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Promoting Women and Minorities in Engineering - A Summer Program for Incoming Freshmen

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Promoting Women and Minorities in Engineering: A Summer Program for Incoming Freshmen

Abstract

Since 2017 our institution has hosted, through a special office in our engineering college, an intensive summer program for underrepresented groups drawn from incoming freshmen who intend to major in a STEM discipline. The stated purpose of the program is to recruit and retain students in STEM. In particular, the program targets women and minorities, though it is open to all incoming freshmen. This three-week, on-campus summer program introduces the participants, many of whom are first-generation college students, to the rigors of higher education. Their daily schedule includes a regimen of condensed STEM courses, with a special emphasis on first semester calculus. Their days are similar to those of typical freshmen in a STEM major, with the addition of evening tutoring, mentoring, and counseling sessions.

In this paper, we present initial results from a longitudinal study to track the academic progress of students who participated in this enrichment program in the summers of 2017 and 2018. We consider persistence in STEM and college retention and compare the program participants to their non-participant classmates. We also consider, in much more detail, two important introductory STEM courses: Calculus I and Physics I. For these two courses our data allow us to compare participants and non-participants in the grade categories final course average, final exam, and classroom attendance. We also calculate ABC rates for Calculus I – that is, the percent of students earning a grade of A, B, or C. In most cases, our data allow us to make comparisons of participants and non-participants by various demographic subgroups. We find some evidence that the program is successful in preparing students for Calculus I – both the overall under-represented minority population and the African American population show some benefit from program participation. We also see some positive results for these populations with regard to retention in STEM majors

Introduction

The dearth of female and minority students in STEM majors is well documented, with stories of underrepresentation appearing frequently in both academic literature and the popular press. University-level strategies to deal with this issue have met with mixed results. For example, during the 2015-2016 academic year, females earned about 58% of all bachelor's degrees conferred by postsecondary institutions, but only 36% of the bachelor's degrees in STEM fields. For the same academic year, whites earned 60% of the bachelor's degrees awarded in STEM fields, compared to 7% for African Americans, a number nearly unchanged from the 2008-2009 year [1]. STEM appears to be the *only* field in which African Americans are significantly more likely than their white counterparts to change majors and earn their degree in another field, a pattern that obtains even when controlling for high school academic preparation [2].

It is useful to think of underrepresentation by these groups as two separate issues: *access* and *retention*. Access involves being admitted into an institution of higher learning – this is not the focus of this paper. We concern ourselves with what happens after students arrive on campus. There is some evidence that retention (also known as *persistence*) of students in these underrepresented groups is the biggest obstacle to overcome to increase representation in STEM fields. A recent *USA Today* opinion piece, for example, highlights just this issue. The authors, two university presidents, put it rather succinctly: "To thrive, minorities and women in STEM need to feel like they belong. Too often, they don't." [3]

In this paper, we document and analyze the efforts of a program at Clemson University which focuses on the issue of *retention* for students who enter as freshmen with a declared STEM major. We consider students who participated in the program in the summers of 2017 and 2018, comparing them with their fellow students who did not. We chose to follow these PWE cohorts through the fall semester of 2019 as subsequent programs (including coursework) were changed significantly during the COVID-19 pandemic.

Our analysis is intended to address a simple question – is the program working? More specifically, we want to know if the program is effective in keeping females and minority students in STEM disciplines. We also obtained extensive data on Calculus I and Physics I, two gateway classes to degrees in STEM fields. We compare performance of participants and non-participants in these two classes, breaking out various subgroups as our data allow. (See Bressoud, et al., [4] for a discussion of Calculus I and its effect on student careers.)

Overview of Program

The summer program is offered through an office located in our College of Engineering. The purpose of this office is to "educate, recruit, and *retain* underrepresented populations in STEM fields through mentoring, academic coaching, counseling, and academic enrichment." Among their offerings is a summer program called PEER/WISE Experience (PWE). PWE is aimed at entering freshmen who have declared a major in a STEM discipline. It is a three-week, three-credit-hour residential program where students get to experience college life, albeit within a much more structured setting. (See Appendix A for a typical daily/weekly schedule.)

There have been several such programs at Clemson over the past 30 years, with the current format in place since the summer of 2017, the year with which we begin our analysis. A brief overview of the current program is important, since several aspects of it endeavor to address some of the issues that women and minorities encounter as students in STEM majors. As mentioned earlier, the feeling of belonging is important, and is addressed both directly and indirectly by features of the PWE program.

Program participants arrive on campus on a Sunday in early July. After an introductory dinner, their parents/guardians leave and the students enter what might be termed a "boot camp" setting, where most every aspect of their life on campus is regimented. Days are filled with classes, and evenings are reserved for mandatory study halls. Tutors, provided by PWE, are available should participants need extra help (see Appendix A). Program counselors and tutors are often alumni of

the program, giving it a familial quality and a feeling of continuity. One might reasonably assume such continuity leads to a feeling of inclusion, and perhaps serves as encouragement for the program participants – seeing previous participants thriving in college gives the new students reason for hope and creates an expectation of academic success.

> *The PWE program helped me become close with my community within Clemson and that made me immensely more comfortable with being enrolled there and knowing that I had a community of people there doing the same thing and making it out. Seeing those same mentors graduate and get jobs in their career field is a satisfying experience.*
> ---2018 PWE Participant

Proposed Study

To answer our question as to the effectiveness of PWE, we will look at several measures of academic achievement. In most cases, we are able to compare participants to non-participants in various demographic sub-groups.

- Calculus I – We look at performance of PWE students in Calculus I in the fall semesters following their summer participation in PWE. We consider final course average, attendance, final exam score, and ABC rates.

- Physics I – We look at performance of PWE students in Physics I in the *spring* semester that followed their summer participation in PWE. We consider spring semester because students have a Calculus I prerequisite for Physics I. The typical PWE student would take Calculus I in the fall and Calculus II and Physics I in the spring. We again consider final course average, attendance, and final exam.

- Persistence/Retention – We obtained university-level data that will give us a look into persistence within STEM, as well as continued enrollment for students who switch out of STEM. We also have average GPA numbers for various subgroups as they progress through their programs.

Calculus I - Demographics and Readiness for Instruction

PWE had 44 participants in 2017, 29 of whom enrolled in Calculus I in the fall, versus 19 of 41 for the 2018 class. We summarize some of the demographics for these students in Table 1. We also present demographics for *all* students enrolled in Calculus I for those two semesters. Two things are worth noting here. One, Calculus I at Clemson is overwhelmingly white, and two, it is male dominated, though to a lesser extent.

Table 1 – Demographics, Students Enrolled in Calculus I, Fall 2017 and Fall 2018

	PWE 2017	PWE 2018		All Calc I Students 2017	All Calc I Students 2018
PWE enrolled in Calc I	29 (of 44)	19 (of 41)		962	1052
Gender[a]					
Male	14 (48.3%)	13 (68.4%)		604 (62.9%)	625 (59.8%)
Female	15 (51.7%)	6 (31.6%)		356 (37.1%)	420 (40.2%)
Race					
African American	15 (51.7%)	14 (73.7%)		66 (6.9%)	61 (5.8%)
White	10 (34.5%)	0 (0%)		796 (82.7%)	837 (79.6%)
Hispanic	4 (13.8%)	4 (21.1%)		43 (4.5%)	75 (7.1%)
Other	0 (0%)	1 (5.3%)		57 (5.9%)	79 (7.5%)

[a]Male + Female may not equal total students because some students did not identify gender.

As mentioned in the introduction, the PWE program targets women and minorities, though it is open to all incoming freshmen. PWE participants tend to be less prepared for Calculus I based on two measures of readiness for instruction: SAT (math plus verbal), and under-18 poverty rate for the county of residence (Table 2). Note: we did not have access to household-level income for any students at our university. Admittedly, the under-18 poverty rate is not a direct measure of readiness, but inasmuch as it gives an indication of educational resources available in the home county for students, we have chosen to present it.

Note that on both measures, we find PWE participants to be less prepared for college work. This is particularly so with the 2018 class, where participants' combined SAT average was 111 points *lower* than their non-PWE Calculus I classmates. Under-18 poverty rates were also higher for PWE participants. For African American PWE participants, this difference was even more pronounced when compared to non-PWE students.

Table 2 – Readiness for Calculus I, Fall 2017 and Fall 2018

	2017			2018	
Number of PWE Participants	44			41	
	PWE	**Non-PWE**		**PWE**	**Non-PWE**
Enrolled in Calculus I, Fall	29	933		19	1033
Average SAT (M+V)[a]	1277	1333		1220	1331
SAT *Difference*	***-56***			***-111***	
Average Under-18 Poverty Rate, County of Residence[b]	20.97%	18.08%		21.70%	18.23%
African American, Average Under-18 Poverty Rate, County of Residence[b]	22.44%	20.15%		23.44%	21.36%

[a]SAT or SAT proxy constructed from ACT per College Board concordance tables.
[b]U.S. Census Bureau (2021). *Poverty Data Tools.* Retrieved from https://www.census.gov/topics/income-poverty/poverty/data/data-tools.html.

Calculus - Findings

A significant portion of class time in the PWE program (Appendix A) is geared toward preparation for Calculus I, a class taken by most STEM majors during the first semester of their freshman year. PWE students participate in a mathematics class each morning (see Appendix B for a topic list) and an afternoon recitation-style session two days per week. Since mathematics represents, by far, the largest component of the PWE program, and we had access to detailed data from Calculus I classes, we examined the performance of PWE students who move into Calculus I in the fall semester following their summer participation.

The metrics we include in this study are final course average (abbreviated FA), number of days absent, and final exam. These metrics demonstrate achievement, persistence, and retention of course material, respectively.

Fig 1 – Final Course Average for Calculus I

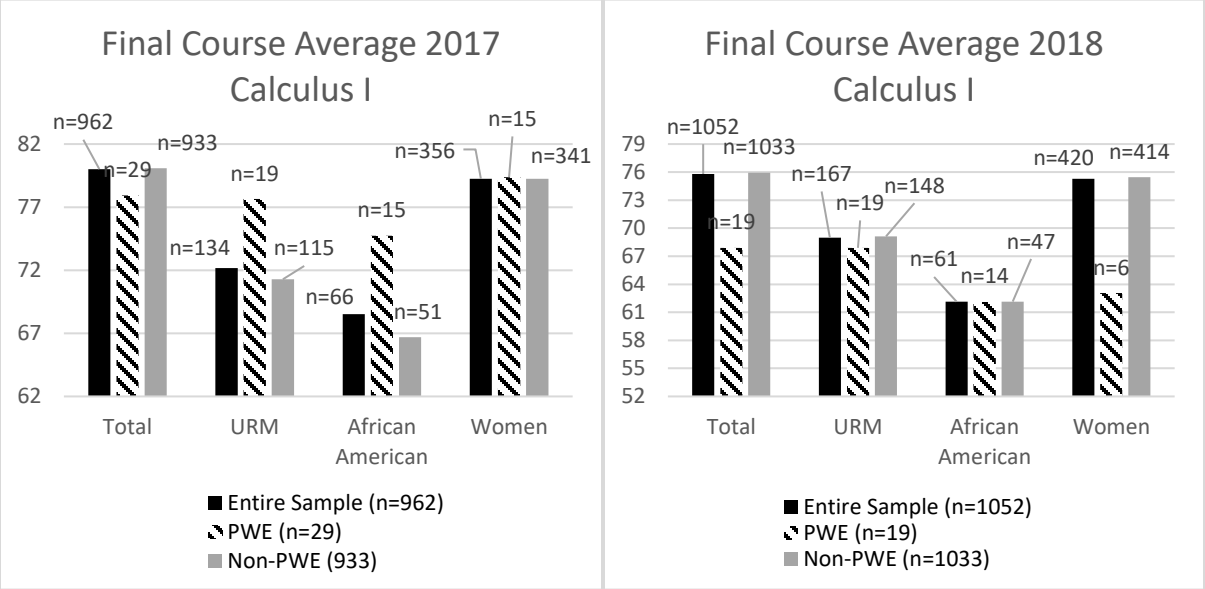


Figure 1 shows FA for students completing Calculus I in the fall semesters of 2017 and 2018 (all averages are between 0 and 100). We also present values for URM (under-represented minorities, consisting of African American, Hispanic, and mixed race), African American, and Women, with sub-groupings into PWE and non-PWE students. Sample-size is listed above the bar for each group. As the percentage of students identifying as Hispanic in the program was small (see Table 1), we do not include this data in this study.

The "Total" bar grouping in Figure 1 represents the FA for the entire sample, the PWE cohort, and the non-PWE students, respectively, for both 2017 and 2018. In this grouping, 2017 PWE students preform about two points lower than their non-PWE peers. This is not an unexpected result, given PWE students tend to be less prepared per our previous discussion of SAT and poverty. It is interesting to note, however, that for the 2017 PWE cohort, the sub-group identifying as URM and the sub-group identifying as African American performed about five points better than their non-PWE peers within these same groups. Within the Women subgroup, PWE and non-PWE students performed about the same. We do *not* see a similar increase for the 2018 cohort when we look at all Calculus I students, nor do we see a substantial difference in any of the subgroups. We attribute this to small sample size (n=19) and the presence of extreme outliers – five of the nineteen PWE students had final averages below 60, with three of these being below fifty and one substantially below forty.

Fig 2 – Days Absent for Calculus I.

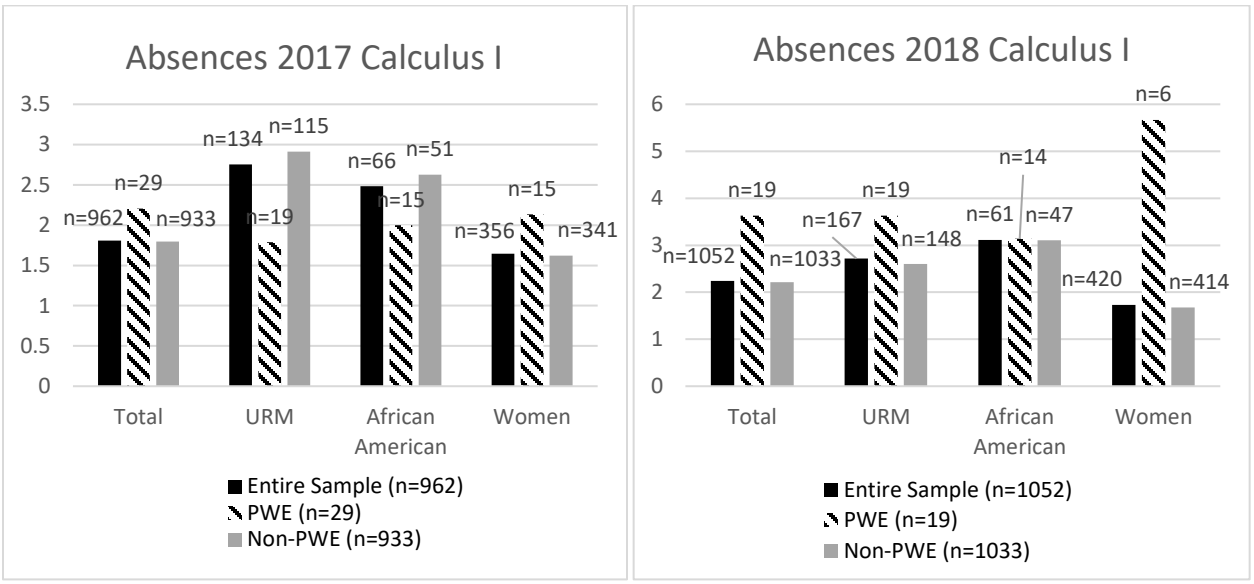


Figure 2 shows attendance (average number of class days missed). Consistent with FA results (Figure 1), the 2017 PWE students identifying as URM are missing roughly one less day of class when compared to their non-PWE peers within the same demographic. Among the African American subgroup, this difference is about one-half day. This improved attendance pattern is not present in the 2018 data.

Fig 3 – Final Exam Average for Calculus I

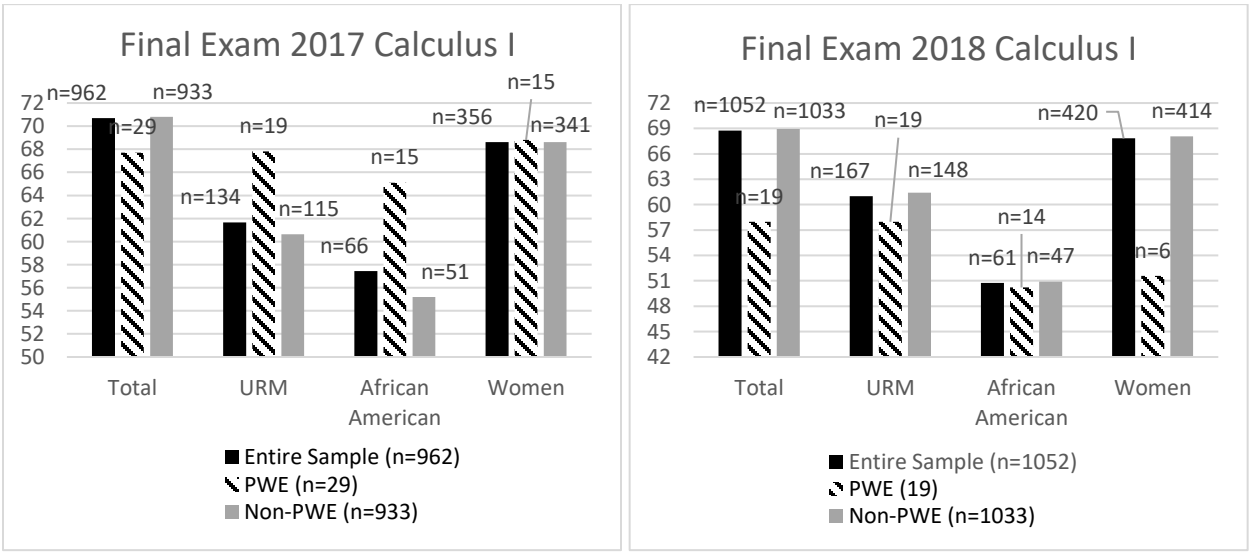


Figure 3 illustrates final exam performance. 2017 PWE students identifying as URM and African American performed approximately six points higher on their final exam than their non-PWE peers within the same subgroups. Among women, PWE and non-PWE are nearly identical. Also consistent with FA (Figure 1), we do not see a positive effect for the 2018 cohort, with a significant decrease in performance in those identifying as women in the PWE program.

Calculus - Final Grades

Many STEM majors require a final letter grade of C or higher in calculus courses before the class will count as credit toward a degree. It is thus worthwhile to consider the ABC rate for the students in Calculus I – are PWE students more or less likely to get a grade of A, B, or C than their non-PWE peers? For the 2017 cohort, we find that PWE students who moved to Calculus I in the fall did not do as well as their non-PWE peers, with about 76% of them in the ABC group, versus 84% for the non-PWE students (Table 3). Again, this is not an unexpected result – as previously noted, we find the PWE students to be less prepared for calculus. When looking at the African American demographic, however, we find the PWE students doing slightly better than their non-PWE peers. We see a similar result with females – 93% of PWE females received grades of A, B, or C, versus 83% for the non-PWE group. Once again, we do not see positive results for the 2018 cohort.

Table 3 - Percent of Students Earning a Grade of A, B, or C in Calculus I

	2017	**2018**
All Calculus I Students		
PWE	75.9%	47.4%
non-PWE	84.1%	78.4%
URM		
PWE	68.4%	47.4%
non-PWE	68.7%	68.2%
African American		
PWE	60.0%	28.6%
non-PWE	58.8%	44.7%
Females		
PWE	93.3%	33.3%
Non-PWE	83%	78.7%

Calculus - Regression Models

We considered various regression models to determine an PWE treatment effect for students in PWE-targeted groups (URM, African American, Female) who took Calculus I in the fall semester following their summer 2017 participation in the program. We summarize these findings in Table 4, with full results presented in Appendix C.

Table 4 – Regression Models

	1		**2**		**3**		**4**
Population	**All URM[a] in Calculus I, Fall 2017**		**All URM[a] in Calculus I, Fall 2017 with SAT**		**All African American in Calculus I, Fall 2017 with SAT**		**All Females in Calculus I, Fall 2017 with SAT**
Dependent Variable	Final Average		Final Average		Final Average		Final Average
Independent Variable(s)	PWE		PWE SAT (M+V)		PWE SAT (M+V)		PWE SAT (M+V)
Regression Statistics							
Multiple R	0.1273		0.5228		0.5942		0.4938
R Square	0.0162		0.2733		0.3531		0.2439
Adjusted R Square	0.0087		0.2617		0.3315		0.2395
Standard Error	17.4348		14.3789		14.6024		12.3814
Observations	134, PWE=29		128, PWE=29		63, PWE=15		347, PWE=15
F	2.1727		23.5068		16.3721		55.4722
Significance F	0.1429		0.0000		0.0000		0.0000
Coefficients							
Intercept/p-val	71.28 (0.0000)		1.03 (0.9236)		-5.85 (0.6680)		2.7652 (0.7063)
PWE/p-val	6.36 (0.1429)		5.40 (0.1335)		4.35 (0.3204)		0.9825 (0.7641)
SAT/p-val	--		0.0571 (0.0000)		0.0627 (0.0000)		0.0582 (0.0000)

[a] URM = African American, Hispanic, or Mixed Race

When considering all students identifying as URM, we find (column 1) that PWE has a positive effect on final course average of about 6.4 points, with a weak *p*-value of 0.143.

We next consider the fall 2017 URM population for which we had SAT scores (column 2). We again find that PWE has a positive effect (about 5.4 points) with an improved, but still weak, *p*-

value of 0.133. We see that combined SAT (M+V), however, has high significance, with a *p*-value of zero to four decimal places.

In column 3, we look at the fall 2017 African American population for which we had SAT scores. We again find that PWE has a positive effect (about 4.3 points) with a very weak *p*-value of 0.320. Once again SAT is significant, with a *p*-value of zero to four decimal places.

Finally, we consider the 2017 female population for which we had SAT scores (Table 4, column 4). We find that PWE has no positive effect (*p*-value 0.764), and once again, SAT is very significant, with a *p*-value of zero to four decimal places.

Physics I

Students are not limited to mathematics in the PWE program. They are exposed to other STEM topics, including chemistry, engineering, computer literacy, writing skills, and introductory physics. Compared to their mathematics preparation, however, PWE students spend much less classroom time on these subjects (see Appendix A). It is hoped that exposure to these peripheral topics will enhance work and schedule management skills (vital to success in college), as well as give participants a flavor of the science and engineering courses they will experience in their first year. We focus on performance in Physics I since we had access to data similar to that in Calculus I. We expected to find limited effects (if any) for this class, owing to the relatively small amount of time spent in the physics classroom. Our analysis confirmed this, so we have chosen to place this material in an appendix.

We present Physics I FA, attendance, and final exam data (similar to Calculus I) in Appendix D. (see Figures D1, D2, and D3). Since Physics I is traditionally taken by students after completing Calculus I, the Physics I population can differ from the Calculus I population in size. Since Calculus I is an official prerequisite course for Physics I, and students typically take Physics I in the *spring* semester of their freshman year, the semester from which this data was collected.

While we see modest gains for the 2017 PWE students in some categories, we conclude there is no significant effect of PWE participation when comparing PWE vs. non-PWE students enrolled in Physics I.

Retention

Retaining STEM majors (often called “persistence”) is an important (and perhaps ultimate) goal of the PWE program. We have therefore tracked student retention for the 2017 and 2018 cohorts in the years following participation in PWE. We show retention at the university level (are they still enrolled?), as well as retention in a STEM major for PWE and non-PWE students, with URM status grouping.

Table 5 summarizes these findings for our URM population. “Retention” here refers to the percentage of the initial class (2017 or 2018) continuing to seek their undergraduate degree at the

Clemson. “STEM Retention” refers to students continuing their undergraduate studies in a STEM major. Considering “Year 4” in Table 8, the 2017 PWE cohort identifying as URM has a retention rate of 76.7%, compared to that of their non-PWE peers (also identifying as URM) of 73.7%. More strikingly, the percentage of 2017 PWE URM students who have retained a STEM major over the course of their undergraduate career (Year 4) is 70% versus only 53.3% for the overall URM population (non-PWE). For the 2018 cohort, we did not see such a dramatic difference in retention. Note – we did not have Year 4 data for the 2018 cohort.

Table 5 – Retention[a] for URM, non-URM, PWE versus non-PWE

Year	PWE Status	URM Status	Retention Year 2	STEM Retention Year 2	Retention Year 3	STEM Retention Year 3	Retention Year 4	STEM Retention Year 4
2017	Non-PWE	Non-URM	93.4%	82.3%	85.1%	69.0%	82.2%	65.9%
2017	PWE	Non-URM	92.9%	92.9%	85.7%	78.6%	85.7%	78.6%
2017	Non-PWE	URM	88.3%	77.4%	78.6%	58.8%	73.2%	**53.3%**
2017	PWE	URM	96.7%	96.7%	80.0%	76.7%	76.7%	**70.0%**
2018	Non-PWE	Non-URM	93.8%	82.4%	85.3%	68.9%		
2018	PWE	Non-URM	[b]					
2018	Non-PWE	URM	90.1%	78.1%	81.4%	63.0%		
2018	PWE	URM	95.1%	68.3%	87.8%	61.0%		

[a]enrolled in the fall semester
[b]2018 PWE Non-URM retention data was not available.

Table 6 illustrates retention grouped in terms of self-identified gender. The 2017 PWE cohort “Year 4” differences (previously discussed) are apparently driven by those identifying as female, who show a nearly 20% improvement in STEM retention over their non-PWE peers. 2017 PWE males have lower retention rates than their non-PWE male peers in both overall retention and STEM major retention. The 2018 PWE cohort demonstrates that both genders (male and female) have a reasonable university retention rate as compared to their non-PWE peers, but many have abandoned their STEM major by Year 3.

Table 6 – Retention by Gender, PWE versus non-PWE

Year	Group	Gender	Retention Year 2	STEM Retention Year 2	Retention Year 3	STEM Retention Year 3	Retention Year 4	STEM Retention Year 4
2017	Non-PWE	F	93.4%	78.3%	89.3%	66.7%	83.1%	**61.1%**
2017	PWE	F	96.2%	96.2%	88.5%	84.6%	88.5%	**80.8%**
2017	Non-PWE	M	92.2%	84.6%	80.2%	68.7%	79.6%	67.2%
2017	PWE	M	94.4%	94.4%	72.2%	66.7%	66.7%	61.1%
2018	Non-PWE	F	93.2%	78.7%	88.0%	67.4%		
2018	PWE	F	94.4%	66.7%	94.4%	61.1%		
2018	Non-PWE	M	93.2%	84.3%	81.8%	68.4%		
2018	PWE	M	95.7%	69.6%	82.6%	60.9%		

GPA

In tables 7 and 8, we track the cumulative grade point average (on a four-point scale) by gender. Each table is separated by URM status, participation in PWE, and whether the student is a STEM major. The GPA is initially tracked at the end of their first semester (end of Fall 2017) continuing until the end of Fall 2019. All 2017 PWE students were STEM majors during this period which explains blank non-STEM entries. Also, all 2017 PWE males self-identified as URM in table 8. The complete table of GPA data is presented in Appendix E, including the 2018 PWE cohort.

Table 7 – Female Student Cumulative GPA

Female Cumulative GPA								
Year	Group	URM	GPA End Fall 2017	STEM GPA End Fall 2017	GPA End Fall 2018	STEM GPA End Fall 2018	GPA End Fall 2019	STEM GPA End Fall 2019
2017	Non-PWE	Non-URM	3.5	3.4	3.54	3.43	3.62	3.57
2017	PWE	Non-URM	[a]	3.17	[a]	3.15	[a]	3.38
2017	Non-PWE	URM	3.31	2.93	3.31	3.09	3.37	3.13
2017	PWE	URM	[a]	3	[a]	2.53	[a]	2.6

[a] All 2017 PWE students were STEM majors during this period.

Table 8 – Male Student Cumulative GPA

Male Cumulative GPA								
Year	Group	URM	GPA End Fall 2017	STEM GPA End Fall 2017	GPA End Fall 2018	STEM GPA End Fall 2018	GPA End Fall 2019	STEM GPA End Fall 2019
2017	Non-PWE	Non-URM	3.28	3.32	3.27	3.2	3.29	3.27
2017	Non-PWE	URM	3.02	3.02	3.08	2.96	3.09	2.95
2017	PWE	URM	[a]	2.93	[a]	2.72	[a]	2.6

[a] All 2017 PWE students were STEM majors during this period.

Consistent with the data presented previously in this work, those with URM status (regardless of category) consistently fall below that of their non-URM peers but still manage to maintain a C average (2.0 or higher) after two years. This is true for those in the PWE program, but we also note a decline in GPA for PWE students in the URM category as they progress through the program (a similar decline is noted in the 2018 PWE data). Of particular concern is the fact that this decline is not as pronounced in non-PWE URM students (whose GPA remains roughly flat). This decline in PWE GPA also lies in contrast to the PWE retention data which may indicate that although we continue to retain PWE students, these students could potentially use continued assistance, support, and supervision as they progress towards their degree.

Summary

Our analysis is intended to answer the question of program effectiveness – does participation in PWE have a positive effect on students, especially women and minorities? Does it improve performance in two gateway courses (Physics I and Calculus I), and does it improve retention at the university and within STEM disciplines? Our findings are mixed. We note again that the 2018 cohort was small, and it contained several outliers who moved numbers in a significant (and negative) way. Our conclusions are thus generated by what our analysis revealed about the larger 2017 PWE cohort.

Calculus I: We find, consistent with our readiness metrics (Table 2), PWE participants performing below their non-PWE peers on three measures: Final Course Average, Attendance, and Final Exam. We do find, however, improved performance over their non-PWE peers on all three measures when we consider the subgroups URM (under-represented minorities) and African Americans. Inasmuch as PWE is intended to improve outcomes for these students, this is a positive result and an indication that the program is effective. To a limited degree, our regression analysis confirms this finding, with PWE participation being associated with a higher Final Course Average. Regression analysis also reveals SAT(M+V) to be a powerful predictor of performance in Calculus I.

Physics I: We do find some positive results, similar to those in Calculus I, but they are not dramatic. We did not expect to see much effect here, inasmuch as time in the Physics classroom is limited.

Retention: Here we find what is perhaps the most positive outcome. PWE participants are 1) more likely to remain enrolled, and 2) more likely to remain in a STEM major than their non-PWE peers. This result obtains across both URM and female subgroups. By their fourth year of college, URM students and female students who participated in PWE are much more likely to remain in a STEM major. This is especially encouraging given the general trend of African American students switching out of STEM majors by their senior year [2].

Conclusion

The overarching goal of the PWE program is to increase the representation of minorities and women in STEM disciplines. The program attempts to do this by introducing incoming freshmen to college life in a controlled setting, allowing them to experience the demands of their first semester before it actually begins. From a classroom standpoint, there is a particular focus on Calculus I, the gateway course for every STEM discipline.

We find some evidence that the program is successful in preparing students for Calculus I – the total URM population and African American populations tend to benefit from PWE participation, with improved final course averages within both subgroups when compared with their non-PWE peers. We do note a decline in GPA as they progress, suggesting interventions beyond our summer program are warranted. For example, a follow-up summer program between

freshman and sophomore year that is structured in a similar manner, but addresses typical sophomore STEM courses might mitigate this GPA decline.

As noted in the introduction, a problem for women and minorities in STEM disciplines is a sense of belonging – they do not feel there is a place for them. Our data on retention of PWE students give us evidence that we may be overcoming this problem at Clemson University. We suggest there is a net positive effect from all activity (classroom and otherwise) for PWE participants. It may well be that the total effect of the program is this – students find a place where they belong, they feel comfortable, and they persist in their pursuit of a degree in a STEM discipline.

Appendix A – Typical Daily/Weekly Schedule for PWE Particpants

Time	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
7:00 AM		**7 AM – 7:50 AM** Breakfast	**7 AM – 7:50 AM** Breakfast	**7 AM – 7:50 AM** Breakfast	**7 AM – 7:50 AM** Breakfast	**7 AM – 7:50 AM** Breakfast	
8:00 AM		**8 AM – 9:45 AM** Class: Calculus	**8 AM – 9:45 AM** Class: Calculus	**8 AM – 9:45 AM** Class: Calculus	**8 AM – 9:45 AM** Class: Calculus	**8 AM – 9:45 AM** Class: Calculus	
9:00 AM							
10:00 AM		**10 AM – 11:45 AM** Class: Intro to Engineering	**10 AM – 11:30 AM** Class: Chemistry	**10 AM – 11:45 AM** Class: Intro to Engineering	**10 AM – 11:30 AM** Class: Physics		
11:00 AM	**11 AM – 1 PM** PWE Arrival/ Check-In						
12:00 NOON		**12 PM – 12:50 PM** Lunch	**12 PM – 12:50 PM** Lunch	**12 PM – 12:50 PM** Lunch	**12 PM – 12:50 PM** Lunch	**12 PM – 12:50 PM** Lunch	
1:00 PM		**1 PM – 2 PM** Class: High School to College Transition		**1 PM – 2 PM** Class: Note Taking Strategies			
2:00 PM	**2 PM – 3 PM** Parents and PWE Student Welcome	**2:15 PM – 3:30 PM** Class: Calculus Review	**2:15 PM – 3:15 PM** Class: Excel	**2:15 PM – 3:30 PM** Class: Calculus Review	**2:15 PM – 3:15 PM** Class: Excel		
3:00 PM							
4:00 PM			**3:30 PM – 4:30 PM (GROUP A)** Class: English/Writing		**3:30 PM – 4:30 PM (GROUP A)** Class: English/Writing		**4 PM – 6 PM** Ice Cream Social
5:00 PM	**5 PM – 6 PM** Dinner						
6:00 PM	**6 PM – 7 PM** Class: Sex, Drugs & Alcohol Talk	**6PM – 7:15 PM** Dinner	**6PM – 7:15 PM** Dinner	**6PM – 7:15 PM** Dinner	**6PM – 7:15 PM** Dinner	**6PM – 7:15 PM** Dinner	
7:30-9:30 PM	Meet Counselors	Study Hall	Study Hall	Study Hall	Study Hall	Study Hall	

Appendix B – Topics Covered in the Calculus Portion of PWE, 2018

Text: Calculus – Early Transcendentals, 3rd edition, Briggs and Cochran (Pearson)

Date	Section	Topic
Monday, July 9	1.1	Review of Functions
	1.2	Representing Functions
Tuesday, July 10	1.3	Inverse, Exponential, Logarithmic Functions
Wednesday, July 11	1.4	Trigonometric, Inverse Trigonometric Functions
Thursday, July 12	2.1	The Idea of Limits
	2.2	Definitions of Limits
Friday July 13	2.3	Analytical Techniques for Computing Limits
Monday July 16	2.3	Analytical Techniques for Computing Limits
Tuesday July 17	2.4	Infinite Limits
Wednesday July 18	–	Midterm Exam
Thursday July 19	–	No Class (Plant Tour)
Friday July 20	2.5	Limits at Infinity
Monday July 23	3.1	Introducing the Derivative
Tuesday July 24	3.2	The Derivative as a Function
Wednesday July 25	3.3	Derivative Rules
Thursday July 26	3.4	Product and Quotient Rules
Friday July 27	–	Final Exam

Appendix C – Full Results of Regression Models

Dependent Variable for all models: Calculus I Final Course Average, Fall 2017

Population: All URM in Calculus I, Fall 2017
Independent: PWE Participation (0 or 1)

Regression Statistics	
Multiple R	0.1273
R Square	0.0162
Adjusted R Square	0.0087
Standard Error	17.4348
Observations	134.00

PWE n=29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1.00	660.4474	660.4474	2.1727	0.1429
Residual	132.00	40124.5609	303.9739		
Total	133.00	40785.0083			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	71.2821	1.6258	43.8441	0.0000
PWE	6.3642	4.3176	1.4740	0.1429

Population: All URM in Calculus I, Fall 2017 with SAT (M+V) score
Independent: PWE Participation (0 or 1), SAT (M+V)

Regression Statistics	
Multiple R	0.5228
R Square	0.2733
Adjusted R Square	0.2617
Standard Error	14.3789
Observations	128

PWE n=29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	9720.2038	4860.1019	23.5068	0.0000
Residual	125	25844.1537	206.7532		
Total	127	35564.3574			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	1.0320	10.7411	0.0961	0.9236
PWE	5.3994	3.5747	1.5104	0.1335
SAT	0.0571	0.0085	6.6940	0.0000

Population: All African American in Calculus I, Fall 2017 with SAT score
Independent: PWE Participation (0 or 1), SAT (M+V)

Regression Statistics	
Multiple R	0.5942
R Square	0.3531
Adjusted R Square	0.3315
Standard Error	14.6024
Observations	63

PWE n=15

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	6982.0546	3491.0273	16.3721	0.0000
Residual	60	12793.7962	213.2299		
Total	62	19775.8508			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-5.8519	13.5756	-0.4311	0.6680
PWE	4.3521	4.3432	1.0020	0.3204
SAT	0.0627	0.0114	5.4982	0.0000

Population: All Females in Calculus I, Fall 2017 with SAT score
Independent: PWE Participation (0 or 1), SAT (M+V)

Regression Statistics	
Multiple R	0.4938
R Square	0.2439
Adjusted R Square	0.2395
Standard Error	12.3814
Observations	347

PWE n=15

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	17007.6340	8503.8170	55.4722	0.0000
Residual	344	52734.7685	153.2987		
Total	346	69742.4025			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	2.7652	7.3315	0.3772	0.7063
PWE	0.9825	3.2705	0.3004	0.7641
SAT	0.0582	0.0055	10.5327	0.0000

Appendix D – Analysis of PWE Students Enrolled in Physics I

Below we present FA, attendance, and final exam data for Physics I (similar to Calculus I).

Fig D1 – Final Course Average for Physics I

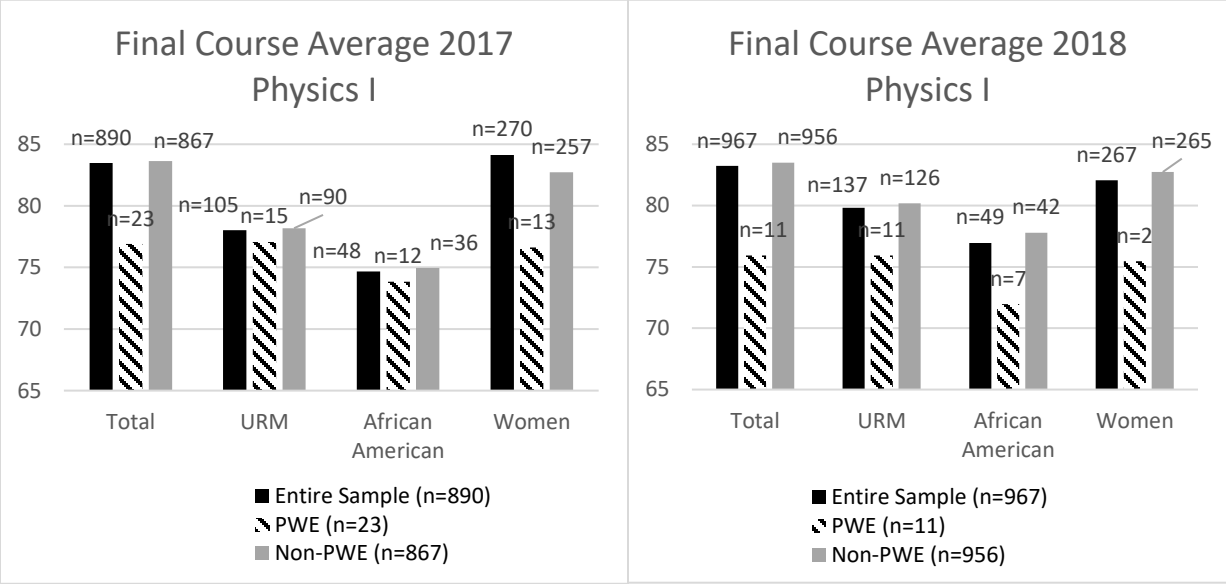


Fig D2 – Classroom attendance by numbers of days absent for Physics I

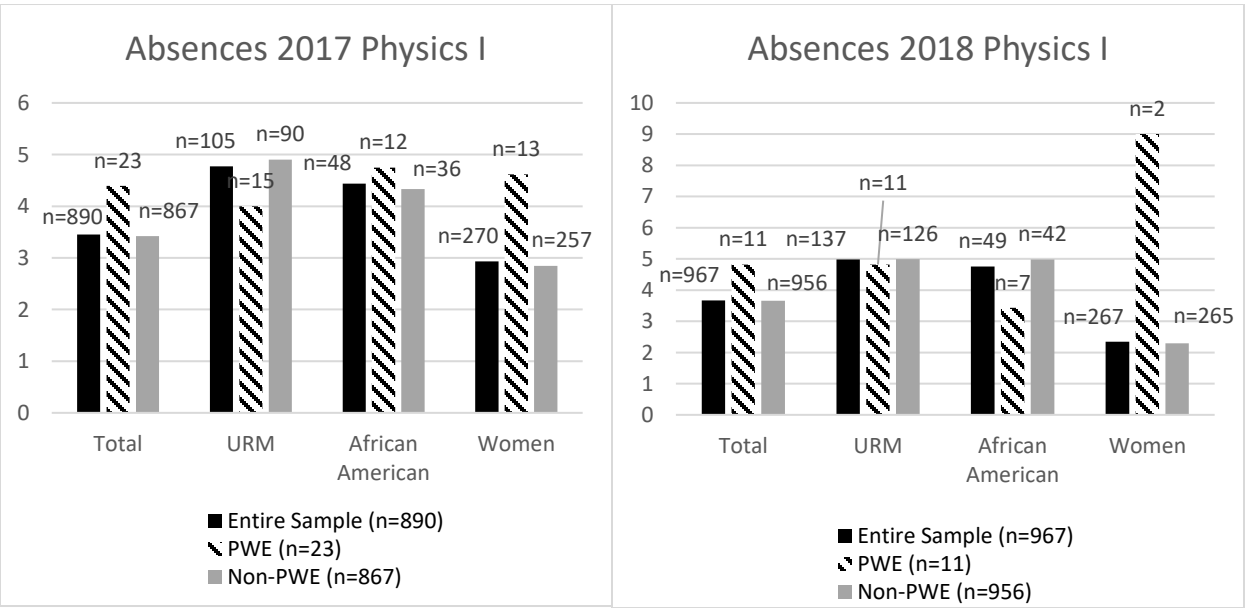
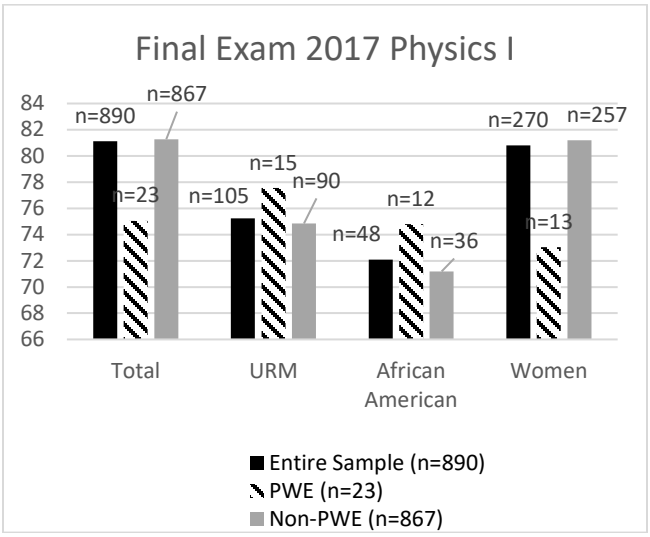
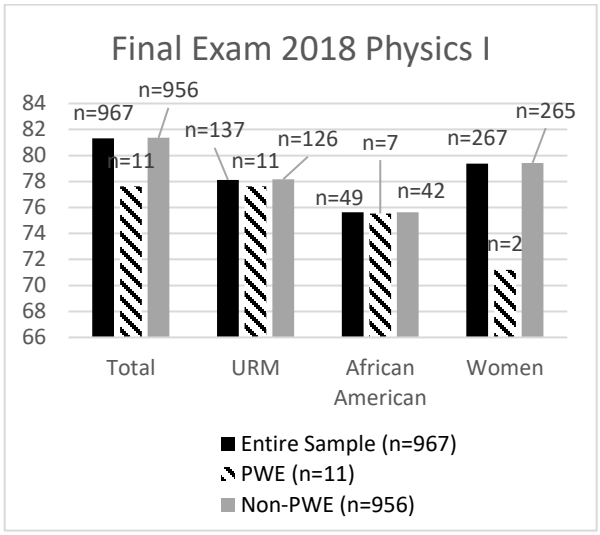


Fig D3 -- Final Exam Average for Physics I





Appendix E – Cumulative GPA Data

Cumulative GPA									
Year	Group	URM	Gender	GPA End Fall 2017	STEM GPA End Fall 2017	GPA End Fall 2018	STEM GPA End Fall 2018	GPA End Fall 2019	STEM GPA End Fall 2019
2017	Non-PWE	Non-URM	F	3.5	3.4	3.54	3.43	3.62	3.57
2017	Non-PWE	Non-URM	M	3.28	3.32	3.27	3.2	3.29	3.27
2017	Non-PWE	URM	F	3.31	2.93	3.31	3.09	3.37	3.13
2017	Non-PWE	URM	M	3.02	3.02	3.08	2.96	3.09	2.95
2017	PWE	Non-URM	F	[a]	3.17	[a]	3.15	[a]	3.38
2017	PWE	URM	F	[a]	3	[a]	2.53	[a]	2.6
2017	PWE	URM	M	[a]	2.93	[a]	2.72	[a]	2.6
2018	Non-PWE	Non-URM	F	[b]	[b]	3.53	3.37	3.54	3.41
2018	Non-PWE	Non-URM	M	[b]	[b]	3.29	3.26	3.28	3.2
2018	Non-PWE	URM	F	[b]	[b]	3.16	2.94	3.29	3.12
2018	Non-PWE	URM	M	[b]	[b]	2.83	2.91	2.87	2.84
2018	PWE	URM	F	[b]	[b]	[a]	2.84	[a]	2.83
2018	PWE	URM	M	[b]	[b]	[a]	2.71	[a]	2.57

[a] All PWE students were STEM majors during this period.

[b] These students entered in Fall 2018, so they do not have Fall 2017 GPA.

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