Sense of Belonging in the Cybersecurity Field of Study

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Cybersecurity Students' Sense of Belonging and Confidence

Abstract

Because cybersecurity professionals are crucial to national security, public safety, and economic prosperity, employment opportunities in cybersecurity continue to increase. To meet the public and private sectors' need for cybersecurity professionals, universities are adding academic programs in cybersecurity. West Virginia University, which is a land-grant R1 university with a vibrant cybersecurity program that offers a B.S. degree, academic minor, and an Area of Emphasis (AoE) in cybersecurity, has received an NSF S-STEM grant to increase the number and diversity of highly qualified cybersecurity graduates by offering scholarships to high-achieving and economically challenged undergraduate students.

Our past research was focused on grit and motivation of the NSF S-STEM scholars from this initiative, their retention and persistence through their educational program, and what elements of the S-STEM program they found most helpful in supporting their development as cybersecurity professionals [1].

This research explores evidence of cybersecurity students' feelings of inclusion or sense of belonging within their discipline. Sense of belonging is one characteristic that has been linked with increased retention [2] – and lack of sense of belonging has been linked with attrition – within many STEM majors [2] which struggle to serve a student body that is as diverse as the broader population of college-age people in the U.S. [3].

1.0 Introduction

Cybersecurity graduates contribute to achieving public and corporate systems' security, national security, and economic prosperity. As the frequency of cyberattacks has increased, the employment outlook for students trained in cybersecurity is high (35%) and growing [4] [5]. The overall goal of the NSF-S-STEM-funded ACCESS project is to increase enrollment and degree-completion of high-achieving, low-income undergraduate students who are working toward a major or Area of Emphasis (AoE) in cybersecurity. The ACCESS program accomplishes this goal through a variety of efforts. One sub-goal of the ACCESS program is to increase student engagement with professional development activities to help students in a cybersecurity field develop a positive professional cybersecurity identity [1]. For the purposes of this research, "cybersecurity field" or "cybersecurity students" refers to undergraduate students with a cybersecurity B.S. major and students with other B.S. majors who pursue an AoE in cybersecurity.

In this paper, we investigate the research question *"Is the sense of belonging for ACCESS scholars different from the sense of belonging for the control group consisting of their peers attending the same required courses?"* by examining student responses to specific survey questions which may shed light on students' sense of belonging. These questions are part of the Motivated Strategies for Learning Questionnaire (MSLQ) [16]. The research question and related items examined are presented in Table 1 below.

Table 1. A list of sub-measures investigated to answer the research question

Research Question	**Sub-Measures from MSLQ survey**
RQ: Is the sense of belonging for ACCESS scholars different from the sense of belonging for the control group consisting of their peers attending the same required courses?	Expectation of "fitting in" as measured by responses to: 1. *I will feel "part of the group" on my job if I enter the cybersecurity field.* 2. *I will be treated fairly on the job. That is, I expect to be given the same opportunities for pay raises and promotions as my fellow workers if I enter the cybersecurity field.*
	Self-Esteem and Confidence. Since a sense of belonging leads to self-esteem and confidence, statements related to behaviors consistent with confidence and comfort in one's environment were used as potential indicators of sense of belonging: 1. *I can make friends with people from different backgrounds and/or values.* 2. *I can cope with friends' disapproval of my chosen major.* 3. *I can cope with being the only person of my race/ethnicity in a class.* 4. *I can approach a faculty or staff member to get assistance with academic problems.* 5. *I can adjust to a new campus environment (2021 survey only)*

2.0 Related Work

"Belongingness refers to a human emotional need for interpersonal relationships, affiliating, connectedness, and being part of a group" [6]. A sense of belonging – feelings of being included, accepted, and valued [7] – is both a human need and a motivator of human behavior [8], [9]. Sense of belonging has been linked with increased retention [2] – and lack of sense of belonging has been linked with attrition – within many STEM majors [2] which struggle to serve a student body that is as diverse as the broader population of college-age people in the U.S. [3].

Belongingness is an important part of every human's "Social Needs," the third element of Maslow's Hierarchy of Needs (following physiological needs and safety and security needs). Along with "Esteem Needs", it is an essential factor in human motivation [6] and happiness [10]. Maslow's "deficit needs" – physiological, security, social, and esteem – must be met to avoid unpleasant feelings or consequences which prevent people from reaching their full potential. In

fact, a 2011 University of Illinois study found that "while the fulfillment of the needs was strongly correlated with happiness, people from cultures all over the world reported that self-actualization and social needs were important even when many of the most basic needs were unfulfilled" [10]. Those results indicate that social needs, including love, acceptance, and belonging, can be strong motivators of human behavior [10] [11].

Several studies worldwide support the importance of creating an engaging and inclusive student environment and the relationship between students' sense of belonging and their academic success and retention.

One 2020 study, reported in the *Philippine Social Science Journal*, investigated the relationship between the "Sense of Belonging and Self-Esteem of High School Students in a Catholic College" and determined that when an institution can create an environment in which students feel a "sense of security, care, and affection, the students are motivated to become engaged in school activities where they develop holistically" [12], and "feel more empowered, productive, competent, belonged, and self-worthy" [12].

Ahn and Davis (2020) investigated aspects of belonging, including academic and social engagement, life satisfaction, and thoughts of leaving the university along with demographic and socio-economic status to discover the relationship of certain factors to students' sense of belonging. Results from the analysis of data from 380 student participants indicated that "students' sense of belonging and retention are crucially influenced by both academic engagement and social engagement, but independently" [13]. A 2023 follow-up study further revealed that their surroundings and personal space also affected students' sense of belonging. "Surroundings equate to participants' living space, and geographical and cultural location, while personal spaces refer to life satisfaction, life attitudes, identity, and personal interests" [14]. Ahn and Davis (2023) further recommend that all four domains (academic and social engagement, surroundings, and personal space) be considered and reflected in the student engagement policies of higher education institutions [14].

While other "[r]esearch suggests that higher education students who have a greater sense of belonging tend to have higher motivation, more academic self-confidence, higher levels of academic engagement and higher achievement" [7], a 2022 study by Pedler, Willis, and Nieuwoudt investigated the relationship between university students' sense of belonging and their motivation, retention, and enjoyment of their university experience. They found that "students who frequently considered leaving the university without completing their degree (i.e., dropping out) had a significantly lower sense of belonging that students who did not" [7], while "university students with a higher sense of belonging reported higher motivation and enjoyment in their studies whereas students who reported lower levels of belonging reported lower levels of motivation and enjoyment" [7]. Additionally, they found a significant difference in the level of

belonging between first-generation students and students whose parents had both completed university degrees.

The ACCESS program seeks to support students by offering opportunities to engage with others studying cybersecurity and with cybersecurity professionals to help them develop a sense of belonging in the field, increase confidence in their abilities, and become excited about their future career. By facilitating engagement, the program also endeavors to help students develop the necessary sense of belonging needed to motivate them to continue toward graduation and enter the cybersecurity profession.

3.0 Methodology

One research question was investigated. To answer this research question, several specific questions from a survey given to students in four courses that are part of the curriculum for the B.S. degree and the AoE in cybersecurity were analyzed. These courses, all required for both the major and AoE in cybersecurity, included: CS 111, Introduction to Data Structures; CS 350, Computer System Concepts; CYBE 366, Secure Software Development; and CYBE 467, Practicing Cybersecurity: Attacks & Countermeasures. All students in these four courses, including the ACCESS scholars, were encouraged, but not required, to participate in the survey. Response data was compared for (1) ACCESS scholar respondents versus a matched pair control group of non-ACCESS survey respondents and (2) ACCESS scholar respondents versus all non-ACCESS students who responded to the survey in the four courses. The survey was administered both in spring 2021 and spring 2022. Students, both ACCESS scholars and non-ACCESS scholars, who may have responded to the 2021 survey and who did not graduate before the spring 2022 may have taken the survey twice (once in spring 2021 and again in spring 2022). Since the responses were anonymous, the researchers have no way to identify those students who took the survey both in 2021 and 2022. Table 2 below describes the sample size for each group of survey respondents analyzed in this paper.

Table 2. Summary of sample sizes for study

Year	ACCESS Scholars	Non-ACCESS Matched-Pair Control Group	Non-ACCESS Full Group of Survey Respondents (larger, non-matched control)
2021	9	9	289
2022	10	10	163

3.1 Research Question & Instrumentation

This research focuses on a small part of a larger survey composed of questions from the Grit assessment [15], the Motivated Strategies for Learning Questionnaire (MSLQ) [16], and

questions related to students' experience and continued interest in the cybersecurity field of study. The survey was given to students in four courses (one freshman-level and three upper-division courses) that are part of the cybersecurity major and AoE in spring of 2021 and 2022. Cohort 1 of ACCESS scholars and their non-ACCESS peers participated in the survey in spring 2021 and Cohorts 1 and 2 of ACCESS scholars and their non-ACCESS peers participated in the survey in spring 2022.

Several specific survey questions were used to answer the following research question: *Is the sense of belonging for ACCESS scholars different from the sense of belonging for the control group consisting of their peers attending the same required courses?*

While sense of belonging was not measured directly, two questions related to students' expectations of "fitting in" on the job after graduation were investigated to shed light on the students' sense of belonging. These statements, to which students responded on a 7-point Likert scale (Strongly Agree, Agree, Slightly Agree, Neither Agree or Disagree, Slightly Disagree, Disagree, Strongly Disagree), were:

1. *I will feel "part of the group" on my job if I enter the cybersecurity field*; and
2. *I will be treated fairly on the job. That is, I expect to be given the same opportunities for pay raises and promotions as my fellow workers if I enter the cybersecurity field.*

Additionally, since a sense of belonging leads to self-esteem and confidence, statements related to behaviors consistent with confidence and comfort in one's environment were also used as a potential indicator of sense of belonging. These statements include:

1. *I can make friends with people from different backgrounds and/or values*;
2. *I can cope with friends' disapproval of my chosen major*;
3. *I can cope with being the only person of my race/ethnicity in a class*; and
4. *I can approach a faculty or staff member to get assistance with academic problems.*

To investigate our research question, descriptive statistics on student demographics, academic record, and responses to the statements related to feelings of belonging, confidence, and expected academic persistence were compiled. The analysis compared ACCESS scholars with (1) a matched cohort of non-ACCESS students and (2) all participating cybersecurity students for specific variables (see Table 2). Observations were made on these data.

3.2 Demographics

The results of the spring 2021 and spring 2022 surveys were analyzed. The demographic information for ACCESS students who responded to the survey is presented in Table 3.

Table 3. Gender and race/ethnicity of 2021 ACCESS Cohort 1 and 2022 ACCESS Cohorts 1 & 2

	Gender		**Race/Ethnicity**	
	Male	**Female**	**Non-minority**	**Minority**
2021	5	4	7	3[1]
2022	5	5	9	2[2]

[1]*One student marked 'White' and 'Hispanic', yielding ten responses for nine students.*
[2]*One student marked 'White' and 'African American', one marked 'White' and 'Asian', and one marked 'Unknown', yielding eleven responses for ten students.*

The nine members of the 2021 ACCESS cohort (ACCESS cohort 1) who completed the survey consisted of five juniors and four seniors by class rank based on number of credits earned. However, by years in college that cohort included two second year students and seven third-year college students. In 2022, a total of 10 ACCESS scholars from cohort 1 (2021) and cohort 2 (2022) who completed the survey were comprised of two freshmen, one sophomore, one junior and six seniors by class rank based on number of credits earned; and by number of years in college, that group contained three first-year students, one second year student, two third-year students, three fourth-year students and one fifth-year student. Clearly, more diversity of student levels was present in the 2022 group of cohort 1 and cohort 2 ACCESS scholars who completed the survey.

Observations were based on both ACCESS scholars versus all non-ACCESS participants as well as ACCESS scholars versus non-ACCESS matched participants (see Table 2).. The matched cohort was utilized to provide a closer comparison of students of comparable demographic status from the non-ACCESS group with the same number of students of ACCESS scholars. Matching was done based on the following criteria:

- Whether or not student was a minority (non-minority was defined as any student who identified as 'White' on the survey; minority was defined as any student who identified as any of the other race/ethnicity categories on the survey)
- Gender of the student
- Major or AoE of the student (major in cybersecurity or another major with an AoE in cybersecurity)
- GPA of the student (GPA of at least 3.0 is required for receiving and renewing the ACCESS scholarship).

Matching was done on a one-to-one, case-by-case basis due to the variety in combinations of the above criteria in the ACCESS cohorts for both survey years (2021 and 2022). Because there were no non-ACCESS students who matched ACCESS students on all four criteria, the matched pair group was created by selecting non-ACCESS students with 3.0 or higher GPAs who

matched with ACCESS students based on minority status, gender, and major or AoE. The demographic data for the ACCESS scholars versus non-ACCESS matched participants in the criteria not covered, namely class and academic level, are summarized and presented in the appendix.

Responses of the ACCESS scholars were also compared to the responses of the non-ACCESS full group of survey respondents. In both years, the full group was more diverse with respect to GPA and student level than the ACCESS survey respondents or their matched pairs. The GPA distributions of the ACCESS respondents, their non-ACCESS matched pairs, and the non-ACCESS full group for the 2021 and 2022 survey respondents are presented for comparison in Figure 1 below.

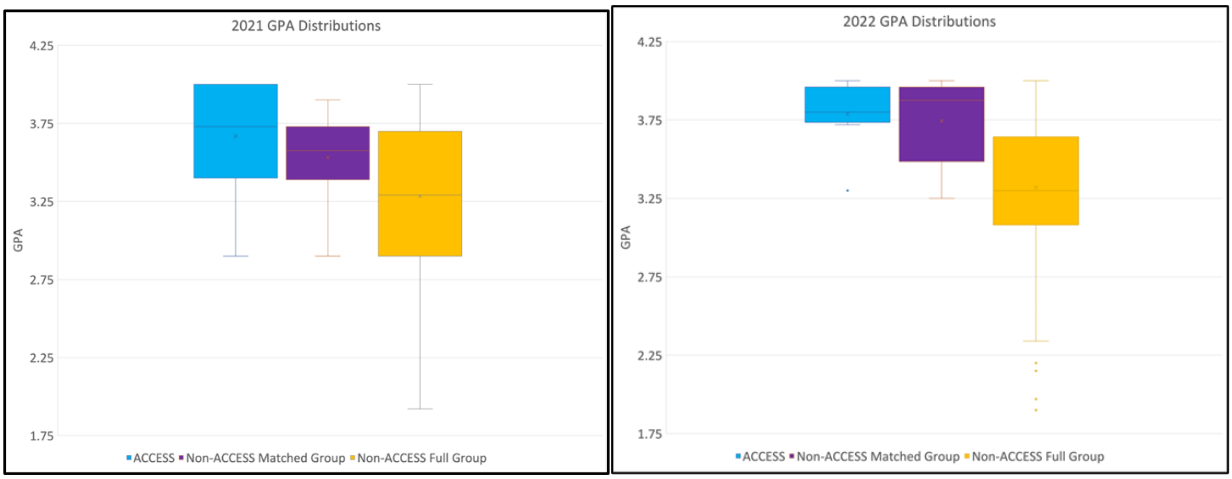

Figure 1. Box and whisker plots comparing the GPAs of the ACCESS, non-ACCESS matched pair group, and non-ACCESS full group of respondents to the spring 2021 and 2022 surveys.
**Note: The GPAs of three ACCESS scholars were not reported in the 2022 survey. The matched non-ACCESS counterparts for these three scholars were thus selected with the criteria of a 3.0+ GPA above as required for all ACCESS scholars.*

While the GPA distributions of the ACCESS scholars and their non-ACCESS matched pairs would be expected to be identical if they were matched by exact GPA, they differ because the matches were selected based on other characteristics (minority status, gender, cybersecurity major or AoE) and GPA greater than 3.0 (not a direct match). Also, for the 2022 survey, some of the ACCESS scholars did not answer the GPA question. In those cases, matching was done on the other characteristics, and the GPAs of the "matched" students were included in the GPA distribution of the matched pair group. The additional GPAs in the matched pair group introduced the additional GPA variability presented in the above graph. All candidates for the non-ACCESS matched pairs, however, met the minimum scholarship criteria (cybersecurity major or AoE and GPA at least 3.0).

As can be seen in Figure 1, while the GPA distributions were different, the overall median GPAs for the ACCESS scholars and their matched non-ACCESS peers was higher than the median GPA for the larger, more diverse non-ACCESS full group in both years.

3.3 Results and Discussion

Results from the Spring 2021 and Spring 2022 surveys are presented below separately. Interesting comparisons of results between the two years are also presented.

Results of the 2021 Survey

Student responses to the specific survey questions are presented in Figure 2 below. For each statement presented in the graph, the top bar represents the responses of the ACCESS respondents, the middle bar represents the responses of the matched pair control group (i.e., non-ACCESS matched), and the third bar represents the responses of the non-ACCESS full group respondents.

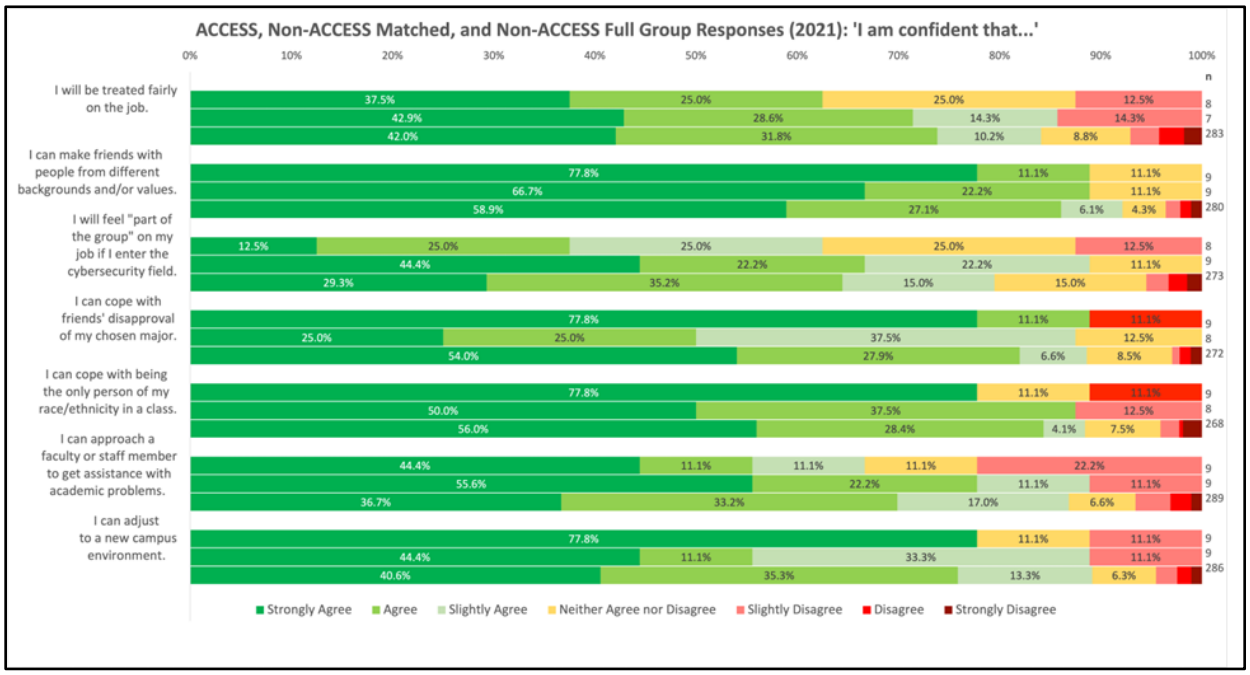

Figure 2. Graph of the 2021 student responses to survey questions indicating their Likert Scale agreement or disagreement with statements related to their confidence levels of various elements related to their "fitting in" on the job after graduation and confidence and comfort in their current environment. The full wording of the first question is: "I will be treated fairly on the job. That is, I expect to be given the same opportunities for pay raises and promotions as my fellow workers if I enter the cybersecurity field." It was shortened in the graph for formatting purposes.

For the 2021 survey, all three groups agreed relatively similarly (with variation only in strength of agreement "Strongly Agree", "Agree" and "Slightly Agree") with the following statements:

- *I can make friends with people from different backgrounds or values (88.9% for ACCESS scholars and their non-ACCESS matched pairs, and 92.1 % for the non-ACCESS Full Group)*

- *I can cope with friends' disapproval of my chosen major (88.9% for ACCESS scholars, 87.5% for the non-ACCESS matched pair group, and 88.5% for the non-ACCESS Full Group).*

For the first statement, only the non-ACCESS full group indicated any disagreement with the statement and there was more variability in the levels of agreement and disagreement in that group. The variation seen in the larger group may be due to the much higher numbers of respondents. Additionally, the non-ACCESS full group was more diverse with relation to GPA and academic level/rank and less diverse with respect to racial/ethnic diversity and gender. ACCESS scholars must maintain at least a 3.0 GPA, which is not the case with the members of the non-ACCESS full group.

One reason for the high level of agreement between all three groups for these statements may be because none of the groups may have encountered much disapproval from their friends regarding their major, since many of their friends may be in an engineering or computing-related major and would consider cybersecurity to be a good major. In addition, many people in the public (i.e., those who are not within the engineering and computing-related fields) consider cybersecurity to be a needed and highly rewarded occupation.

Interesting, 62.5% of the 2021 ACCESS cohort agreed (at some level) with the following two statements while their Non-ACCESS peers – both in the matched group and in the Non-ACCESS full group – had higher levels of agreement:

- *I will be treated fairly on the job*
- *I will feel "part of the group" on my job if I enter the cybersecurity field.*

In each case, however, 25% of the ACCESS students indicated "Neither Agree nor Disagree." Comparing the measures of disagreement for these two statements, 12.5% of the ACCESS scholars slightly disagreed with both statements, while the responses for both control groups varied. For the "*I will be treated fairly on the job*" statement, 14.3% of the non-ACCESS matched pair group indicated disagreement (slightly more than the 12.5% ACCESS scholar disagreement) while only 7.2% of the non-ACCESS full group disagreed at various levels.

For the "*I will feel 'part of the group*' *on my job if I enter the cybersecurity field*" statement, while 12.5% of ACCESS scholars disagreed, none of the non-ACCESS matched pair group disagreed and 5.5% of the non-ACCESS full group disagreed at some level.

These results may be related to the differences in socio-economic status between the groups. One of the requirements for receiving an ACCESS scholarship is having a financial need. The non-ACCESS matched group and the non-ACCESS full group may have more variation in socio-economic status, which may account for the higher confidence in being treated fairly or feeling "part of the group" on the job. It should be noted that we do not have data on the socio-

economic status of the non-ACCESS students. In addition, while we do not have data related to students' home or permanent residence environments, some of the ACCESS scholars may come from rural backgrounds which may influence their responses. Again, it is possible that there is more variability in background in the non-ACCESS matched group and the non-ACCESS full group related to their background.

Three other statements relate to confidence in their role on campus, including:

- *I can cope with being the only one of my race/ethnicity in a class*
- *I can approach a faculty or staff member to get assistance with academic problems*
- *I can adjust to a new campus environment.*

These statements were intended to reflect confidence which is evidence of comfort and a sense of belonging. In each case, the ACCESS scholars indicated lower agreement than their counterparts in the full group.

While all groups indicated agreement, the ACCESS scholars, at 77.8% strongly agree, indicated lower agreement with their ability *to cope with being the only one of their race/ethnicity in a class* and with their ability *to adjust to a new campus environment*. Examining the level of disagreement with the "race/ethnicity" related statement, the ACCESS scholars (11.1%) and the non-ACCESS matched pair group (12.5% disagreement) indicate relatively close amounts of disagreement. The non-ACCESS full group indicated only 4% disagreement with this statement. One reason for this disparity may be related to the racial/ethnicity composition of each group. The full group is more homogeneous and less diverse than the ACCESS scholars or their non-ACCESS matched pairs (because the pairs were matched on race/ethnicity as one of the factors). Since students in the non-ACCESS full group are predominantly of the majority white race/ethnicity, they likely would never be the only person of their race/ethnicity in a class, so they may not have experienced the situation about which they were responding.

Similarly, 11.1% of both the ACCESS scholars and their non-ACCESS matched pairs indicated slight disagreement with the statement that "*I can adjust to a new campus environment*" while only 4.5% of the non-ACCESS full group disagreed with that statement. These results may reflect the student rank/level of all groups. While the non-ACCESS full group was more diverse with respect to student level/rank, all groups were predominantly second year or higher students who had already proven to themselves their ability to adjust to a new campus environment. Since the survey was given in the spring term, many of the first-year students may have felt that they had already adjusted to their new campus environment. A few students may have interpreted the question to infer their ability to adapt to another change in environment (i.e., if they were to transfer to a different institution, their ability to adjust to a "new" campus environment). Variations in levels of agreement or disagreement with that statement may also be attributed to the very small numbers in the ACCESS scholars and non-ACCESS matched pair groups.

Interesting differences appear on the statements in which the ACCESS scholars' responses differ from the responses of the non-ACCESS matched pairs.

The non-ACCESS matched pair group indicated higher levels of agreement than the ACCESS scholars for:

- "*I will feel 'part of the group' on my job if I enter the cybersecurity field*" (88.8% versus 62.5% ACCESS scholars) with the level of agreement being much stronger for the non-ACCESS matched pair group.
- "*I will be treated fairly on the job*" (85.8% versus 62.5% ACCESS scholars)
- "*I can approach a faculty or staff member to get assistance with academic problems*" (88.9% versus 66.6% ACCESS scholars).

One reason for this discrepancy may be related to the financial status of the two groups. The ACCESS scholars are high achieving students with financial need. The non-ACCESS matched pair students were matched on variables such as GPA, gender, ethnic/racial minority, and major (or AoE), but not financial status because it was not available. These students had the academic credentials to qualify for the ACCESS scholarship program but did not apply or were not awarded the scholarship because they may not have the level of financial need of the ACCESS scholars. Perhaps financial status influences students' feelings of belonging and confidence.

Another explanation for the discrepancy may be the students' permanent residence. Students from rural areas may have different confidence levels compared to those from the larger cities or from the city in which the university resides. Students from the university city likely did not experience many of the challenges associated with moving to another location for school and learning to find one's way around the new environment.

Results of the 2022 Survey

Turning now to the 2022 survey, a few differences are noted. First, the survey was shortened and one of the statements that was removed was "*I can adjust to a new campus environment*." Additionally, 2022 student respondents identifying as ACCESS scholars included both the 2021 cohort and the 2022 cohort of ACCESS scholars. The 2021 ACCESS scholars were in their second year of the ACCESS program and many of them were close to graduation, while the 2022 ACCESS scholars were in the second semester of their first year in the program. Only 10 ACCESS scholars (out of 18) responded to the 2022 survey.

The survey results of the ACCESS scholars, the non-ACCESS matched pair group, and the non-ACCESS full group are presented in Figure 3 below. For each statement presented in the graph, the top bar represents the responses of the ACCESS respondents, the middle bar represents the responses of the non-ACCESS matched pair control group, and the third bar represents the responses of the non-ACCESS full group respondents.

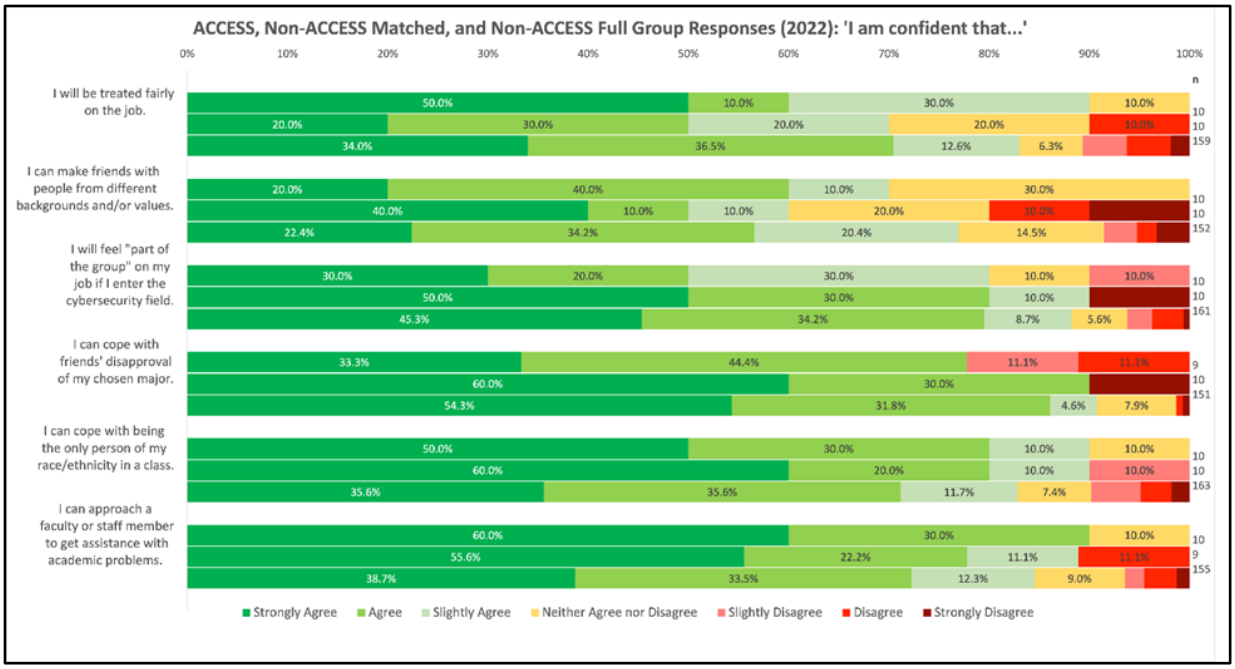

Figure 3. Graph of the 2022 student responses to survey questions indicating their Likert Scale agreement or disagreement with statements related to their confidence levels of various elements related to their "fitting in" on the job after graduation and confidence and comfort in their current environment. The full wording for the first question is: "I will be treated fairly on the job. That is, I expect to be given the same opportunities for pay raises and promotions as my fellow workers if I enter the cybersecurity field." It was shortened in the graph above for formatting purposes.
**Note: In 2022, a few changes were made to the survey to make it shorter. The statement "I can adjust to a new campus environment" was omitted from the 2022 survey.*

There are some notable differences in the ACCESS scholars' 2022 response distributions compared to 2021 responses. When asked if "*I will be treated fairly on the job*", ACCESS students primarily indicated agreement, and in fact showed the most agreement (90% overall) out of the three groups. This result represents a significant increase over the previous year's 62.5% agreement with the statement, which may be due to the facts that cohort 1 students who took the survey in 2022 were receiving the scholarship for two academic years and most of them had summer internships

With respect to being able to "*...make friends with people from different backgrounds and/or values*", the full group of non-ACCESS respondents showed the highest level of agreement for this statement (77%), while the ACCESS and matched non-ACCESS respondents (70% and 60%, respectively) showed slightly less agreement in comparison. ACCESS scholars tended to be less likely to indicate 'Strongly Agree' to this question, which is interesting considering that ACCESS aims to distribute scholarships to diverse cohorts. The small numbers in the ACCESS and matched non-ACCESS respondent groups may have affected these results.

Although all three groups tended to respond favorably to feeling "*part of the group*", ACCESS scholars were behind their non-ACCESS counterparts (by approximately 10%) in the agreement responses and only 30% chose "Strongly Agree" for this question.

ACCESS scholars again did not provide as strong an agreement for the statement "*I can cope with friends' disapproval of my chosen major*" compared to their non-ACCESS counterparts; however, this result may possibly be attributed to ACCESS scholars' class status. In 2022, many of the ACCESS scholars were under-classmen.

At 90% agreement, both ACCESS scholars and their non-ACCESS matched counterparts were steady in their agreement with the statement, "*I can cope with being the only person of my race/ethnicity in a class.*" This result is in line with what would be expected; since ACCESS scholars from 2022 did not experience as much diversity in their cohort, it is likely that the respondents from this year's survey were responding to a statement that they were already experiencing. It is also likely that many students of the majority race/ethnicity responded to the question positively even if they had not experienced being the only one of their race or ethnicities in a class.

Finally, the ACCESS students' overwhelmingly positive responses to the statement "*I can approach a faculty or staff member to get assistance with academic problems*" indicates alignment with a common trend in education. Since ACCESS scholars are classified as "good students" who meet specific GPA requirements, it is more likely that they are comfortable with approaching faculty members for assistance.

Comparing Results of the 2021 and 2022 Survey Responses

When comparing responses from the spring 2021 survey and the spring 2022 survey, the following three observations stand out:

For the "*I will be treated fairly on the job*" statement, the ACCESS scholar agreement levels increased from the 2021 level of 62.5% to 90% on the 2022 survey. Since the 2022 survey respondents consisted of ACCESS scholars from both cohort 1 and cohort 2, these results may indicate an area of growth for some of the ACCESS scholars.

For the "*I can make friends with people from different backgrounds and/or values*" statement, all three groups indicated lower agreement in 2022 than in 2021. The ACCESS scholars' level of agreement dropped 18.9% from an overall 88.9% agreement (with 77.8% strongly agree) in 2021 to an overall 70% agreement (with only 20% strongly agree) in 2022. The non-ACCESS matched pair group demonstrated a larger drop; from 88.9% agreement (with 66.7% strongly agree) in 2021 to 60% (with 40% strongly agree) in 2022. The non-ACCESS Full Group dropped 15.1%, from an overall 92.1% agreement (with 58.9% strongly agree) to 77% agreement (with 22.4% strongly agree).

For the "*I can approach a faculty or staff member to get assistance with academic problems*" statement, the ACCESS scholar agreement level increased 23.4% from 66.6% in 2021 to 90% in 2022, while the matched non-ACCESS students' agreement remained the same at 88.9% and the non-ACCESS full group's agreement decreased slightly (2.4%) from 86.9% in 2021 to 84.5% in

2022. This result is interesting because several of the faculty members who teach cybersecurity courses are also engaged at some level in the ACCESS program. These faculty may be more visible to the ACCESS scholars since they help to arrange and also attend many of the ACCESS program events throughout the year. It appears that the faculty and staff engagement in ACCESS activities may contribute to students' level of comfort in approaching them for assistance when they need it.

4.0 Limitations

Conclusions from this research are restricted by several study limitations. First, the ACCESS scholar cohorts, and therefore the non-ACCESS matched groups, are too small to make any statistically significant claims. Because of the small sample size, no statistical tests were run. Second, since the ACCESS program has a minimum 3.0 GPA requirement, all students in the ACCESS cohorts and their non-ACCESS matched peers had GPAs of at least 3.0. Hence the GPA variation in these groups is too small to see a noticeable reflect difference in academic performance due to any of the ACCESS activities. Even more, many ACCESS activities, such as the technical and career development seminars, are open to all students and benefit all that attend. Third, the effects of COVID and the associated restrictions of recent years may pose a threat to the validity of this study. The 2021 cohort's first year was under many of the COVID-related restrictions on campus and those isolation and people avoidance behaviors may have affected students' perception of belonging. The 2022 cohort experienced the first year of the "new normal" on campus, with many of the face-to-face activities restarting.

While a longitudinal analysis of the cohorts may be interesting, since the 2021 and 2022 cohorts had many upper-level students, very few students will be in the program for the full four years. For example, the final students from cohort 1 are expected to graduate in May 2023. As students graduate, their scholarship is awarded to another student, thereby creating turnovers within a relatively short timetable. Additionally, not all ACCESS scholars responded to the survey questions in the second year it was conducted.

5.0 Summary of Results, Conclusions, and Suggestions for Future Research

The research question investigated was: *Is the sense of belonging for ACCESS scholars different from the sense of belonging for the control group consisting of their peers attending the same required courses?* To answer this question based on the data presented in this work, Table 4 summarizes the results of the multiple survey question responses to elements from the MSLQ survey that relate to expectations of "fitting in" and behaviors of confidence and self-esteem that may indicate a sense of belonging.

Table 4. Summary of results to sub-measure statements from ACCESS scholars, non-ACCESS matched pair control group, and non-ACCESS full control group. Numbers presented represent percent agreement to the statement (i.e., "Strongly Agree", "Agree" and "Slightly Agree")

Research Question	Sub-measures for MSLQ Survey	Year	ACCESS Scholars	Matched Pair Control Group	Full Control Group
Is the sense of belonging for ACCESS scholars different from the sense of belonging for the control group?	***Expectation of "fitting in"***				
	1. I will feel "part of the group" on my job is I enter the cybersecurity field	2021	62.5	88.8	79.5
		2022	80.0	90.0	88.2
	2. I will be treated fairly on the job. That is, I expect to be given the same opportunities for pay raises and promotions as my fellow workers if I enter the cybersecurity field.	2021	62.5	85.8	84.0
		2022	90.0	70.0	83.1
	Self Esteem and Confidence				
	1. I can make friends with people from different backgrounds and/or values.	2021	88.9	88.9	92.1
		2022	70.0	60.0	77.0
	2. I can cope with friends' disapproval of my chosen major.	2021	88.9	87.5	88.5
		2022	77.7	90.0	90.7
	3. I can cope with being the only person of my race/ethnicity in a class.	2021	77.8	87.5	88.5
		2022	90.0	90.0	82.9
	4. I can approach a faculty or staff member to get assistance with academic problems.	2021	66.6	88.9	86.9
		2022	90.0	88.9	84.5

A review of the responses to the identified sub-elements appears to indicate that the ACCESS scholars have a different sense of belonging than the control groups studied. Specifically, their expectation of feeling "part of the group" in their future job in the cybersecurity field is lower than the expectations of their peers in both survey years. The difference, however, is much smaller in the 2022 survey due to the significantly increased agreement with the statement among ACCESS scholars. Their expectation of fair treatment in the cybersecurity profession also increased for ACCESS respondents between the 2021 and the 2022 surveys. Some of that increase may be due to personal growth and the positive experiences described in seminars presented by cybersecurity experts through the ACCESS program, as well as to students' experiences during their summer internships. Similarly, ACCESS students appear to have increased their confidence in being able to approach a faculty or staff member to get assistance with academic problems between the 2021 and 2022 surveys. This result may be explained by the changing population of ACCESS students. All 2021 survey respondents were in their first year of the ACCESS program, while among 2022 survey respondents some students were in their first and other in their second year of the ACCESS program. The variation of time in the ACCESS program, along with the natural maturity gained by completing another year of college and life, may explain some of the increase.

Future work may include augmenting the survey with additional questions related to the sense of belonging. Furthermore, we plan to include questions related to the socio-economic status and location of students' permanent residence, which will help us to better explain the findings. Lastly, the ACCESS scholar group in the incoming spring 2023 survey will consist of three cohorts, with a larger number of scholars which will hopefully lead to larger sample sizes.

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Appendix

ACCESS Cohort 1 versus Non-ACCESS Full Group Responses (2021): I am confident that… [*For each statement: Top row = ACCESS Cohort 1 Responses; bottom row = Non-ACCESS student responses*]							
	Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
I will be treated fairly on the job…	3 (37.5%)	2 (25.5%)	0	2 (25.5%)	1 (12.5%)	0	0
	119 (42.0%)	90 (31.8%)	29 (10.2%)	25 (8.8%)	8 (2.8%)	7 (2.5%)	5 (1.8%)
I can make friends…	7 (77.8%)	1 (11.1%)	0	1 (11.1%)	0	0	0
	165 (58.9%)	76 (27.1%)	17 (6.1%)	12 (4.3%)	4 (1.4%)	3 (1.1%)	3 (1.1%)
I will feel "part of the group" on my job...	1 (12.5%)	2 (25%)	2 (25%)	2 (25%)	1 (12.5%)	0	0
	80 (29.3%)	96 (35.2%)	41 (15.0%)	41 (15.0%)	6 (2.2%)	5 (1.8%)	4 (1.5%)
I can cope with friends' disapproval of my chosen major.	7 (77.8%)	1 (11.1%)	0	0	0	1 (11.1%)	0
	147 (54.0%)	76 (27.9%)	18 (6.6%)	23 (8.5%)	2 (0.7%)	3 (1.1%)	3 (1.1%)
I can cope with being the only person…	7 (77.8%)	0	0	1 (11.1%)	0	1 (11.1%)	0
	150 (56.0%)	76 (28.4%)	11 (4.1%)	20 (7.5%)	5 (1.9%)	1 (0.4%)	5 (1.9%)
I can approach a faculty….	4 (44.4%)	1 (11.1%)	1 (11.1%)	1 (11.1%)	2 (22.2%)	0	0
	106 (36.7%)	96 (33.2%)	49 (17.0%)	19 (6.6%)	10 (3.5%)	6 (2.1%)	3 (1.0%)
I can adjust…	7 (77.8%)	0	0	1 (11.1%)	1 (11.1%)	0	0
	116 (40.6%)	101 (35.3%)	38 (13.3%)	18 (6.3%)	6 (2.1%)	4 (1.4%)	3 (1.0%)

ACCESS Cohorts 1 & 2 versus Non-ACCESS Full Group Responses (2022): I am confident that… [*For each statement: Top row = ACCESS Cohort 1 & 2 response and the bottom row = Non-ACCESS student responses*]							
	Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
I will be treated fairly on the job…	5 (50.0%)	1 (10.0%)	3 (30.0%)	1 (10.0%)	0	0	0
	54 (34.0%)	58 (36.5%)	20 (12.6%)	10 (6.3%)	7 (4.4%)	7 (4.4%)	3 (1.9%)
I can make friends…	2 (20.0%)	4 (40.0%)	1 (10.0%)	3 (30.0%)	0	0	0
	34 (22.4%)	52 (34.2%)	31 (20.4%)	22 (14.5%)	5 (3.3%)	3 (2.0%)	5 (3.3%)
I will feel "part of the group" on my job...	3 (30.0%)	2 (20.0%)	3 (30.0%)	1 (10.0%)	1 (10.0%)	0	0
	73 (45.3%)	55 (34.2%)	14 (8.7%)	9 (5.6%)	4 (2.5%)	5 (3.1%)	1 (0.6%)

I can cope with friends' disapproval of my chosen major.	3 (33.3%)	4 (44.4%)	0	0	1 (11.1%)	1 (11.1%)	0
	82 (54.3%)	48 (31.8%)	7 (4.6%)	12 (7.9%)	0	1 (0.7%)	1 (0.7%)
I can cope with being the only person…	5 (50.0%)	3 (30.0%)	1 (10.0%)	1 (10.0%)	0	0	0
	58 (35.6%)	58 (35.6%)	19 (11.7%)	12 (7.4%)	8 (4.9%)	5 (3.1%)	3 (1.8%)
I can approach a faculty….	6 (60.0%)	3 (30.0%)	0	1 (10.0%)	0	0	0
	60 (38.7%)	52 (33.5%)	19 (12.3%)	14 (9.0%)	3 (1.9%)	5 (3.2%)	2 (1.3%)

2021 survey ACCESS versus Non-ACCESS Matched Demographic Data Summary

Class	**ACCESS**	**Non-ACCESS**
Sophomore	0	6 (66.7%)
Junior	5 (55.6%)	1 (11.1%)
Senior	4 (44.4%)	2 (22.2%)

Year	**ACCESS**	**Non-ACCESS**
Second-Year College Student	2 (22.2%)	7 (77.8%)
Third-Year College Student	7 (77.8%)	2 (22.2%)

2022 survey ACCESS versus Non-ACCESS Matched Demographic Data Summary

Class	**ACCESS**	**Non-ACCESS**
Freshman	2 (20%)	0
Sophomore	1 (10%)	2 (20%)
Junior	1 (10%)	3 (30%)
Senior	6 (60%)	5 (50%)

Year	**ACCESS**	**Non-ACCESS**
First-Year College Student	3 (30%)	0
Second-Year College Student	1 (10%)	3 (30%)
Third-Year College Student	2 (20%)	4 (40%)
Fourth-Year College Student	3 (30%)	2 (20%)
Fifth-Year College Student or Above	1 (10%)	1 (10%)