AAP STUDENT EXPERIENCES - LIFE SCIENCES & PHYSICAL SCIENCES

Celeste Vargas Vera

EDUC-199

Dr. Alice Ho

June 16, 2023

I. Abstract

The Academic Advancement Program (AAP) was created by and for students that have been historically underrepresented in higher education, and the program aims to help minority students not only graduate from UCLA, but also excel in their studies during their time at UCLA. AAP has over 4,000 members across all majors. STEM students comprise around 57%, and of the STEM students in AAP, only 9% are in the fields of Physical Science compared to 42% majoring in the Life Sciences. With the use of the AAP Annual Survey data, a survey distributed by the Research, Assessment, and Evaluation unit in AAP to learn about AAP student experiences in both AAP and the UCLA campus, this paper examines students' participation in AAP services aimed to provide academic support while building community, like AAP Peer Learning. In addition, the paper compares the experiences of AAP students in the Physical Sciences and those in the Life Sciences, as well as how student experiences differ between genders and within each field. More specifically, I examine their sense of belonging, as well as academic confidence and doubt. Results indicate that overall, Physical Science students self-report to utilize AAP Peer Learning less than Life Science students, and Physical Science students and female students in the Life Sciences reported higher levels of self academic doubt when compared to their male counterparts, and females in the Physical Sciences reported higher levels of self academic doubt when compared to females in the Life Sciences.

II. Introduction

The popular discourse is that minority students and female students are underrepresented and at a disadvantage when it comes to science, technology, engineering, and mathematics (STEM), with some of the reasons why students might be discouraged about pursuing STEM are not exclusive to course difficulty, inadequate high school preparation, low grades, and extreme competitiveness (Strenta et al., 1994). Furthermore, while males and females have similar interests in pursuing STEM, females tend to persist in STEM less than males, specifically in fields such as those in the Physical Sciences and mathematics (Strenta et al., 1994). Some studies have found that attending higher ranked universities can negatively impact less prepared minority student graduation rates in STEM (Arcidiacono et al., 2016). Other studies have found that females' interest in STEM can be dependent on their sense of belonging in STEM when compared to their male counterparts (Xu & Lastrapes, 2021, Smith et al., 2012).

To change the discourse, research is blooming with solutions on how to increase minority and female STEM interest and retention, and academic confidence and a sense of belonging seem to be integral to academic success. Summer bridge programs have shown success in the increase of female and minority student retention in STEM associated with better preparation along with a higher sense of belonging (Tomasko et al., 2016, Nostrand & Pollenz, 2017). Mentorship programs have also shown an increase in academic confidence and sense of belonging for STEM students (Apriceno et al., 2020). The Academic Advancement Program (AAP) at the University of California, Los Angeles (UCLA) is dedicated to helping underrepresented students adjust and thrive in college by providing resources such as Counseling, Peer Counseling, Graduate Mentoring, Peer Learning mentorship, among other resources. This study will analyze whether these resources are not only helping the students they

serve in terms of their sense of belonging and academic confidence, but also determine how female students and students in STEM are benefiting from these resources in those categories. Most of the literature has compared STEM students versus non-STEM students as control, like in Griffith (2010), where STEM measures were often compared to non-STEM measures, so this study will further break down how students are doing within STEM. Several studies also often pool students in the Life Sciences and Physical Sciences and do not compare within them, just like in Nostrand and Pollenz (2017). The study ultimately wants to investigate if Physical Science students have different levels of sense of belonging and academic confidence compared to Life Science students. In this study, the prediction is that Physical Science students have overall lower levels of academic confidence and sense of belonging, when compared to Life Science students.

Peer mentoring and learning communities are also important factors in student STEM retention. Dagley et al. (2016) found that their creation of an EXCEL program dedicated to being a learning college community increased minority students and female students' retention and graduation rates in STEM. While the EXCEL program focuses mostly on first- and second-year students, the first two years of college can be pivotal when remaining in STEM (Griffith, 2010). This is especially important when grades are one of the biggest predictors of students remaining in the Physical Sciences (Kopparla, 2019). AAP offers Peer Learning sessions for lower division courses to their students and given that learning communities can help student retention and grades are an important factor of student retention in STEM, the study wants to observe whether an increase of Peer Learning engagement could be recommended to Life Science students or Physical Science students if they report a different in their sense of belonging and academic confidence.

There are, however, studies that prove otherwise. Jordan and Carden (2017) found no relationship between self-efficacy and gender. They do suggest that further research should be performed at bigger universities to observe if this is a general finding or a finding that is unique to their community at Trevecca Nazarene University. With over forty thousand undergraduate students, and four thousand AAP students, UCLA falls into the category of those big universities worth investigating. Moreover, Van Soom and Donche (2014) found no significance between females and levels of self academic concept. However, their study does suggest that a high-pressure environment can lead to higher levels of "controlled motivation." They also cite that the study being conducted in Belgium could be an additional finding for these factors, in which they explain that in Belgium, students are not burdened with tuition fees due to university programs being free and there are no "central exams" at the of their high school level education. Higher education in the United States and UCLA follow an opposite paradigm than universities in Belgium, rendering this study worth performing for the student population within AAP at UCLA.

III. Methods

I. Data Description

The data for this research came from the AAP Annual Survey, a survey distributed by the Research, Assessment, and Evaluation (RAE) unit of the Academic Advancement Program (AAP). The survey was distributed for the first time to the AAP student population during the Spring academic quarter of the University of California, Los Angeles (UCLA) in 2022, utilizing an online method of distribution. Thus, the sample of students comprises the graduating classes of 2022, 2023, 2024, and 2025. The entire dataset is composed of 477 observations and 231

variables. The variables include not only demographics of each student, academic status, and grade point average, but also their recorded responses to the survey.

II. Sample

To successfully conduct this research, students who were recorded as Life Science students and Physical Science students were subset from the main dataset, resulting in two datasets, one for Life Science students and one for Physical Science students. The Life Science students' dataset had 225 observations and 231 variables, while the Physical Science students' dataset had 40 observations and 231 variables. The focus variables of the research are Peer Learning utilization, self academic doubt, self academic confidence, and sense of belonging. In the Life Science students, for self academic doubt and self confidence, 196 students responded, whereas for sense of belonging 197 students responded and 216 students responded to Peer Learning utilization. In contrast, 34 Physical Science students responded for self academic doubt, 36 Physical Science students responded for academic confidence and sense of belonging, while 38 students responded to Peer Learning utilization. Moreover, to identify trends in gender, both the Life Science dataset and the Physical Science dataset were further split into female Life Science and male Life Science datasets, as well as female Physical Science and male Physical Science datasets.

The female Life Science students' data had 182 observations and 231 variables, while the male Life Science students' data had 38 observations and 231 variables. The female Physical Science students had 28 observations and 231 variables and the male Physical Science students had 12 observations and 231 variables. The variable breakdown for each dataset was that for female life students, 156 students had a mean for self academic doubt, 158 students had a mean

for self academic confidence and 158 had a mean for sense of belonging. Male Life Science students had a mean for 35 students for both self academic doubt and sense of belonging and 33 had a mean for self academic confidence. Female Physical Science students, 25 students had a mean for self academic doubt and 27 students had a mean for self academic confidence and sense of belonging. Male Physical Science students had 9 students with mean for all variables. However, to protect these identities, the sample size will be treated as 10 students. For gender identities, only female and male identities because Physical Science students did not have any students identifying themselves as other genders, so there was no comparison for the students in the Life Sciences with different gender identities.

III. Survey

The variables of central focus to this study are self academic doubt, self academic confidence, sense of belonging, and AAP Peer Learning utilization.

IV. Self Academic Doubt

The category of Self Academic Doubt originated from articles by Reynolds, W. M. (1988) and Flowers, L. O., Raynor, J. E., & White, E. N. (2013), both of which focused on the measurement of the self academic concept of college students. In this survey, the variable Self Academic Doubt is measuring the students' average self doubt factor from the self concept scale. The variable of Self Academic Doubt followed a four level Likert scale ranging from 1 as "Strongly disagree" ro 4 as "Strongly Agree" for the following questions:

- I sometimes feel like dropping out of school.
- I often get discouraged about school.
- I feel that I do not have the necessary abilities for certain courses in my major.
- At times I feel like a failure.
- At times I feel college is too difficult for me.

- I have doubts that I will do well in my major.
- I have a hard time getting through school.
- I often expect to do poorly on exams.

V. Self Academic Confidence

The category of Self Academic Confidence originated from articles by Reynolds, W. M. (1988) and Flowers, L. O., Raynor, J. E., & White, E. N. (2013), both of which focused on the measurement of the self academic concept of college students. In this survey, the variable Self Academic Confidence is measuring the students' average self confidence in academics factor from the self concept scale. Additionally, the variable of Self Academic Confidence followed a four level Likert scale ranging from 1 as "Strongly disagree" ro 4 as "Strongly Agree" for the following questions:

- Most courses are very easy for me.
- Most exams are easy for me.
- Most of the time while taking a test I feel confident.

VI. Sense of Belonging

The category of Sense of Belonging was sourced from the article by Hurtado, S., & Carter, D. F. (1997), which talked about the effects of the college transition on Latino students' sense of belonging. Moreover, the variable of Sense of Belonging averaged student responses to questions pertaining to sense of belonging and followed a ten level numerical scale ranging from 0 as "Strongly disagree" ro 10 as "Strongly Agree" for the following questions:

- I see myself as part of the campus community.
- I feel that I am a member of the campus community.
- I feel a sense of belonging to the campus community.

VII. AAP Peer Learning Engagement

The variable of AAP Peer Learning Engagement was the self-reported Peer Learning engagement measurements that followed an ordinal scale, in which 0 meant "Did NOT utilize or was NOT involved with," and the number 1 meant "Yearly" until number 5 is reached with "Daily" to answer the following question:

- On average, this academic year, how often did you utilize or were you involved with each of the following AAP units/services? Peer Learning

VIII. Data Analysis

To analyze the relationships of the factors of self academic doubt, self academic confidence and sense of belonging in gender and field of study, the study was divided in three sections, one for each factor, and then each section was further divided into three categories each: Overall, By Field, and By Gender. The "Overall" category explores the relationship between the overall population of Life Science students and the overall population of Physical Science students. The "By Field" category explores the relationship between females and males within each field, such as the relationship between females in the Life Sciences and males in the Life Sciences with respect to sense of belonging, for instance. On the other hand, the "By Gender" category explores gender differences across fields, such as exploring the relationship between female Life Science students and female Physical Science students with respect to self academic doubt. To analyze these relationships, nine Mann-Whitney U tests were performed. Because Likert-like data have a tendency to not have normal distributions and some of these groups are small in population size, a non-parametric hypothesis test was chosen. Additionally, Şimşek (2023), found that in Likert-like data, the Mann-Whitney U test provided higher statistical power and lower Type I errors over the Student's t-test and the Welch t-test consistently. The Welch t-test has also been found to inflate Type I errors in small samples, even

when assumptions are met (Adusah & Brooks, 2011). The summary statistics used to give more detail of these relationships were the median and the Interquartile Range because the distributions per question were similar visually.

IX. Exploratory Data Analysis

AAP Peer Learning Self-reported Engagement

Descriptive statistics in self-reported AAP Peer Learning Engagement showed that students in the Life Sciences (Figure 1) utilized Peer Learning more often than Physical Science students (Figure 2). Students in the Life Sciences saw around 35% of the sample utilize Peer Learning weekly, compared to around 21% of Physical Science students. Around 45% of Physical Science students reported not utilizing Peer Learning, and around 30% of Life Sciences students reported not utilizing Peer Learning. When filtered for underclassmen, the trends were the same for both Physical and Life Science students.

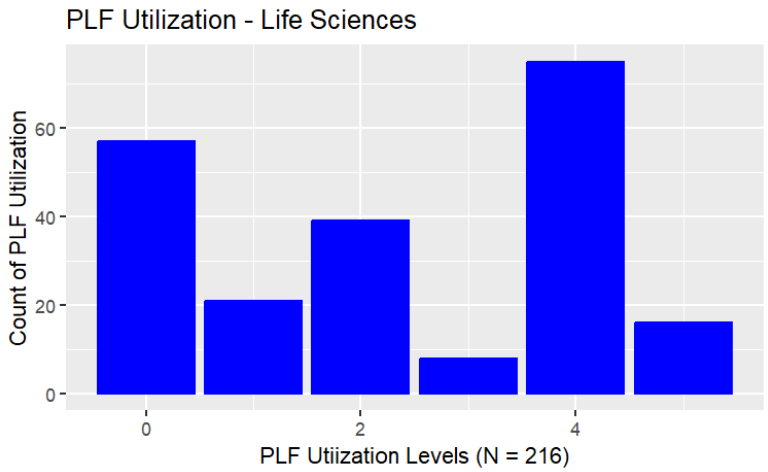

Figure 1. Life Science Peer Learning Utilization
Key: 0 (Did not utilize), 1 (Yearly), 2 (Quarterly), 3 (Monthly), 4 (Weekly), 5 (Daily)

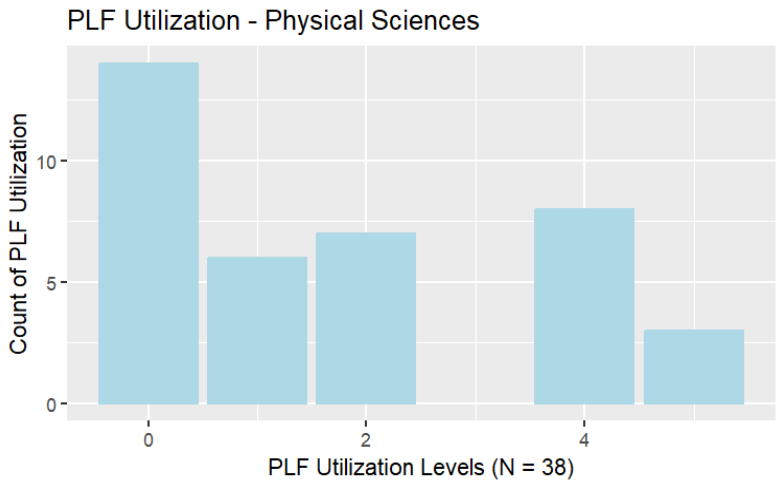

Figure 2. Physical Science Peer Learning Utilization
Key: 0 (Did not utilize), 1 (Yearly), 2 (Quarterly), 3 (Monthly), 4 (Weekly), 5 (Daily)

IV. Results

I. Self Academic Doubt

Tables 1-3 depict the results of self academic doubt. Overall, students in the Physical Sciences had a statistically significantly higher median of self academic doubt (median 2.75, IQR 1.22) when compared to Life Science students (median 2.5, IQR 0.875). Within the Life Science students, females reported statistically significantly higher medians of self academic doubt (median 2.56, IQR 0.91) than their male counterparts (median 2.12, IQR 1.12), and females in the Physical Sciences reported statistically significantly higher medians of self academic doubt (median 2.88, IQR 1.12) than females in the Life Sciences (median 2.56, IQR 0.91).

Overall	Life Science (n = 196)	Physical Science (n =35)
Median(IQR)	2.5 (0.875)*	2.75 (1.22)*

Table 1. Self academic doubt overall Life Science vs Physical Sciences comparison.
Note: Asterisk (*) indicates significant difference of p<0.05

By Field	Female	Male
Life Science (n = 156, n = 35)	2.56 (0.91)*	2.12 (1.12)*
Physical Science (n = 25, n = 10)	2.88 (1.12)	2.38 (1.12)

Table 2. Self academic doubt Life Science vs Physical Sciences comparison by Field
Note: Asterisk (*) indicates significant difference of p<0.05

By Gender	Life Science	Physical Science
Female (n = 156, n = 25)	2.56 (0.91)*	2.88 (1.12)*
Male (n = 35, n = 10)	2.12 (1.12)	2.38 (1.12)

Table 3. Self academic doubt Life Science vs Physical Sciences comparison by Gender
Note: Asterisk (*) indicates significant difference of p<0.05

II. Self Confidence in Academics

Tables 4-6 depict the differences in median levels of self academic confidence. Females did have smaller median levels of self academic confidence than males in both the Life Sciences and Physical Sciences (Tables 5 & 6). However, these results were not statistically significant.

Overall	Life Science (n = 196)	Physical Science (n =37)
Median(IQR)	2 (0.67)	2 (0.75)

Table 4. Self confidence in academics overall Life Science vs Physical Sciences comparison

By Field	Female	Male
Life Science (n = 158, n = 33)	2 (0.67)	2.33 (0.67)
Physical Science (n = 27, n = 10)	2 (1)	2.33 (1)

Table 5. Self confidence in academics Life Science vs Physical Sciences comparison by Field

By Gender	Life Science	Physical Science
Female (n = 158, n = 27)	2 (0.67)	2 (1)
Male (n = 33, n = 10)	2.33 (0.67)	2.33 (1)

Table 6. Self confidence in academics Life Science vs Physical Sciences comparison by Gender

III. Sense of Belonging

Tables 7-9 depict the differences in median levels of sense of belonging. Sense of belonging median levels differed within field and gender. However, these results were not statistically significant.

Overall	Life Science (n = 197)	Physical Science (n =37)
Median(IQR)	7 (3)	7.17 (3.08)

Table 7. Sense of belonging overall Life Science vs Physical Sciences comparison

By Field	Female	Male
Life Science (n = 157, n = 35)	7 (2.67)	6.33 (3)
Physical Science (n = 27, n = 10)	6 (2.83)	7.67 (2.83)

Table 8. Sense of belonging Life Science vs Physical Sciences comparison by Field

By Gender	Life Science	Physical Science
Female (n = 157, n = 27)	7 (2.67)	6 (2.83)
Male (n = 35, n = 10)	6 (2.83)	7.67 (2.83)

Table 9. Sense of belonging Life Science vs Physical Sciences comparison by Gender

V. Discussion

In terms of academic confidence and sense of belonging, there were no significant differences between students in the Life Sciences and Physical Sciences overall. There were reported differences between students in terms of self academic doubt between students in the Life Sciences and Physical Sciences, as well as reports of female Life Science students with higher levels of self academic doubt than their male counterparts, and female Physical Science students having higher levels of self academic doubt than females in the Life Sciences. The study also observed that students in the Physical Sciences are not utilizing Peer Learning as much as students in the Life Sciences, with measures of 45% and 30% of students not utilizing Peer Learning, respectively.

From previous studies, it is unfortunately not surprising that female students are usually upon the most affected populations in terms of self academic concept, in this case self academic doubt, especially those in the Physical Sciences, concurrent with the study by Strenta et al. (1994). However, it was refreshing to find that in terms of self academic confidence and sense of belonging, students in either field or gender had no significant difference, suggesting that AAP is helping students get acclimated to UCLA, also concurrent with studies by Apriceno et al. (2020), Nostrand and Pollenz (2017), and Tomasko et al. (2016). To decrease self academic doubt between students, it is suggested to get more students taking Peer Learning, as studies have shown that peer mentoring is beneficial for students (Dagley et al., 2016).

Lastly, there are, however, limitations that have to be acknowledged. For instance, Peer Learning engagement is only self-reported based on students that answered the survey. Second, some of the populations in this data were small in nature, resulting in sacrificed statistical power in the statistical analysis component. Lastly, the data from this paper was gathered from the first ever administered AAP Annual Survey. More longitudinal research needs to be conducted in order to get the full picture of the AAP student population.

References

Adusah, A. K., & Brooks, G. P. (2011). Type I Error Inflation of the Separate-Variances Welch t test with Very Small Sample Sizes when Assumptions Are Met. *Journal of Modern Applied Statistical Methods*, *10*(1), 362–372. https://doi.org/10.22237/jmasm/1304224320

Apriceno, M., Levy, S. R., & London, B. (2020). Mentorship During College Transition Predicts Academic Self-Efficacy and Sense of Belonging Among STEM Students. *Journal of College Student Development*, *61*(5), 643–648. https://doi.org/10.1353/csd.2020.0061

Arcidiacono, P., Aucejo, E. M., & Hotz, V. J. (2016). University Differences in the Graduation of Minorities in STEM Fields: Evidence from California. *The American Economic Review*, *106*(3), 525–562. https://doi.org/10.1257/aer.20130626

Dagley, M. A., Georgiopoulos, M., Reece, A. J., & Young, C. Y. (2016). Increasing Retention and Graduation Rates Through a STEM Learning Community. *Journal of College Student Retention: Research, Theory and Practice*, *18*(2), 167–182. https://doi.org/10.1177/1521025115584746

Flowers, L. O., Raynor, J. E., & White, E. N. (2013). Investigation of academic self-concept of undegraduate in STEM courses. Journal of Studies in Social Sciences, 5(1), 1-11.

Griffith, A. L. (2010). Persistence of women and minorities in STEM field majors: Is it the school that matters? *Economics of Education Review*, *29*(6), 911–922. https://doi.org/10.1016/j.econedurev.2010.06.010

Hurtado, S., & Carter, D. F. (1997). Effects of college transition and perceptions of the campus racial climate on Latino college students' sense of belonging. Sociology of Education, 70(4), 324-345. https://doi.org/10.2307/2673270

Jordan, K., & Carden, R. (2017). Self-efficacy and gender in STEM majors. *Modern Psychological Studies*, *22*(2), 8. https://scholar.utc.edu/cgi/viewcontent.cgi?article=1275&context=mps

Kopparla, M. (2019). Role of Mathematics in Retention of Undergraduate STEM Majors: A Meta-Analysis. *Journal of Mathematics Education*, *12*(1). https://doi.org/10.26711/007577152790041

Nostrand, D. F., & Pollenz, R. S. (2017). Evaluating Psychosocial Mechanisms Underlying STEM Persistence in Undergraduates: Evidence of Impact from a Six-Day Pre–College Engagement STEM Academy Program. *CBE- Life Sciences Education*, *16*(2), ar36. https://doi.org/10.1187/cbe.16-10-0294

Reynolds, W. M. (1988). Measurement of academic self-concept in college students. Journal of Personality Assessment, 52(2), 223-240. https://doi.org/10.1207/s15327752jpa5202_4

Şimşek, A. S. (2023). The power and type I error of Wilcoxon-Mann-Whitney, Welch's t, and Student's t tests for Likert-type data. *International Journal of Assessment Tools in Education*, *10*(1), 114–128. https://doi.org/10.21449/ijate.1183622

Smith, J. L., Lewis, K. L., Hawthorne, L. M., & Hodges, S. D. (2012). When Trying Hard Isn't Natural. *Personality and Social Psychology Bulletin*, *39*(2), 131–143. https://doi.org/10.1177/0146167212468332

Strenta, A. C., Elliott, R., Adair, R. K., Matier, M. W., & Scott, J. (1994). Choosing and leaving science in highly selective institutions. *Research in Higher Education*, *35*(5), 513–547. https://doi.org/10.1007/bf02497086

Tomasko, D. L., Ridgway, J. S., Waller, R. J., & Olesik, S. V. (2016). Research and Teaching: Association of Summer Bridge Program Outcomes With STEM Retention of Targeted

Demographic Groups. *Journal of College Science Teachin*, *045*(04). https://doi.org/10.2505/4/jcst16_045_04_90

Van Soom, C., & Donche, V. (2014). Profiling First-Year Students in STEM Programs Based on Autonomous Motivation and Academic Self-Concept and Relationship with Academic Achievement. *PLOS ONE*, *9*(11), e112489. https://doi.org/10.1371/journal.pone.0112489

Xu, C., & Lastrapes, R. E. (2021). Impact of STEM Sense of Belonging on Career Interest: The Role of STEM Attitudes. *Journal of Career Development*, 089484532110330. https://doi.org/10.1177/08948453211033025