, and Spring 2024 semesters. First year students' data was collected in the required first year course at the start of the Fall 2023 and Spring 2024 semesters.

Data Analysis

Data was analyzed using thematic analysis, as described by Braun and Clarke [13]. Two researchers independently reviewed the contents of a few of the digital whiteboards to become familiar with the data. Eccles' Expectancy Value theory was used as a framework for thematic analysis, specifically Attainment Value, Interest Value, Utility Value [10]. Operationalized definitions of Eccles' definitions of those value codes created by Matusovich et al. [10] for engineering students were adapted for GCSP students in this study, as seen below in Table 1.

Table 1. Codes and definition of codes used to represent Eccles' Value codes for this study (Adapted from [10])

Value Code	**Eccles' definition [11]**	**Definition for becoming an engineer [10]**	**Definition for becoming a Grand Challenges Scholar**
Attainment Value	The perceived importance of doing well on a task, particularly how engaging in the task is consistent with self-concept	A reason for pursuing (or not pursuing) engineering that is related to being the type of person who is an engineer	A reason for becoming a Grand Challenges Scholar that is related to being the type of person who is a Grand Challenges Scholar
Interest Value	The enjoyment experienced in doing the task	The enjoyment (or lack of enjoyment) experienced in doing engineering activities and/or being or becoming an engineer in the future	The enjoyment experienced in participating in GCSP and/or doing GCSP related activities (classes, events, experiences, etc.)
Utility Value	The perceived future direct or indirect importance of engaging in the task	The perceived usefulness (or lack of usefulness) of being or becoming an engineer and/or earning an engineering degree	The perceived future usefulness of becoming a Grand Challenges Scholar, engaging in activities to become a Grand Challenges Scholar (i.e. competency related activities)

Based on observations made during the initial review of the data, the researchers defined four additional codes related to Connections: Connections to People (general), Connections to Students, Connections to Faculty, and Connections to Activities. Two researchers then independently coded the data, labeling portions of the data that aligned with each of the seven themes (those in Table 1 and the Connections themes just mentioned). Researchers also used the label "other" to identify other potentially interesting findings in the data. The analysis results from both researchers were compared and any discrepancies were discussed until agreement was reached for inter-rater reliability. Additional themes were identified based on items labeled as "other". The number of students for which each theme appeared in the data was counted, and examples for each theme were identified.

Results and Discussion

The results from thematic analysis are presented in Table 2 below. More specifically, Table 2 shows the number of responses for each theme found in students' responses organized by class level (i.e., first year, etc.). The last five rows in the table included new themes that emerged from the data (i.e. from items labeled as "other").

Table 2. Number of students' responses that show each theme (total and by class level)

	Total	1st year	2nd year	3rd year
N (number of students in group)	321	124	119	78
Attainment Value	31	10	13	8
Interest Value	25	6	10	9
Utility Value	174	61	62	51
Connections: People	89	35	33	21
Connections: Students	41	6	27	8
Connections: Faculty	47	4	33	10
Connections: Activities	112	24	45	43
Broader view/perspective	81	6	44	31
Impact on Society	33	14	12	7
Mentorship	4	0	1	3
Access to Resources	21	2	9	10
Identify Interests	23	7	8	8

Utility Value was the most prevalent theme, found in the largest number of students' responses at all three class levels. This indicates that students across all levels consider participation in the GCSP and becoming a Grand Challenges Scholar to be useful. For example, some students mentioned how GCSP will help them build stronger resumes and will benefit their professional development and career path. Others discussed how they felt that GCSP would help them to build useful skills or gain real-world or hands-on experience. Some students discussed how GCSP helped them to define or structure their pathway toward their academic and/or career goals. Below are a few example responses for this theme.

"Being a part of the GCSP program has formed a pathway to my college education, opening new doors and opportunities for me constantly. I have met valuable industry and faculty mentors."

"GCSP provided me with opportunities and motivation to work on meaningful projects and research early. This was critical to my professional development and got me to where I am now."

"GCSP has truly helped me grow as an individual as well as an engineer. GCSP has allowed me to grow and expand my perspectives allowing me to be an excellent engineer."

"GCSP always keeps me engaged with my degree path, and helps me to make sure that I pick extracurriculars and electives that will benefit my career path."

"GCSP will teach me about the 5 competencies which are essential for my career development. I hope to get a good portfolio and become a better person after the program."

The theme that was found in the second largest number of students' responses is Connections: Activities. Students found GCSP valuable in connecting them to and/or motivating them to pursue other activities, including research opportunities, service learning activities, study abroad programs, etc. Below are several examples of the Connections: Activities theme in student responses:

"During my first year of GCSP, I was encouraged to look into research labs focusing on topics of interest to me, which ultimately led me to join the lab that I am currently in."

"GCSP has also encouraged me to join [service learning program] where I otherwise wouldn't have. This has allowed me to expand my skills and knowledge set while also helping my community."

"GCSP has also given me more motivation to try and reach for something that I might normally be too nervous to even attempt. For example, I did [undergraduate research program] in my second semester."

"GCSP has encouraged me to be involved, specifically EWB [Engineers Without Borders]. My 3 semesters spent working on a project has given me so much insight in the global aspect of engineering."

The third most prevalent theme was Connections: People. This theme was applied whenever students mentioned connecting with people or groups of people (e.g., industry professionals, alumni, engineers, etc.). Below are some examples of the Connections: People theme:

"For me, GCSP has led me to connect with engineers of all kinds, not just those in my direct field. It's opened my eyes to the way we are connected to each other and the world."

"This program led me to network with different industry professionals in the VR industry, and I am now working with one of them doing research in Virtual Reality."

"The most alluring thing that G.C.S.P. provides is Connection by meeting with new people -> Different mindsets and perspectives -> New way to look at things."

"GCSP is also a great networking tool, I have several connections at Fortune 500 companies thanks to the programs I've joined as GCSP requirements."

"GCSP helps its members create relationships with students, staff, and companies. This helps the student with opportunities in their future after ASU."

Connections: Faculty and Connections: Students theme codes were applied when students specifically mentioned connecting with Faculty (professors) or Students (peers). Connections with Faculty and Students did not appear as often as the more general Connections to People. Perhaps not surprisingly, Connections: Faculty often appeared when students mentioned connecting to research opportunities (Connections: Activities).

Out of the five new themes that were identified from the data during the coding process (shown in the last five rows in Table 2), two are somewhat related to connections: Mentorship and Access to Resources. The Mentorship theme was applied when students mentioned mentorship directly in response to the value prompts. The Access to Resources theme was applied when students described the funding opportunities and resources in general as a valuable part of GCSP. Below are example responses for Access to Resources theme:

"My participation in the Grand Challenges Scholars Program has been valuable to me because it has given me the opportunity to build a network of resources and support with like-minded individuals."

"GCSP provides a structure for me to involve myself in the engineering community. Through the [GCSP funding opportunity for research], I was able to explore my passion in research."

During the coding process, the researchers observed that these Connections themes (Connections: Activities, Connections: People, Connections: Faculty, Connections: Students), Access to Resources theme, and Mentorship theme, could all perhaps be considered to relate to Utility Value. Students may see connections and resources as something they can utilize to achieve their goals. Interestingly, the appearance of these themes in the data also indicates that perhaps what students value is the Social Capital they gain through the GCSP. According to Social Capital theory, social capital is the "resources gained through relationships", and thus social relationships influence an individual's ability to achieve their goals [14]. These connections, resources, and mentorship themes may indicate that students gain (or expect to gain) valuable Social Capital through the GCSP.

The other value codes, Attainment Value and Interest Value, were not as prevalent in the responses as Utility Value was. Responses labeled as Interest Value were those in which students mentioned that they were excited, enjoying what they were doing, or doing something they were interested in. Based on the definitions provided earlier, Attainment Value was used to label responses where students mentioned the value of being in GCSP as related to the type of person who is in GCSP (or a Grand Challenges Scholar). This was somewhat difficult to identify in student responses, but appeared when students described the value of GCSP as becoming a more well rounded engineer. Examples of the Attainment Value theme are included below:

"GCSP will push me to explore many different areas of engineering and how they all intersect, which will ultimately push me to be a well-rounded engineer."

"I want to get the most of the college experience through exploring my interests, and being as well rounded as possible. GCSP helps me in those goals through the competencies."

"I want to be a more well rounded and experienced engineer who will be able to fill a lot of roles and niches in the industry due to my extensive skill set and knowledge."

An additional theme that arose from the data during coding is Impact on Society. This particular theme may actually relate to Attainment Value, as one of the goals of the GCSP is to prepare students to be changemakers, who will possess a strong technical skillset and broader mindset to address global challenges to improve society. Some students who value GCSP for the impact

they can have on society, may be saying that because they see Grand Challenges Scholars as people who have that impact. Below are examples of this Impact on Society theme:

"GCSP will help me in my quest to discover the domain where I can fully leverage my skillset. I aspire to make a societal impact by actively helping the community."

"GCSP has ignited my desire to make a change in the world by building valuable businesses that are sustainable to last and are driven by the purpose of solving a problem."

Another new theme that arose from the data, which also may be related to Attainment Value, is Broader View/Perspective. This theme was applied to responses that mentioned an interdisciplinary perspective, different way of thinking, different view of engineering, etc. People often think of Grand Challenges Scholars as having a broader perspective and/or way of thinking due to the competencies that they achieve through the program, so it is possible students are mentioning this interdisciplinary/broader thinking because they see it as a characteristic of a Grand Challenges Scholar. Below are some example responses that illustrate this Broader View/Perspective theme:

"GCSP has helped ensure I always have a multidisciplinary and multicultural mindset and viewpoint, which I think is vital to a good engineer."

"The opportunities that GCSP offers help undergraduate engineers develop an interdisciplinary mindset and excel when it comes to exceeding industry expectations."

An additional theme that arose from the data during the coding process is Identify Interests. Students described identifying new interests or career paths, or confirming their interests in responses within this theme. Below are two examples or this Identify Interests theme:

"GCSP is a great opportunity to define my career path and understand what I really want to do with it."

"Discovering a passion in engineering."

"I want to find something that I am really passionate about while gaining extracurricular experience."

To address the second research question regarding differences between class levels, theme frequencies were compared between first year, second year, and third year students. Data was normalized for comparison purposes. Figures 1-3 show the percentages of students' responses that show the themes. Overall, themes appeared in more responses from third year students

when compared to second and first year students, though the specific distribution of frequencies amongst different class levels varied for different themes.

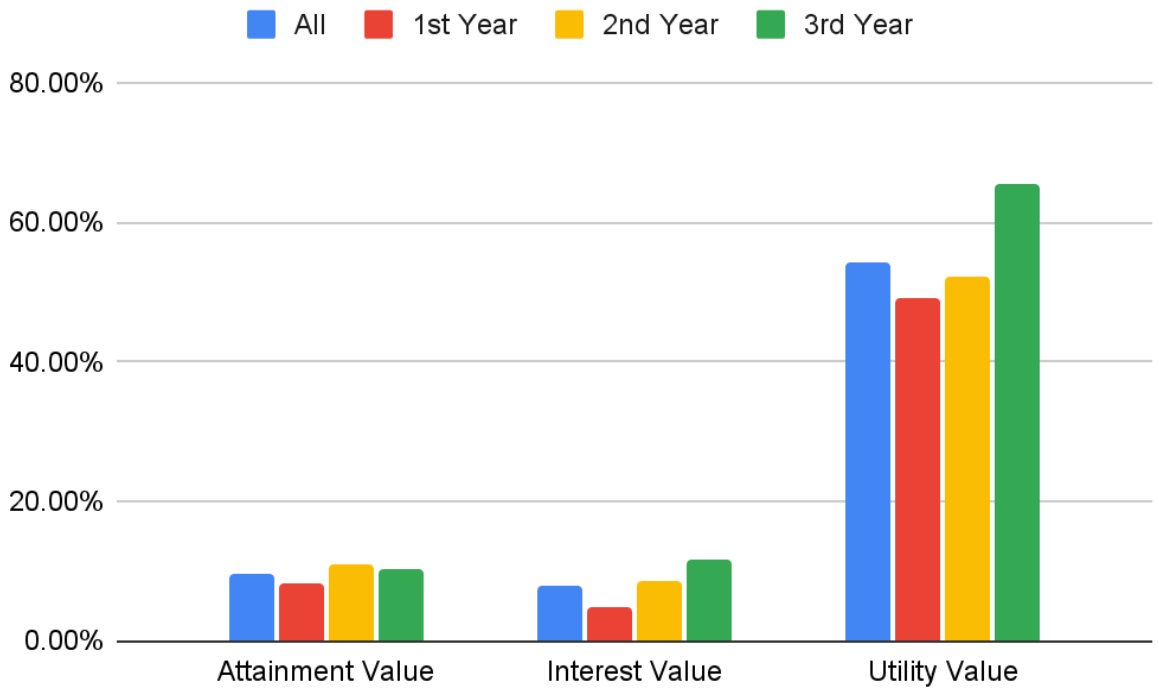

Figure 1. Percentage of students' responses that show the themes that represent the Eccles' Value codes (total and by class level)

As seen in Figure 1, there were not any significant trends or differences observed between class levels. Of the three Value codes, Utility Value had by far the largest prevalence in each class level. As seen in Figure 2, Connections: Activities was much more prevalent in third year students, perhaps because they have had more time to experience how GCSP has helped them make those connections. Interestingly, Connections: Students and Connections: Faculty appear more in second year students than other levels. One possible reason for this may be because students starting their second year course have completed the first year course in which they are asked to work in teams with other GCSP students, and have met faculty guest speakers.

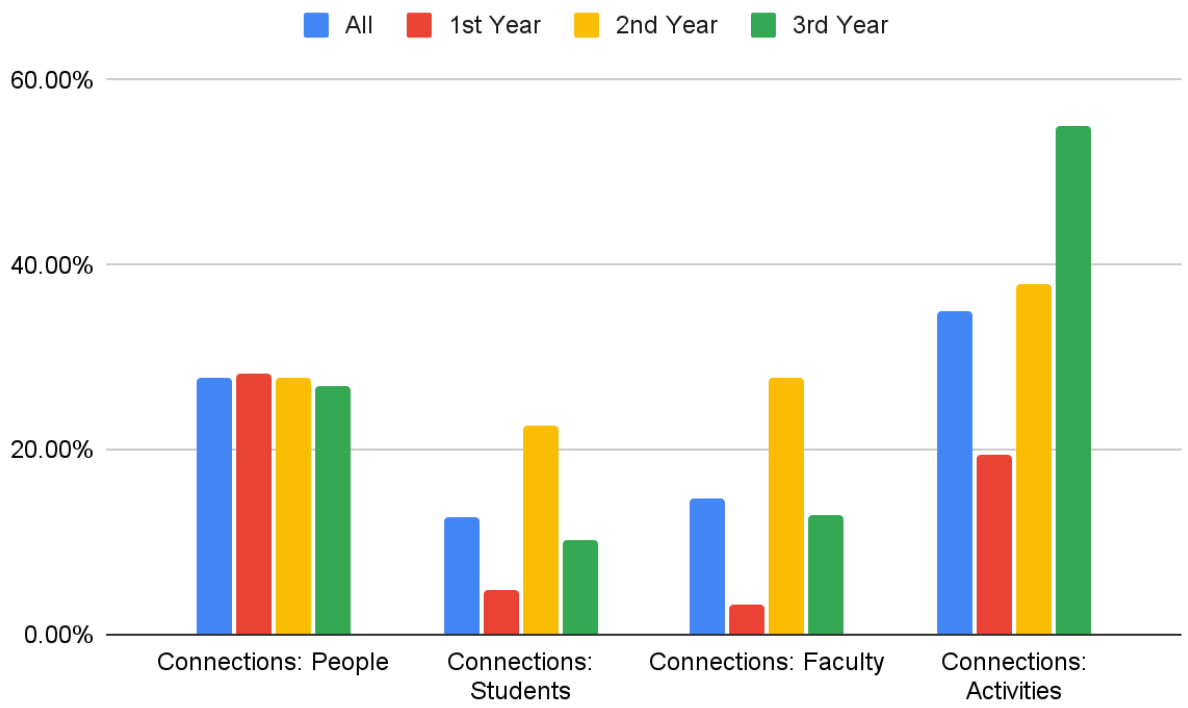

Figure 2. Percentage of students' responses that show the Connections themes (total and by class level)

Some interesting trends with first year students were observed for some of the new themes that arose from the data, as seen in Figure 3 below. First year students had far fewer appearances of the Broader View and Access to Resources themes. This may be explained by the timing of the activity, as first year students completed this activity when they were in week one of their first or second semester on campus. Second and third year students, on the other hand, had completed the first year GCSP course which focuses on exploring global challenges from an interdisciplinary systems perspective, and also possibly have more experience due to more time spent on campus[8, 15].

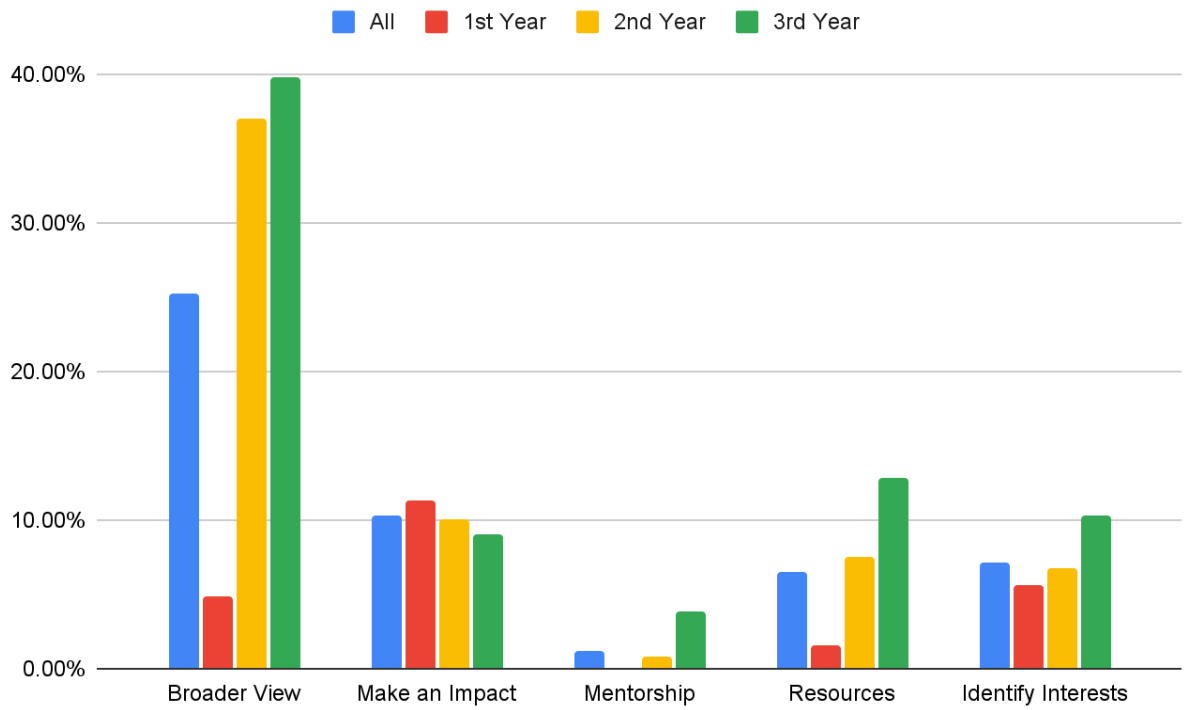

Figure 3. Percentage of students' responses that show the other themes emerged (total and by class level)

Conclusion

This work seeks to understand students' perceived value of participating in a multi-year, co-curricular program, the Grand Challenges Scholars Program, and how these perceived values compare across students' class levels. To answer these research questions, first, second, and third year students' responses to prompts about the value of program participation were analyzed qualitatively. These prompts asked students how they believe their participation in GCSP has been valuable to them and how they believe their participation in GCSP will be valuable to them in the future. Results from the thematic analysis show that students at all levels consider participating in the program useful for their career and professional development, indicating that they perceive Utility Value in the GCSP. There was also an indication that students greatly value the connections to both activities and people that GCSP provides. Perhaps surprisingly, there were minimal differences in the results across the three class levels (first year, second year, third year). Insights gained from this study could be utilized to inform future programming and support for students in GCSP at ASU. This information could also help other institutions decide what activities and/or support might be most valuable to implement to support their students within their GCSP or other multi-year co-curricular programs. Possible future work includes further exploration of students' perceived value through more in depth data collection and

analysis (e.g. interviews), and conducting longitudinal studies to observe how students' value perceptions may influence their success in the program.

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