Board 397: The Development of Professional Mentors to Supplement Low Socio-Economic Students' Webs-of-Support

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Abstract

The National Science Foundation approved a program in 2016 to investigate the influence of adult mentor networks on low socio-economic students seeking collegiate degrees in STEM fields. Students who expressed a strong desire for an engineering major at a state-supported land grant institution and were denied admission into engineering, and then admitted into Exploratory Studies, were given scholarships and focused mentoring by faculty and staff. The Rising Scholars program had a very specific pathway of activities through a collegiate career, designed to introduce the student to a variety of potential adult mentors. Students were enrolled in several experiential activities, placing them in proximity with multiple faculty, graduate students, and staff members. Support network members were tracked by researchers throughout the study, and a special index was developed which identifies professional contact. Results indicated that students applying the mentor recruitment methodology actively enhanced their support networks and finished college with a strong web of professional support.

Introduction

The question of pursuing higher education, particularly in demanding STEM majors, is not simple. Some young people in lower socio-economic status (SES) households have many more things to consider than 'am I qualified?' Their decisions generally involve other family members and home responsibilities [1] [2]. To work through these considerations and to prepare for an academically demanding collegiate major, and then be denied admission into it at their local state institution can be emotionally crushing [3] [4]. It is particularly upsetting when it is known that traditional engineering admissions metrics discriminate against otherwise qualified students from challenged backgrounds [5] [6]. Researchers at Purdue University attempted to design an alternative means of selection that utilized a measurement of a student's adult mentor support network, reasoning that if the student had adequate circle of adult backers, then they were more than likely to persevere and successfully complete higher education.

The researchers earned an NSF S-STEM grant in 2016 to study the effects of mentor network connectedness on collegiate STEM field persistence. Students from low SES backgrounds who had expressed an interest in STEM majors and were given admission into exploratory studies were selected as the target pool of participants. These students have become known colloquially as 'Rising Scholars' (RS) [7] [8]. Twenty-one admitted students were selected through a process designed to quantize and measure the quality of a student's adult mentor support network [9]. During the execution of the program, it was hypothesiszed that certain types of mentors, Purdue faculty, staff, and students, might prove more useful in transitioning to a professional career than others. Metrics were developed to measure this influence within the support networks, and this paper provides the results of a study on the effectiveness of that index. The balance of this paper will provide a review of the literature on Rising Scholar students and the larger study results, the methodology of determining the 'Purdue index', the results of the analysis, and conclusions from this work.

Review

It is reasonably well accepted that the current regimen of high stakes collegiate entrance examinations does not predict collegiate success [10] [11] [12], and the problem is compounded when considering low SES students [13] [14]. Even the administration of the College Board that provides SAT and AP testing, concedes that statistical relevance of the exams becomes progressively poorer as students advance deeper into college courses [15]. Fortunately, there are other potential indicators of likely student success. Multiple researchers through several studies have concluded that students' support networks have the single largest influence on their academic and life successes [16] [17] [18] [19] [20].

Purdue researchers decided to focus on the influence of adult and professional support network members and how they might correlate with student success. The recently published Gallup-Purdue index corroborated that interaction with university professionals was imperative for the alumni to their current satisfaction with their job and life in general. Alumni well-being was broken into five views: Purpose: liking what you do; Social: strong interaction with other people; Financial: increased security and reduction of stress; Community: liking and pride in where you live; and Physical: good health and energy. A person could be thriving, struggling, or suffering in these areas. These well-beings are additive, so the more areas a person is thriving in, the more they should be satisfied with life. A Gallup study of 30,000 alumni from universities across the country found that 29% of respondents were not thriving in any area [21].

The Gallup-Purdue index went on to find how satisfied alumni were with their alma maters. It was found that if the alumni felt that their college prepared them for life, their engagement at work was tripled. The important ways that the university environment prepared them for life included six elements. The student needed a professor that supported them, got them excited about learning, and encouraged their dreams. The more engaged employees also had meaningful internships, worked on a project that took a year or more, and were actively engaged in extracurriculars during their college career. Others continued the research to determine what types of interactions created the most impactful faculty-student interactions. They agreed that research with a faculty member in an area of interest or engaging in a long-term project, as well as major specific internships provided the best support for students [22]. These were the types of opportunities that were built into the Rising Scholar Program.

Consequently, the research team designed a program that channeled the selected students into significant levels of contact with professional personnel at the university. Students were taught how to acquire and nurture mentors. They were required to participate in working experiences in a faculty member's laboratory and develop their own research project, in conjunction with a faculty member. The RS pathway during their time at the university is shown in Figure 1. Reporting on the program's efforts to help students develop effective mentor networks [23] and the correlation of this activity with undergraduate retention in a STEM discipline [24] have been provided.

Climate was also recognized as being a vital element of a meaningful collegiate experience [21]. The administration of the Purdue Rising Scholars program worked diligently to replicate the comfortable, community feeling proven to be advantageous in advocacy organizations [25] [26] [27] and small engineering departments [28]. Many of these elements are combined to produce a high-touch environment that indicates to the students that they are supported. Activities, such as an academic bootcamp, annual seminars, dinners, programs, and group events, create kinship and foster comradery, but just as importantly, they keep the students in contact with the program administration, so they become more comfortable interacting with them.
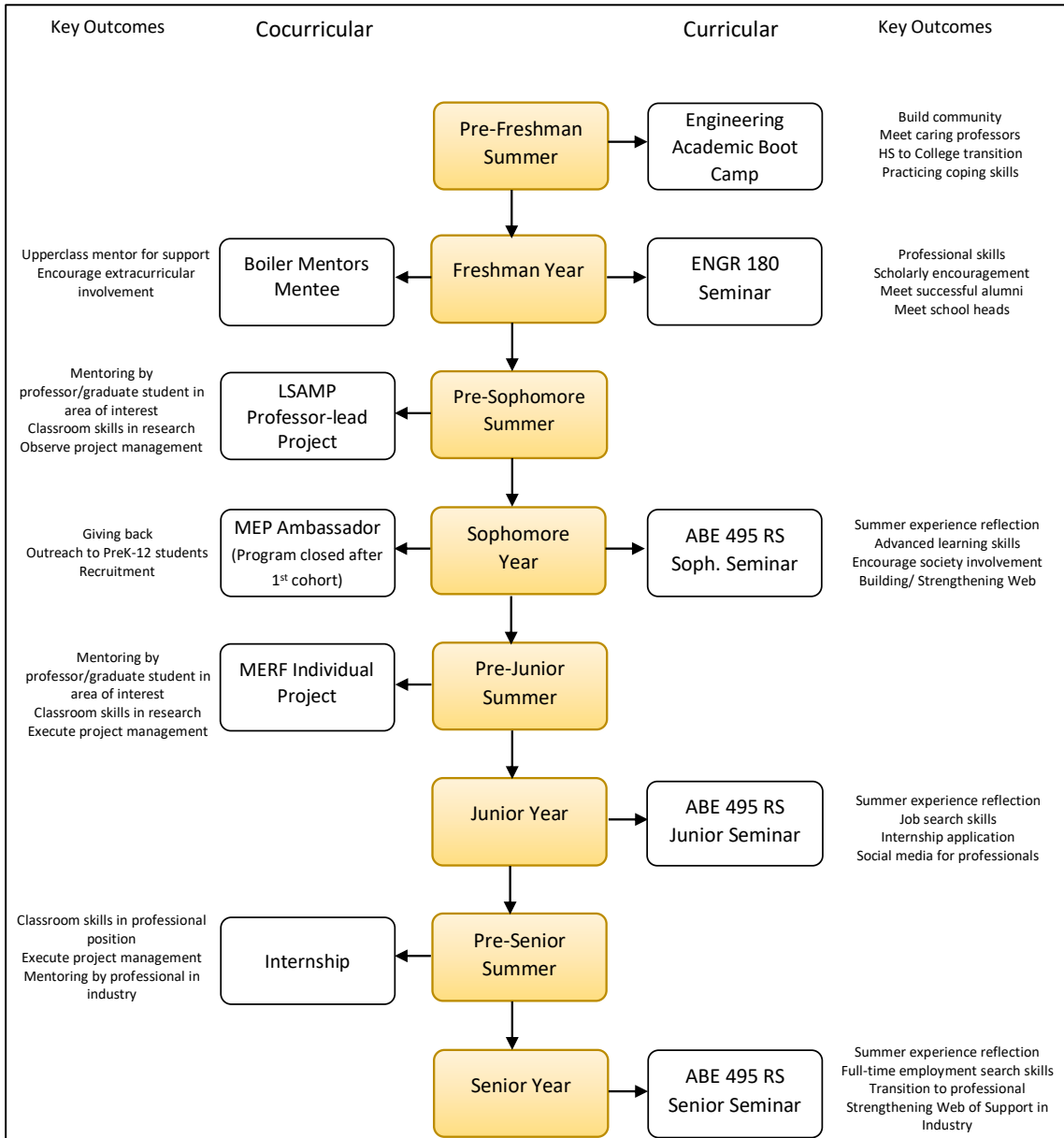
Key Outcomes — **Cocurricular** — **Curricular** — **Key Outcomes**

Key Outcomes (Cocurricular)	Cocurricular	Phase	Curricular	Key Outcomes (Curricular)
		Pre-Freshman Summer	Engineering Academic Boot Camp	Build community / Meet caring professors / HS to College transition / Practicing coping skills
Upperclass mentor for support / Encourage extracurricular involvement	Boiler Mentors Mentee	Freshman Year	ENGR 180 Seminar	Professional skills / Scholarly encouragement / Meet successful alumni / Meet school heads
Mentoring by professor/graduate student in area of interest / Classroom skills in research / Observe project management	LSAMP Professor-lead Project	Pre-Sophomore Summer		
Giving back / Outreach to PreK-12 students / Recruitment	MEP Ambassador (Program closed after 1st cohort)	Sophomore Year	ABE 495 RS Soph. Seminar	Summer experience reflection / Advanced learning skills / Encourage society involvement / Building/ Strengthening Web
Mentoring by professor/graduate student in area of interest / Classroom skills in research / Execute project management	MERF Individual Project	Pre-Junior Summer		
		Junior Year	ABE 495 RS Junior Seminar	Summer experience reflection / Job search skills / Internship application / Social media for professionals
Classroom skills in professional position / Execute project management / Mentoring by professional in industry	Internship	Pre-Senior Summer		
		Senior Year	ABE 495 RS Senior Seminar	Summer experience reflection / Full-time employment search skills / Transition to professional / Strengthening Web of Support in Industry

Figure 1 - Rising Scholar "Best path" through the university to maximize building of collegiate web of support.

Experiential activities and communication skills were emphasized throughout the program's operation. Students were required to participate in a faculty member's research project through the Louis Stokes Alliance for Minority Participation (LSAMP) program to learn technical management skills and then conduct their own project in the Multi-disciplinary Engineering Research Fellowship (MERF) program. Project management skills are highly valued during entry-level job interviews [29] [30], and having more project-based experiential learning provides a breadth of experiences and professional maturity that helps candidates stand-out [31] [32]. Having students interact with faculty and staff members increases their confidence level and allows them to build deeper relationships than those formed only through classroom

association [33] [34]. Helping to forge their written communications skills additionally provides long-term value in professional employment [35] [36]. Outcomes from the Purdue Rising Scholars programs associated with experiential activities have been analyzed and published [37] [38].

The RS cohorts were originally chosen using the number of mentor supporters that the student reported as an evaluation factor. Further analysis of the Rising Scholars' mentor support networks following the COVID pandemic helped develop a methodology which additionally provided a qualitative measure of the depth of an individual mentor's connection to the student. Rather than relying upon simply a self-reported numerical number of contacts, which might artificially inflate a student's level of adult support, a metric was developed that gauged the overall aggregate strength of a student's support using a cumulative index of a weighted relationship quality level. Using this new metric, the Rising Scholar students were parsed into a heavily-webbed group and a thinly webbed group. In general, the Thickly Webbed students were able to maintain their academic focus and performance during the COVID years of 2020 & 2021 better than their thinnly-webbed colleagues [39]. When looking at the growth of the students' mentor support networks as a part of this analysis, special consideration was given to new supporters with an academic background. The rationale for this local-connection enhancement was that professional contacts were the ones likely to be able to help develop an individual's initial career opportunities. The balance of this paper is about the inferences indicated with this local-connection metric operational.

Methodology

The state of each of the Rising Scholars' support networks was investigated each semester over the course of the program. A yearly index of supporters was created with all people that were included in the year's questionnaire. The name of the supporter, the origin of their connection, and the ways that this person supported the Rising Scholar were recorded from the survey. The types of supporters the student listed during their recruitment into the RS were broken into subsets of Parents & Relatives, High School personnel, and Other Adults. Once the student had joined the university, three types of mentors were added, which included: Professors, Staff, and Upperclassmen. The 'Purdue' index was analyzed on how it grew during college and whether the strength of these university personnel impacted how well the Rising Scholar integrated into the university community. The strength of the relationship was found by the student choosing in what ways the mentor interacted with them by choosing between 10 questions. The more connections a student had with a supporter, then the stronger a mentor that person was. A detailed description of this process can be seen in reference [23].

In accordance with the Peterson methodology, students with five or more mentors that were strongly connected, were classified as "Thickly Webbed" (TW) [18]. The other Rising Scholars

were considered "thinly webbed" (tW). While it was hoped that all Rising Scholars coming into the program would be TW, it was found that six of the 17 final students, began and continued to lag behind the rest in their success of cultivating of support individuals. This paper will show results indicating how the Rising Scholars built their webs of support during their college careers, with particular interest in the university personnel as they moved through their pathway through the university.

These two levels of webbed students were also compared in their responses to the altered class presentation and isolation of the COVID epidemic. A matched pair of an engineering student to each Rising Scholar had been created, as the students entered their freshman year. These engineering students were matched by ethnicity, gender, and residency status. Then the closest high school metrics and first semester class schedule were then used to make a final match to the RS. These matches have then been used to compare academic performance and retention throughout the college tenure. A complete description of this process is presented in reference [9].

Whether the incoming TW RS were able to grow their adult support mentor networks on campus better than the tW individuals was examined by looking at the consistency and growth of support networks across time and the inclusion of professionals with increasing time on-campus. These on-campus individuals will be represented by the Purdue Index across the first three years. Various Rising Scholars seemed to handle the COVID epidemic differently, so the research group analyzed whether the students having more problems came from the tW group. None of these data have sample sizes large enough to provide a definitive statistical analysis of these research questions, since this work represents the disaggregation of an already small group. However, the implications of the RS experience across both groups certainly hints that further work on support networks is warranted.

Results

The incoming TW individuals had more mentors in each category type of initial supporters. This group had stronger family ties (3.4 vs 1.8), more school personnel in their webs (2.9 vs 0.8), and a wider variety of other people (1.4 vs 0.0) listed in their mentor data, than their tW counterparts in the program. The TW RS continued to list more people across time and document tighter connections with their families and other people known from high school throughout their collegiate careers.

Of more interest to this study, the TW students began to grow their webs with university personnel more quickly and had closer relationships with new professional acquaintances than their tW colleagues. The Purdue Index took into account that some individuals would be easier to add to their webs of support. A staff member was considered to have a 1.0 weight, for ease of interaction on

the campus. Upperclassmen would be even easier to meet and relate to, so they were given a 0.5 weighting. Professors can seem more unapproachable to students in general, and particularly to freshman, so they were given a 2.0 weighting. All RS students added university mentors to their networks. However, some TW RS students had added Purdue faculty during their first year, while no tW student did so. These data on mentor network growth are presented in Table 1, which shows a randomized presentation of the individuals in this comparison between TW and tW individuals through the third year, where the Purdue Index finally converged for the two groups. A compilation of the yearly averages for each type of mentor category can be seen within Table 1. Figure 2 provides a visual representation of the temporal change in mentors between TW and tW individuals from the initial recruitment point to the end of the third year. Figure 3 presents one TW and one tW RS student as they were interviewed to begin the program and what they provided three years later. These representations are included as typical and only illustrative of the relative differences between the groups.

Table 1 - Progression of the eleven "Thickly Webbed" and six "thinly webbed" Rising Scholars from their application into the program through Year 3 of attendance.

INITIAL	TW1	TW2	TW3	TW4	TW5	TW6	TW7	TW8	TW9	TW10	TW11	Avg Thickly Webbed	tw1	tw2	tw3	tw4	tw5	tw6	Avg thinly webbed
Parents/Relatives	3	3	4	2	1	10	3	5	4	1	1	2.8	2	2	1	1	4	1	2.5
High School People	4	3	0	4	1	3	2	4	4	5	2	3.8	1	1	0	1	0	2	1.0
Others	0	0	0	0	3	0	4	7	0	1	0	2.0	0	0	0	0	0	0	0.0
1st YEAR																			
Parents/Relatives	6	3	4	1	1	9	1	5	1	3	3	3.0	2	2	1	2	3	0	1.5
High School People	1	3	0	0	1	0	0	6	0	0	0	1.5	0	1	0	0	0	1	0.5
Others	2	0	0	0	0	0	0	6	0	3	0	2.3	0	0	1	0	0	1	0.5
XX Index	3.5	3.5	0.0	0.5	0.0	0.0	0.5	2.0	0.0	0.0	2.0	1.0	0.0	1.0	0.0	3.0	0.0	1.0	0.5
Professor (*2)	1	1	0	0	0	0	0	1	0	0	1	0.5	0	0	0	0	0	0	0.0
Staff	1	1	0	0	0	0	0	0	0	0	0	0.0	0	1	0	3	0	1	0.5
Upperclassmen (*0.5)	1	1	0	1	0	0	1	0	0	0	0	0.0	0	0	0	0	0	0	0.0
2nd YEAR																			
Parents/Relatives	8	3	4	2	3	8	1	5	1	2	3	2.8	2	3	1	2	4	0	2.0
High School People	4	3	0	0	0	0	0	2	0	0	0	0.5	0	0	0	0	1	1	1.0
Others	6	0	0	0	5	0	0	4	0	0	0	1.0	0	1	1	0	0	1	0.5
XX Index	5.5	6.5	0.0	5.5	5.0	0.5	1.0	2.0	0.0	0.0	3.5	1.4	0.0	0.0	0.0	0.0	4.0	4.0	4.0
Professor (*2)	2	2	0	2	1	0	0	1	0	0	1	0.5	0	0	0	0	1	1	1.0
Staff	1	2	0	1	3	0	1	0	0	0	1	0.3	0	0	0	0	2	2	2.0
Upperclassmen (*0.5)	1	1	0	1	0	1	0	0	0	0	1	0.3	0	0	0	0	0	0	0.0
3rd YEAR																			
Parents/Relatives	7	3	4	2	2	10	1	7	5	2	3	4.3	2	3		2		0	0.0
High School People	4	2	0	0	0	1	0	2	1	1	0	1.0	0	0		0		0	0.0
Others	3	0	0	0	8	0	0	4	5	1	2	3.0	0	0		0		0	0.0
XX Index	5.5	5.5	3.0	7.5	10.5	7.5	0.5	3.0	9.0	4.0	3.5	4.9	5.0	3.0	0.0	2.0	0.0	8.5	4.3
Professor (*2)	2	1	1	3	3	3	0	1	2	1	1	1.3	2	1		1		3	3.0
Staff	1	2	1	1	3	1	0	1	2	2	1	1.5	1	1		0		2	2.0
Upperclassmen (*0.5)	1	3	0	1	3	1	1	0	6	0	1	1.8	0	0		0		1	1.0
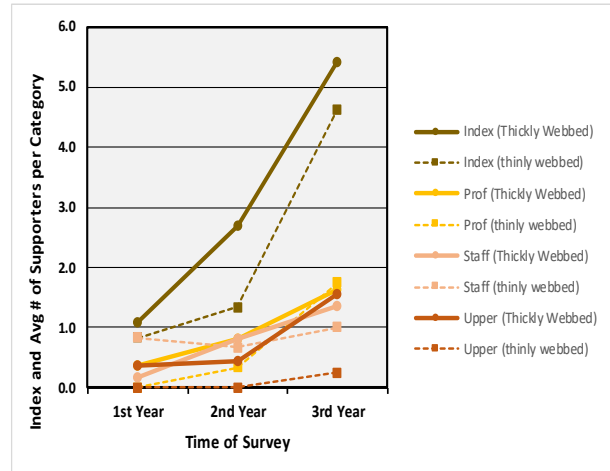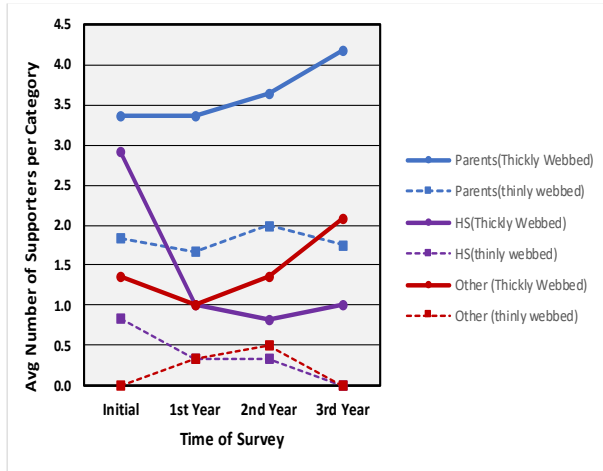
(A) PreCollege Supporters

(B) Collegiate Campus Supporters

Figure 2 - Average progression of the average yearly Web of Support between "Thickly Webbed" and "thinly webbed" and split between (A) Pre-College Supporters and (B) Collegiate Campus Supporters.
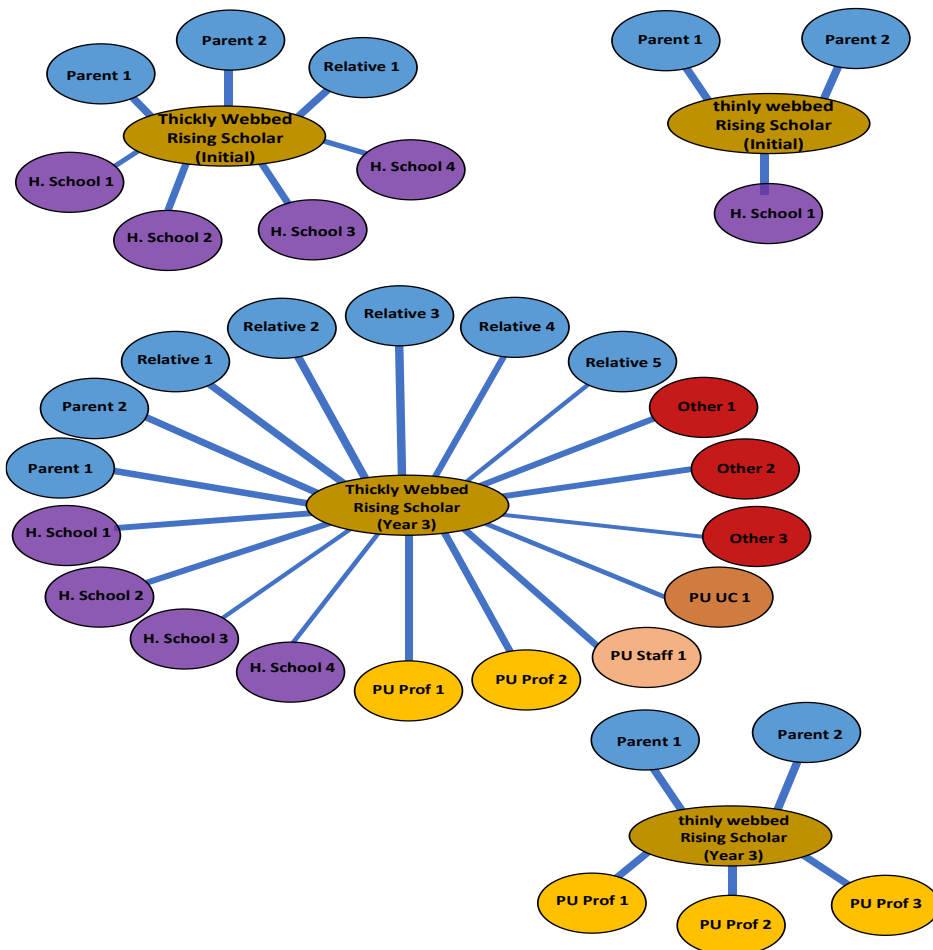

Figure 3 - Specific progression between two individual Rising Scholars from their application to year 3 of college.

The analysis of pre- and post-COVID academic performance between the TW and tW categories of RS students used their Fall 2020 grades as a representation of pre-COVID performances and then compared those indices to the Spring 2021 and Fall 2021 grades. The paired engineering student for each Rising Scholar was also added into this comparison. Figure 4 and Table 2 presents the pre-COVID cumulative grade point average for each group, which shows a slight rise in performance in the Spring 2020 grades, since professors tended to be lenient in their grading during the first semester of COVID, as classroom presentation style changed in the middle of the semester. These data also display that the tW RS students, who were not able to adapt as quickly to this different style of delivery, with the possible hypothesis that they were not as engaged with their professors or classmates as the other groups might have been. All groups did have a drop in performance with the Fall 2020 courses, since for the most part the professors resumed standard grading policies, even though the course presentation methods had not yet returned to the status quo. The TW RS students remained having the highest grade index performance of the four groups. Of significance to the importance of being TW is the ability to withstand changes in life circumstances. Unfortunately, the "thinly webbed" students went from performing better than their matched pair group to having the most problems with their academic courses. The ramifications of COVID have continued to impact these tW RS students. This group has had a reduced interest in their majors, caused by trouble recovering from past course failures, more times on probation, and a lengthened time to graduation. This has not been helped by university aid and college policies that dictate guidelines requiring the passing of 30 hours of courses each year and only allowing three tries at a given course.
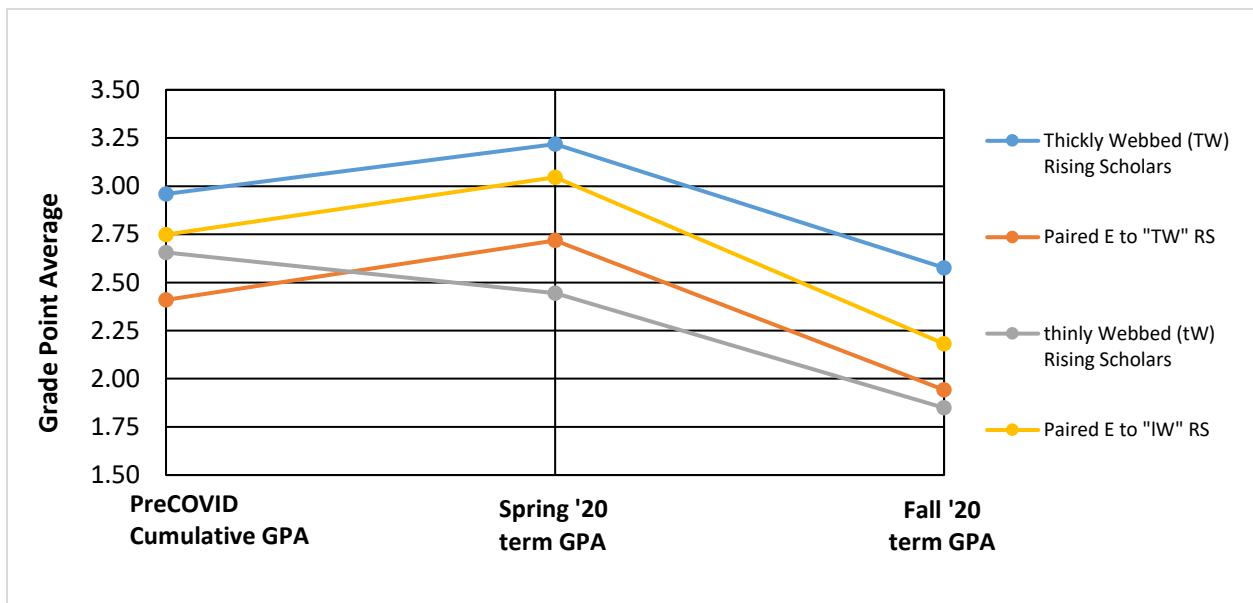

Figure 4 - Comparison between groups of the Pre-COVID cumulative GPAs compared to term GPAs during the first two semesters of the pandemic.

Table 2 – Tabular representation between groups of the Pre-COVID cumulative GPAs compared to term GPAs during the first two semesters of the pandemic.

	Pre-COVID cumulative GPA	Spring 2020 term GPA	Fall 2020 term GPA
Thickly Webbed (TW) Rising Scholars (n=11)	2.96	3.22	2.58
Paired E to "TW" RS (n=11)	2.41	2.72	1.94
thinly Webbed (tW) Rising Scholars (n=6)	2.66	2.44	1.85
Paired E to "tW" RS (n=5)	2.75	3.05	2.18

Conclusions

The students that began the study with a better understanding the importance of adult mentors tended to continue adding new on-campus supporters as they progressed through college. While all RS students were presented with material on the importance of an adult mentor support network during yearly seminars and had the opportunity to meet these types of mentors, only the incoming TW students tended to take advantage of the introductions provided by the pathway through the RS program. The Purdue Index seemed to do a good job of balancing the introduction of campus adults to the students' adult support mentoring networks. Studies have shown that professors generally serve as better mentors for students seeking internships and full-time positions. The lack of a well-developed support network for the tW RS students may tend to disadvantage these students' academic progress.

The RS students are continuing to progress toward graduation through academic majors in STEM fields at Purdue University at rates elevated over their matched pair cadres, which were students chosen as statistical matches. The web quality analysis, pioneered using the COVID study [39], has expanded the potential ways in which the Rising Scholars data could be analyzed, once larger data sets are available. Incorporating a local professional connection weighting seems equally as intriguing and shows promise, also suggesting further investigation. As the Rising Scholars students continue to graduate and enter the workforce as STEM professionals, the Purdue researchers will continue to track and provide longitudinal updates on their professional status.

References

[1] L. Weis, K. Cipollone and H. Jenkins, Class Warfare: Class and Race in Affluent and Elite Secondary Schools, Chicago: University of Chicago Press, 2014, ISBN 978-0226134925.

[2] W. G. Bowen, M. M. Chingos and M. S. McPherson, Crossing the Finish Line: Completing College at America's Public Universities, Princeton: Princeton University Press, 2011, ISBN 978-0691149905.

[3] J. Major and A. Godwin, "Towards Making the Invisible Engineer Visible: A Review of Low-Socioeconomic Students' Barriers Experiencing College STEM Education," in *2018 IEEE Frontiers in Education Conference*, San Jose, 2018, doi: 10.1109/FIE.2018.8659241.

[4] M. S. Giani, "The Postsecondary Resource Trinity Model: Exploring the Interaction Between Socioeconomic, Academic, and Institutional Resources," *Research in Higher Education 56,* pp. 105-126, 2015, doi: 10.1007/s11162-014-9357-4.

[5] M. N. Bastedo and N. A. Bowman, "Improving Admission of Low-SES Students at Selective Colleges: Results from an Experimental Simulation," *Educational Researcher 46,* no. 2, pp. 67-77, 2017, doi: 10.3102/0013189X17699373.

[6] B. M. Holloway, T. Reed, P. K. Imbrie and K. Reid, "Research-informed policy change: a retrospective on engineering admissions," *Journal of Engineering Education,* vol. 103, no. 2, pp. 274-301, 2014, doi: 10.1002/jee.20046.

[7] Kent State University, "Rising Scholars," 2021. [Online]. Available: https://www.kent.edu/stark/rising-scholars. [Last Accessed 17 February 2021].

[8] Stanford University, "Stanford GSB Rising Scholars Conference," 2020. [Online]. Available: https://www.gsb.stanford.edu/faculty-research/faculty/conferences/rising-scholars-conference. [Last Accessed 17 February 2021].

[9] G. L. Baldwin, V. L. Booth Womack, S. E. LaRose, C. S. Stwalley, R. M. Stwalley III, "Using support networks as a predictor of success for STEM degrees: preliminary results detailing a selection process for test subjects engaged in a longitudinal study of low socio-economic status American undergraduate students," *International Journal of Engineering Pedagogy,* vol. 12, no. 6, pp. 16-49, 2022, doi: 10.3991/ijep.v12i6.25547.

[10] V. Strauss, "What one college discovered when it stopped accepting SAT/ACT scores," *Washington Post 9/27/2015,* 2015.

[11] T. Armstrong, "15 Reasons Why Standardized Tests are Worthless," 2013. [Online]. Available: https://www.institute4learning.com/2013/02/28/15-reasons-why-standardized-tests-are-worthless-2/. [Last Accessed 2020].

[12] C. Harper, "Two professors retake the SAT: is it a good test?," *The Chronicle of Higher Education,* 4 June 2009.

[13] M. M. Holland, "Navigating the Road to College: Race and Class Variation in the College Application Process," *Sociology Compass 8/10,* no. 10.1111, pp. 1191-1205, 2014, doi: 10.1111/soc4.12203.

[14] R. D. Kahlenberg, America's Untapped Resources: Low Income Students in Higher Education, New York: The Century Press, 2004, ISBN 0870784854.

[15] K. D. Mattern and B. F. Patterson, "Is performance of the SAT related to college retention," College Board, New York, 2009.

[16] D. Peterson, "The Other Side of the Student Report Card: What it is and Why it Matters," in *National School Board Association*, Boston, 2016.

[17] National Scientific Council on the Developing Child, "Support Relationships and Active Skill-Building Strengthen the Foundation of Resilience: Working Paper 13," Harvard University, 2015.

[18] D. Peterson, "Solutions and Outcomes," 2010. [Online]. Available: https://icar-us.com/. [Last Accessed 14 May 2020].

[19] P. C. Scales, P. L. Benson, E. C. Roehlkepartain, A. Sesma Jr. and M. van Dulmen, "The role of developmental assets in predicting academic achievement: A longitudinal study," *Journal of Adolescence,* vol. 29, pp. 691-708, 2006, doi: 10.1016/j.adolescence.2005.09.001.

[20] P. L. Benson, "Childhood and Adolescence: Developmental Assets," in *International Encyclopedia of the Social and Behavioral Sciences*, N. Leffert, Ed., Santa Barbara, Fielding Institute, 2001, pp. 1690-97, doi: 10.1016/B0-08-043076-7/00366-1.

[21] Gallup, Inc., "Great Jobs, Great Lives: The 2014 Gallup Purdue Index Report," Gallup, Inc., Washington D.C., 2014.

[22] E. R. Raposa, M. Hagler, D. Liu and J. E. Rhodes, "Predictors of close faculty - student relationships and mentorship in higher education: findings from the Gallop-Purdue index," *Annals of the New York Academy of Sciences,* vol. 1483, pp. 36-49, 2021, 10.1111/nyas.14342.

[23] G. L. Baldwin, V. L. Booth Womack, S. E. LaRose, C. S. Stwalley, R. M. Stwalley III, "Mentoring low-SES students and developing professional support networks," in *2022 ASEE Annual Conference & Exposition (Minneapolis)*, Washington, DC, 2022, NSF-PARS 10358079.

[24] G. L. Baldwin, V. L. Booth Womack, S. E. LaRose, C. S. Stwalley, R. M. Stwalley III, "Using enhanced professional networks to increase overall student retention," in *2021 ASEE Annual Conference & Exposition (Long Beach)*, Washington, DC, 2021, Archived @ https://peer.asee.org/37990.

[25] M. Brown, M. P. Hitt, A. Stephens and E. M. Dickmann, "Rocky Mountain Scholars Program: impact on female undergraduate engineering students," *International Journal of Engineering Pedagogy,* vol. 10, no. 4, pp. 9-24, 2020, doi: 10.3991/ijepv10i4.12139.

[26] F. Khan, "Lessons learned from an NSF pilot project on minority student retention," in *ASEE 1997 Frontiers in Education - Pittsburgh*, Washington, DC, 1997, NSF-PARS 0-7803-4086-8.

[27] F. Khan and B. Siddique, "An NSF pilot project on miinority student retention," in *ASEE 1996 Frontiers in Education - Washington*, Washington, DC, 1996, NSF-PARS 0-7803-3348-9.

[28] G. L. Baldwin, V. L. Booth Womack, S. E. LaRose, C. S. Stwalley, R. M. Stwalley III, "The value of climate in educational programs for diverse student populations within engineering disciplines," in *ASABE 2021 AIM - Pasadena*, St. Joseph, 2021, doi: 10.13031/aim.212100005.

[29] R. M. Stwalley III, "Assessing improvement and professional career skill in senior capstone design through course data," *International Journal of Engineering Pedagogy 7,* no. 3, pp. 130-146, 2017, doi: 10.3991/ijepv7i3.7390.

[30] R. M. Stwalley III, "Professional career skills in senior capstone design," in *ASEE Capstone Conference - Columbus*, Washington, DC, 2016, Archived @ http://capstonedesigncommunity.org/sites/default/files/proceedings_papers/0022.pdf.

[31] R. M. Stwalley III, "Definition, mission, and revitalization of cooperative education programs," in *2006 ASEE Annual Conference & Exposition*, Washington, DC, 2006, doi: 10.18260/1-2--975.

[32] R. M. Stwalley III, "Survival and success in co-op programs through market analysis and core values," in *CEIA 2006 Cincinnati Proceedings*, Dallas, 2006.

[33] Y. K. Kim and L. J. Sax, "The effects of student-faculty interaction on academic self-concept: does academic major matter?," *Research in Higher Education,* 2014, doi: 10.1007/s11162-014-9335-x.

[34] Y. K. Kim and L. J. Sax, "Different patterns of student-faculty interactions in research universities," Center for Studies in Higher Education - University of California-Berkeley, Berkeley, California, 2007, Archived @ https://files.eric.ed.gov/fulltext/ED502857.pdf.

[35] J. McCarthy, "Reflective writing, higher education, and professional practice," *Journal for Education in the Built Environment,* vol. 6, no. 1, pp. 29-43, 2011, doi: 10.11120/jebe.2011.06010029.

[36] G. Bolton, "Narrative writing: reflective enquiry into professional practice," *Educational Action Research 14,* no. 2, pp. 203-218, 2006, doi: 10.1080/09650790600718076.

[37] G. L. Baldwin, V. L. Booth Womack, S. E. LaRose, C. S. Stwalley, R. M. Stwalley III, "Using broad spectrum technological projects to introduce diverse student populations to Biological & Agricultural Engineering (BAE): a work in progress," in *2021 ASEE Annual Conference & Exposition (Long Beach)*, Washington, DC, 2021, Archived @ https://strategy.asee.org/37986.

[38] G. L. Baldwin, V. L. Booth Womack, S. E. LaRose, C. S. Stwalley, R. M. Stwalley III, "Value of experiential experiences for diverse student populations within engineering disciplines: a work in progress," in *ASEE Annual Summer Conference (Long Beach)*, Washington, DC, 2021, Archived @ https://strategy.asee.org/38008.

[39] G. L. Baldwin, V. L. Booth Womack, S. E. LaRose, C. S. Stwalley, R. M. Stwalley III, "A comparison of the academic performance of Rising Scholars with other student demographic groupings before and during the COVID pandemic," in *2022 ASABE Annual Internatinal Meeting - Houston, Texas*, St. Joseph, 2022, doi: 10.13031/aim.202200205.