

Can Undergraduate Research Participation Reduce the Equity Gap?

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Abstract: Undergraduate research (UGR), one of several high-impact practices (HIPs) in education, can positively impact student retention and graduation rates. However, not all students take advantage of UGR opportunities, with fewer students from underrepresented minority groups, those with first-generation status, and students eligible for a Pell grant or federally subsidized loan. We obtained retention and graduation data from our Office of Institutional Research and Planning for all UGR participants for academic years 2009–2010 to 2016–2017. We specifically focused on data for UGR participants from underrepresented demographics that historically have lower retention and graduation rates than those of the overall student body. We created Sankey-like ribbon diagrams to analyze the characteristics of UGR participants, whether they participated in UGR for 1 year or longer, their class standings when they started UGR, retention rates for 1st- and 2nd-year students for the year following their UGR participation, and graduation rates for all participants. Our data show that irrespective of demographics, students who participated in UGR were significantly more likely to persist in college and graduate within 6 years compared to students who did not. Persistence and success in college may depend on students' socioeconomic status, sense of belonging, and other factors. Assessing the impact of a single HIP, such as UGR, on retention and graduation rates, can, therefore, be complicated. However, our study indicates that UGR participation can significantly improve persistence and success for students traditionally considered “at-risk,” irrespective of their socioeconomic status, family background, or class standing. This information can be important for campus leaders and other stakeholders interested in facilitating student success and reducing the equity gap by incorporating UGR in more students' college experiences. We describe our analytical methods and discuss our findings. We also demonstrate the effectiveness of Sankey-like diagrams for visualizing and analyzing large programmatic data sets, and as a tool for communicating program impacts to a general audience.

Keywords: undergraduate research, high-impact practice, student success, equity gap, ribbon tool

Introduction

Undergraduate Research as a High-Impact Practice

Kuh (2008) identified 10 (later modified to 11, Kuh, O'Donnell, & Schneider, 2017, Figure 1) high-impact practices (HIPs) in education that can promote student engagement, academic achievement, persistence, satisfaction, and attainment of desired academic outcomes. The effects of HIPs have been shown to be more pronounced on students from underserved backgrounds (e.g., Kuh, O'Donnell, &

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Schneider, 2017), such as those who are from historically underrepresented racial or ethnic groups, are first in their family to attend college, or are less prepared academically.

Undergraduate research (UGR), where students work closely with mentors outside the classroom to address various research questions, is one of the HIPs. This experience allows students to engage in addressing contested questions and in creating new knowledge through inquiry under the mentorship of practitioners. Besides academic benefits while in college, UGR can also provide long-term benefits after graduation. For example, the results from a recent Gallup survey (Ray & Kafka, 2014) demonstrate that students who participated in experiential learning activities and who felt emotionally supported by at least one mentor in college were much more likely to be engaged at work and achieve a higher quality of life. Similarly, Griswold (2019) showed the impact of UGR experience on identifying future career paths for students after graduation. However, despite such documented direct and indirect benefits, students from underserved backgrounds often do not participate in extracurricular HIPs, such as UGR (e.g., Finley & McNair, 2013; Kuh et al., 2017). The reasons for this include but are not limited to lack of time, family and/or financial constraints, or a lack of awareness of available mentored research opportunities or the benefits thereof.

The type and manner of UGR also vary from campus to campus. Johnson and Stage (2018) defined UGR as a HIP in which upper-level undergraduate students help faculty with their research agendas, or where the institution provides independent research opportunities for undergraduate students. The duration and requirements for participation in UGR can also vary. The duration can range from 5- to 10-week summer research programs or off-campus REU (research experience for undergraduates) programs to one or two academic terms (semesters, trimesters, or quarters) for a senior thesis or capstone project on campus. Participation in most REU programs involves obtaining recommendation letters from faculty and requires an above-average grade point average (GPA). These requirements can often disproportionately exclude students from traditionally underserved backgrounds from participating in UGR. For example, returning adult students, first-generation students, and transfer students, who may not have found a connection with faculty/staff members or who may not feel comfortable approaching faculty outside of classrooms, often end up not obtaining letters of recommendation from faculty. GPA requirements may exclude students with poor academic preparation and/or those who need extra time adjusting to the demands of college, as well as those who can devote less time to coursework than the traditional student population because of health issues and/or work and family obligations. Therefore, although institutions provide UGR opportunities, these opportunities may not always be equitable.

How We Managed to Increase UGR Participation From Underserved Groups at the University of Wisconsin–Whitewater

This project was conducted at the University of Wisconsin–Whitewater (UW-W), a 4-year regional comprehensive university that merged with a 2-year branch campus during the 2018–2019 academic year. We have established two parallel programs administered by the UW-W Undergraduate Research Program (URP). The traditional URP offerings are based on the philosophy that UGR experiences are most suitable for those students who have already demonstrated the disciplinary background, academic standing, and habits necessary for success in college. Students participating in the traditional URP are most often in their 3rd or 4th year in college, have a cumulative GPA of 2.75 or higher, and have already identified mentors to guide their research projects in their chosen disciplines. In contrast, our Research Apprenticeship Program (RAP) piloted in the 2011–2012 academic year, focuses on beginning and transfer students and also allows for international student participation. RAP recruits these students as paid research assistants for interested faculty mentors, without considering their GPA, research experience, or academic background.

Participants in the traditional URP are expected to develop their research proposals themselves with help and guidance from their mentors, as opposed to mostly acting as research assistants for their mentors. These participants can apply for research credits to count toward their academic degree program but are not paid for their work unless it is done during the summer months. They are also expected to present their research to a general audience on campus and at appropriate off-campus venues. In contrast, RAP participants are not expected to develop their own research projects but are paid to assist with the research agenda of their mentors. They are encouraged to present their work but are not required to do so. Both traditional URP and RAP students are expected to participate in research for two academic semesters after being accepted in the chosen program.

The framework for our campus URP, therefore, allows us to offer several key HIPs, by giving students the opportunity to engage in exploring contested questions outside the classroom, participate in one-on-one mentorship, receive frequent constructive feedback, and publicly demonstrate their competence. The differences in the characteristics of students participating in the traditional URP and RAP are summarized in Table 1.

Table 1. Characteristics of participants in the traditional Undergraduate Research Program (URP), the Research Apprenticeship Program (RAP), and the overall student body.

Characteristic	Traditional URP participants (%; <i>N</i> = 621)	RAP participants (%; <i>N</i> = 338)	Overall student body weighted average (%; <i>N</i> = 65,325)
White/Caucasian	88	65	84.34
African-American/Black	2	8	4.46
Hispanic/Latino or Latina	4	12	4.74
Two or more races	2	7	1.89
International	2	3	1.09
Southeast Asian	1	3	0.80
Other Asian	1	2	0.82
Under 24 years old at entry	91	96	97.88
First-generation status	31	44	40.72
Pell grant recipient	26	29	18.68
Federally subsidized loan recipient	24	19	No data
Joined as 1st-year student	3.16	53.98	
Joined as sophomore	15.78	36.93	
Joined as junior	33.72	5.97	
Joined as senior	47.35	3.13	

Note. All weighted averages 2011–2017 except for under 24 years old at entry (weighted average 2014–2019).

A member of an underrepresented minority (URM) is defined on campus as a student who indicates a race/ethnicity of African American/Black, American Indian, Hispanic/Latino or Latina, or Southeast Asian, either alone or in combination with other races/ethnicities. Table 1 shows that the RAP has been more successful than the traditional URP in recruiting an ethnically diverse student population, with students from all URM groups being overrepresented, and also in engaging students in research early in their college career. Besides students from URM groups, a significant proportion (almost 41%) of the UW-W student body also identified as a first-generation student (defined as an undergraduate student whose parents have not earned a 4-year college/university degree), and/or

qualified for a Pell grant (almost 19%) or some form of federally subsidized loan; indicators of financial need. Both the traditional URP and the RAP have been successful in recruiting students from these underserved demographics as well. Finally, the mean cumulative ACT scores for traditional URP participants (23.86) and RAP participants (23.41) are comparable to the overall average cumulative ACT score (22.2) for incoming 1st-year students on campus.

Research Question

Historically on our campus, students belonging to URM groups, first-generation students, and those eligible for a Pell grant or federally subsidized loan have shown lower retention and 6-year graduation rates than those of the overall student body. For this article, we wanted to address the following research question: *Can the retention and 6-year graduation rates for students from underserved demographics be impacted by participating in the traditional URP and/or RAP on campus?*

To address this question, we used data collected by the UW-W Office of Institutional Research and Planning for traditional URP participants spanning the academic years 2007–2008 to 2016–2017, and for RAP participants from 2010–2011 to 2016–2017. The authors were administrators of the traditional URP and the RAP for the entirety of this period and had a direct role in acquiring the data and ensuring that the data set was robust, reviewed, and internally consistent. Our data include student demographic information (URM status, first-generation status, and whether participants were eligible for a Pell grant or federally subsidized loan) for all participants, 2nd- and 3rd-year retention data for all RAP participants, and 6-year graduation rates for all traditional URP participants.

We broke down our overall research question into the following constituent parts for detailed analyses:

1. At what stage(s) of their college career do students from different demographics enroll in the traditional URP and/or RAP?
2. How do the 6-year graduation rates for students from underserved groups participating in UGR compare to the 6-year graduation rates for students from those specific groups in the overall student body?
3. How do the 6-year graduation rates for all students participating in UGR for 1 year and 2- or more years compare with the 6-year graduation rate for the overall student body?
4. What is the retention rate for students from different demographics after completing a year of UGR in their 1st or 2nd year of college compared to the 2nd- and 3rd-year retention rate for students from those demographics in the overall student body?

Method

Traditionally, Sankey diagrams are used in disciplines such as engineering and supply chain management, among others, to visualize energy and/or material flows (Sankey, 1898; Schmidt, 2008a, 2008b). In these diagrams, the thickness of the flows indicates the relative proportions of the material flowing between categories. For this project, we used our URP/RAP participant data set to create Sankey-like diagrams using the online Ribbon tool developed by researchers at the University of California, Davis (2018; Molinaro, Steinwachs, Li, & Guzman-Alvarez, 2017). This tool has been used to visualize how students select or leave academic majors throughout their college career (e.g., Bradforth et al., 2015). We used these diagrams to visualize and analyze URP/RAP participation trends for different student populations during their college career (Figure 1).

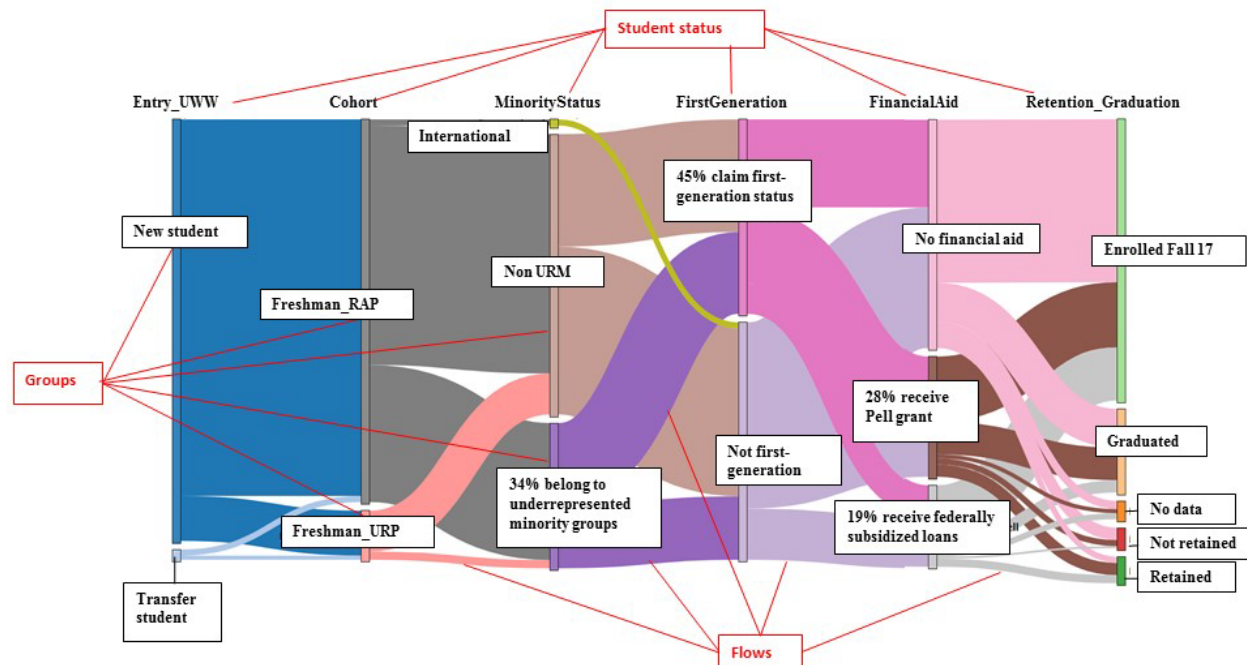


Figure 1. Example of a visualization diagram created using the Ribbon tool. The diagram displays data for students who joined the traditional Undergraduate Research Program (URP) or the Research Apprenticeship Program (RAP) at the University of Wisconsin–Whitewater (UWW) within their 1st year of study; data collected 2011–2017 ($N = 222$).

The two most important aspects of these types of diagrams are the segmented columns, labeled “student status” in Figure 1 but referred to as “time steps” by the creators of the Ribbon tool (Molinaro et al., 2017; University of California, Davis, 2018), and the “flows” joining different segments of those columns. The width of the flows is proportional to the number of elements (in this case, number of student participants) in the flow. Conventionally, the time steps represent academic years or semesters spanning the data set. However, for our project the time steps represented different pieces of student information, such as financial aid status, first-generation status, and class standing at the time students started participating in UGR, among others. The segments of each column are called “nodes” in traditional Sankey diagrams. On Ribbon diagrams they are referred to as “groups.” Groups or nodes are zones where the flows originate, end, converge, or diverge. There has to be a minimum of two groups at either end of a Ribbon diagram. The width of a group is proportional to the number of students in that group.

The web-based Ribbon tool allows users to obtain the number of students in each group and the relative percentages of different student groups distributed across the studied population. This capacity allowed us to analyze and synthesize our data set and conveniently extract relevant information for different student demographics participating in UGR for this project. Examples of information obtained from the Ribbon tool are shown as text boxes on the Ribbon diagram (Figure 1).

We reformatted and reorganized the URP/RAP participant data set obtained from the UWW Office of Institutional Research and Planning to be compatible with the Ribbon tool. For our analyses, each participant was identified by a unique computer-generated seven-digit identification number (CID). We defined the student status and related groups corresponding to each CID as shown in Table 2.

Table 2. Student status codes in the Ribbon tool and corresponding groups within them as used in our analyses.

Student status code	Student status subgroup
Entry_UWW (Status when enrolling in UW-W)	New student
	Transfer student
Cohort (Class standing when joining either the URP or the RAP for the first time)	RAP_1 st yr
	RAP_2 nd yr
	URP_1 st yr
	URP_2 nd yr
	URP_junior
	URP_senior
MinorityStatus (Whether student belongs to a URM group or is an international student)	International
	Non_URM
	URM
FirstGeneration	1 st Gen
	Not 1 st Gen
FinancialAid (Whether eligible for a Pell grant or federally subsidized loan)	Pell
	Federally subsidized loans
	No financial aid
UR participation	One year
	2 or more years
CurrentStatus (Current academic status, including whether students were retained for 1 year past their UGR experience)	Enrolled in Fall 17
	Graduated
	Retained
	Not retained
	No Data (includes students who transferred to another campus)

Note. Gen = Generation; RAP = Research Apprenticeship Program; UR = undergraduate research; URP = Undergraduate Research Program; UWW and UW-W = University of Wisconsin-Whitewater; yr = year.

Results

In this section we briefly describe the information we gathered from the Ribbon tool regarding the overall patterns of UGR experiences for the following student demographics: (a) transfer students, (b) first-generation students, (c) students belonging to a URM group, (d) students receiving a Pell grant, and (e) students receiving a federally subsidized loan. Students belonging to these groups are traditionally considered “academically at-risk,” and we focused our analyses on exploring how participating in the traditional URP or RAP might affect academic success for them. We used data for all students ($N = 1,049$) who participated in UGR during 2011–2017 (in either the traditional URP or RAP) unless otherwise specified. We have broken down the results according to the different constituent parts of our research question, listed above.

At what stage(s) of their college career do students from different demographics enroll in the traditional URP and/or RAP?

- a) **Transfer students:** Transfer students made up 23% ($n = 239$) of all students participating in UGR used for this analysis. Of these, 82% ($n = 197$) joined the traditional URP, most as seniors (45%, $n = 108$), juniors (28%, $n = 66$), and sophomores (9%, $n = 21$). The rest (18%, $n = 42$) participated in the RAP, primarily as sophomores (9%, $n = 22$). Eighty-three percent of transfer students ($n = 199$) participated in UGR for 1 year, while 17% ($n = 40$) participated for 2 or more years.
- b) **First-generation students:** First-generation students made up 35% ($n = 369$) of all UGR participants in this analysis. Of these, 43% ($n = 157$) participated in the RAP, 22% ($n = 83$) in their freshman year and 15% ($N = 55$) during their sophomore year. Twenty-five percent ($n = 92$) joined the traditional URP as seniors and 19% ($n = 71$) as juniors. Eight-four percent ($n = 310$) of first-generation students participated in UGR for 1 year, while 16% ($n = 59$) participated for 2 or more years.
- c) **Students belonging to a URM group:** Students belonging to a URM group made up 17% of UGR participants used for this analysis ($n = 171$). Of these, 64% ($n = 108$) joined the RAP, 40% ($n = 68$) in their first year and 16% ($n = 28$) in their sophomore year; 12% ($n = 21$) joined the traditional URP in their junior year and 20% ($n = 34$) in their senior year. Eighty-seven percent ($n = 149$) of participants belonging to a URM group participated in UGR for 1 year, while 13% ($n = 22$) participated for 2 or more years.
- d) **Students receiving a Pell grant:** Students receiving a Pell grant made up 27% of UGR participants used for this analysis ($n = 286$). Of these, 63% ($n = 183$) joined the traditional URP, the majority as seniors (34%, $n = 97$) and juniors (21%, $n = 61$). The rest (36%, $n = 103$) joined the RAP, mostly as 1st-years (18%, $n = 52$) and sophomores (15%, $n = 43$). Eighty-four percent ($n = 241$) of Pell recipients participated in UGR for 1 year, while 16% ($n = 45$) participated for 2 or more years.
- e) **Students receiving a federally subsidized loan:** Students receiving a federally subsidized loan made up 22% of UGR participants used for this analysis ($n = 233$). Of these, 73% ($n = 171$) joined the traditional URP, the majority as seniors (31%, $n = 72$), juniors (23%, $n = 53$), and sophomores (16%, $n = 38$). The rest (27%, $n = 62$) joined the RAP, mostly in their first (13%, $n = 31$) or sophomore (9%, $n = 22$) year. Eighty-one percent ($n = 188$) of students receiving a federally subsidized loan participated in UGR for 1 year, while 19% ($n = 45$) participated for 2 or more years.

How do the 6-year graduation rates for students from underserved groups participating in UGR compare to the 6-year graduation rates for students from those specific groups in the overall student body? How do the 6-year graduation rates for all students participating in UGR for 1 year and 2 or more years compare with the 6-year graduation rate for the overall student body?

We calculated the 6-year graduation rates for UGR participants broken down for different student demographics using the Ribbon tool. For a comparison we calculated 5-year weighted averages of 6-year graduation data for corresponding student demographics spanning academic years 2006–2007 to 2010–2011 for the overall student body using data provided by the UW-W Office of Institutional Research and Planning. We conducted the same analyses on 6-year graduation rates for all first-time students, full-time students, and those with 1 year and 2 or more years of UGR experience, irrespective of their demographics or socioeconomic status, and compared these with the 5-year weighted average of the 6-year graduation rate for the overall student body.

We conducted chi-square and Fisher's exact tests to see if students participating in UGR were statistically significantly more likely to graduate from college within 6 years than their peers not participating in UGR. The Fisher's exact test is more conservative than the chi-square test, and any significant difference between groups can be considered meaningful. The results are shown in Table 3. The 6-year graduation rates of students participating in UGR were statistically significantly higher than those of corresponding student populations in the overall student body.

Table 3. Statistical analyses of 6-year graduation rates of students participating in UGR and graduation rates for corresponding student populations in the overall student body, academic years 2006–2007 to 2010–2011.

Student status category	χ^2	Fisher's exact test	6-year graduation rate		<i>p</i>
			UGR participants	Overall student body	
Transfer students (<i>N</i> = 206)	39.669	< .00001	89%	67.87%	< .00001
First-generation students (<i>N</i> = 250)	52.505	< .00001	80%	56.42%	< .00001
Members of URM groups (<i>N</i> = 101)	19.445	0	63%	40.75%	< .00001
Pell grant recipients (<i>N</i> = 219)	85.311	< .00001	81%	48.24%	< .00001
Federally subsidized loan recipients (<i>N</i> = 167)	51.202	< .00001	87%	58.83%	< .00001
Students with 1 year of UGR experience (<i>N</i> = 618)	164.94	< .00001	84%	58.2%	< 0.00001
Students with 2 or more years of UGR experience (<i>N</i> = 135)	54.238	< .00001	90%	58.2%	< .00001

Student status category	χ^2	Fisher's exact test	6-year graduation rate		<i>p</i>
			UGR participants	Overall student body	
First-time, full-time students (<i>N</i> = 547)	142.37	< .00001	84%	58.2%	< .00001

Note. UGR = Undergraduate research; URM = underrepresented minority. All *p* values significant at *p* < .05.

What is the retention rate for students from different demographics after completing 1 year of UGR in their 1st or 2nd year of college compared to the 2nd- and 3rd-year retention rates for students from those demographics in the overall student body?

The 2nd- and 3rd-year retention rates for students from the specified demographics are provided in Tables 4 and 5, respectively. The 2nd-year retention rates (Table 4) were calculated on 176 students (152 students participating in the RAP and 24 in the traditional URP) who joined the traditional URP or RAP as 1st-year students. Statistical analyses show that the 2nd-year retention rate of students participating in UGR was statistically significantly higher at the 95% confidence level than that of students from the same demographics in the overall student body, except for students receiving a federally subsidized loan. The 3rd-year retention rates (Table 5) were calculated on 239 students (135 students participating in the RAP and 104 in the traditional URP) during their sophomore year. Statistical analyses show that the 3rd-year retention rate of students participating in UGR was statistically significantly higher than that of students from the same demographics in the overall student body. These numbers exclude students who joined the program during the 2016–2017 academic year. Since very few transfer students joined the traditional URP or RAP as first-years and sophomores, Tables 4 and 5 do not include separate retention rates for transfer students. Instead, we compared 2nd-year retention data for all first-time, full-time students and 3rd-year retention data for all sophomores participating in UGR to the corresponding overall student body retention rates (5-year weighted average). Retention data for specific student demographics from the overall student body were obtained from the UW-W Office of Institutional Research and Planning.

We conducted chi-square and Fisher's exact tests to determine if students participating in the traditional URP or RAP during their 1st or 2nd year of college were statistically significantly more likely to be retained in the academic year following their UGR participation. These results for 1st- and 2nd-year students are also shown in Tables 4 and 5, respectively.

Table 4. Second-year retention rates of students participating in UGR versus the overall student body for selected demographics.

Student category	2nd-year retention rate		χ^2	Fisher's exact test	<i>p</i>
	UGR participants	Overall student body			
First-generation students (<i>N</i> = 80)	94.94%	77.7%	11.7989	.0002	.000593 ^a
Students belonging to	89.47%	73.27%	5.0865	.0233	.024113 ^a

Student category	2nd-year retention rate		χ^2	Fisher's exact test	<i>p</i>
	UGR participants	Overall student body			
URM groups (<i>N</i> = 59)					
Pell grant recipients (<i>N</i> = 59)	94.74%	76.79%	7.112	.007	.007657 ^a
Federally subsidized loan recipients (<i>N</i> = 39)	97.30%	81.15%	3.1479	.0955	.076025 ^b
All 1st-year students in traditional URP/RAP (<i>N</i> = 176)	94.05%	80.05%	10.3165	.0008	.001318 ^a

Note. RAP = Research Apprenticeship Program; UGR = undergraduate research; URM = underrepresented minority; URP = Undergraduate Research Program.

^aSignificant at $p < .05$. ^b $0.1 > p > 0.05$.

Table 5. Third-year retention rates retention rates of students participating in UGR versus the overall student body for selected demographics.

Student category	3rd-year retention rate		χ^2	Fisher's exact test	<i>p</i>
	UGR participants	Overall student body			
First-generation students (<i>N</i> = 96)	93.55%	66.92%	24.0267	< .00001	< 0.00001
Students belonging to URM groups (<i>N</i> = 36)	90.63%	60.73%	5.8228	.0153	.015819
Pell grant recipients (<i>N</i> = 65)	93.55%	64.95%	16.6083	0	.000046
Federally subsidized loan recipients (<i>N</i> = 57)	98.08%	71.5%	8.905	.0016	.002844
All 2nd-year students in traditional	94.03%	70.05%	44.5297	< .00001	< 0.00001

Student category	3rd-year retention rate		χ^2	Fisher's exact test	<i>p</i>
	UGR participants	Overall student body			
URP/RAP (<i>N</i> = 239)					

Note. RAP = Research Apprenticeship Program; UGR = undergraduate research; URM = underrepresented minority; URP = Undergraduate Research Program. All *p* values significant at *p* < .05.

Discussion

Mentored UGR is well integrated in our campus culture. UGR participants can engage in mentored research for one or more years as an extra- or cocurricular activity. They receive one-on-one mentoring, opportunity to design and take ownership of their own projects (mostly traditional URP participants), or help faculty mentors or upper-level students with their research (RAP participants). Traditional URP participants are also expected to present their research on campus during spring and/or fall Undergraduate Research Days and off campus at the National Conference on Undergraduate Research or statewide symposia for scholarly and creative activities. While a presentation is not expected of RAP participants, they are strongly encouraged to participate during on-campus UGR celebration events. UGR participants also have the opportunity to apply to the UW-W Summer Undergraduate Research Fellowship program, a highly competitive 10-week summer research program.

Being engaged in research has various tangible and intangible benefits for students. They learn to effectively communicate orally and in writing, analyze and synthesize their data to make valid conclusions, critically evaluate concepts from different perspectives, and other valuable skills. A survey by Hart Research Associates (2015) found that employers strongly endorsed an emphasis on applied learning in college and believed that working on applied learning projects would prepare students better for a career after graduation and improve their chances of being hired. Student researchers also learn how to work as part of a team, be respectful of others, receive constructive criticism, and deal with setbacks. Being part of a group/research team, hands-on experience, and being engaged in solving a real-world problem are among the benefits of mentored research, all of which can increase students' sense of belonging and provide a support network for them to persist in college (e.g., Strayhorn, 2019).

Both traditional URP and RAP students work closely with faculty and staff mentors and in many cases, also have upper-level students acting as near-peer mentors. We surveyed RAP students (Institutional Review Board Protocol Number: B14509018Q) in academic years 2014–2015 and 2016–2017 at the beginning of their research experience, after one semester of conducting research, and again at the end of their one academic year of RAP experience to gauge the progressive change in their self-perceptions of skills and knowledge gain (Bhattacharyya, Chan, & Waraczynski, 2018). We also gathered information on what beginning students identified as benefits of research besides learning to do research. Our results show that 28.1% of responders (68 participants over three cohorts) identified “network and support” from faculty and staff mentors and peers as one of the major benefits of conducting mentored research.

Positive impacts of mentoring on undergraduate STEM students, especially on those from minority backgrounds have been documented (e.g., Haeger & Fresquez, 2016). Students from traditionally underrepresented groups in STEM fields who participated in mentored UGR showed

significantly higher cumulative GPAs and similar graduation rates to those of matched peers. Furthermore, students participating in UGR for an extended period of time (longer than one academic semester or one summer) showed significantly higher gains in research skills and level of research independence.

Our data show that students participating in UGR as part of either the traditional URP or the RAP were statistically significantly more likely at a 95% confidence level to be retained during the academic year immediately following their UGR experience, as well as graduate from college within 6 years, irrespective of their background or socioeconomic status, including students traditionally considered academically at-risk. On our campus, considerable equity gaps remain in retention and graduation rates between students from underserved demographics and majority students. UGR participation can potentially be a way to reduce this gap. This is especially relevant given the changing student demographics at UW-W. Figure 2 shows changes in the URM student population at UW-W over the last 10 years (2009–2019). The data show an increase in the overall URM population from 9.2% in the 2009–2010 academic year to 14.5% in 2018–2019. Over the same time span, our Hispanic/Latino or Latina student population has increased from 2.7% to 7.4% of the overall student population. Increasing UGR participation for these students can be a way to help all students succeed.

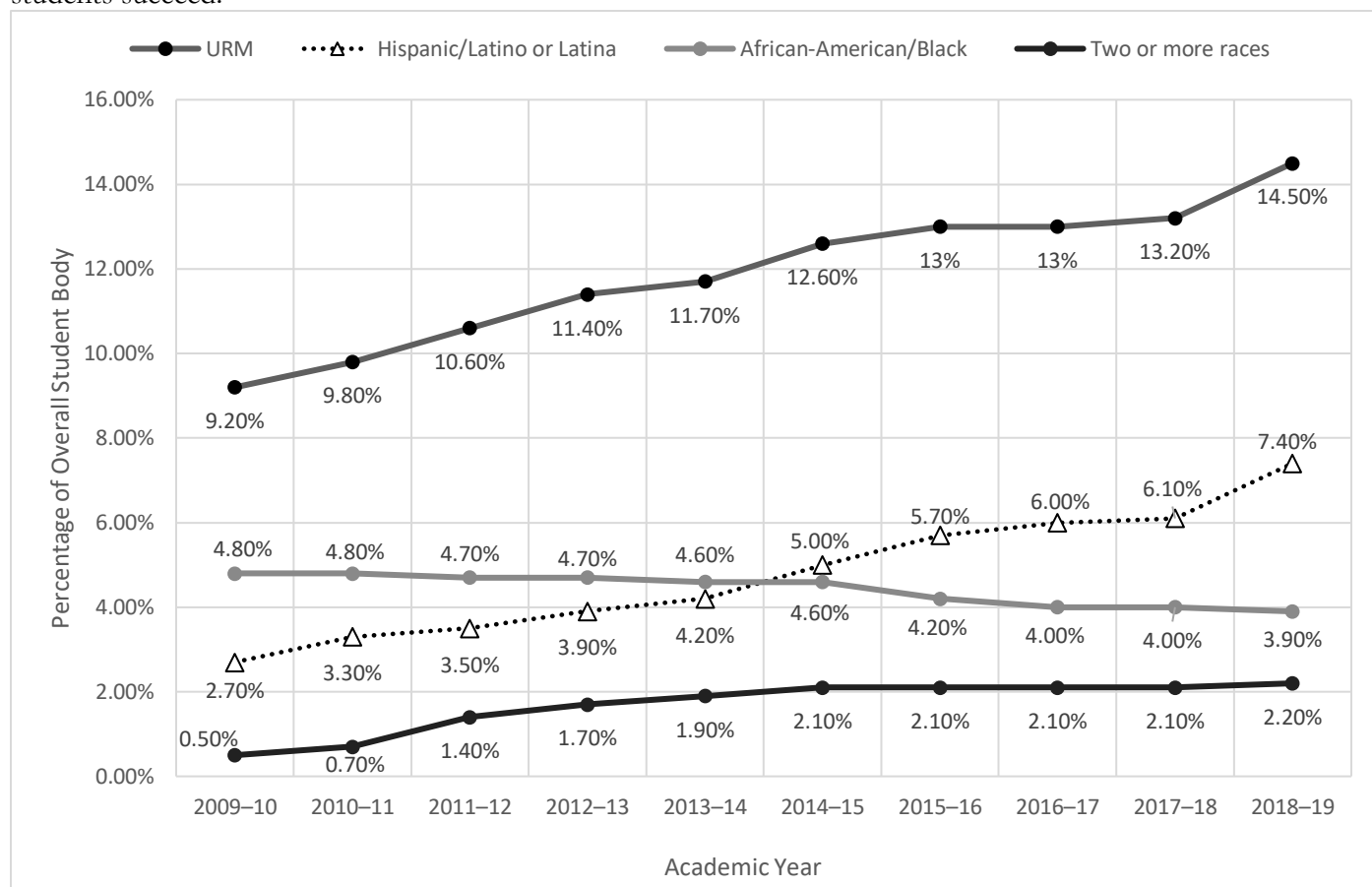


Figure 2. Changes in percentage of underrepresented minority (URM) student groups on campus from 2009–2010 to 2018–2019.

We should not, however, assume that UGR participation is the sole driver of student success. Students who self-select to participate in UGR are also more likely to participate in other HIPs, such as internships. Most traditional URP participants joined in their junior or senior year (Table 1), and

therefore, they had already successfully navigated their way through their first 2 years of college when students are most at risk of dropping out. They also met the minimum GPA requirement for the traditional URP, indicating that they were academically in good standing and therefore more likely to graduate within 6 years. Traditional URP students were also more likely to have made a connection with a faculty mentor in their chosen discipline and to have developed an identity as a scholar and researcher.

In contrast, RAP recruits beginning students who have not yet made a connection to campus or their discipline and pairs them with research mentors as paid research assistants to help faculty with their research agenda. While the data on student retention (Tables 4 and 5) demonstrate the impact of UGR participation on 2nd- and 3rd-year retention of beginning students, especially those traditionally considered to be academically at-risk, the RAP program is still relatively new, and we do not yet have the data to measure its sustained impact on student retention and graduation rates. Also, for logistical reasons, only a limited number of students can participate in RAP in any given semester, and therefore, more work still needs to be done to broaden UGR participation for beginning students.

Nonetheless, our data on the positive effects of UGR participation on students' academic outcomes, even if incomplete, are promising. Currently, many colleges and universities are working on strategies to boost retention and graduation rates of their students as part of their moral obligation as institutions of higher education. This undertaking also has financial consequences for public institutions in states with performance-based funding models, whereby allocation of state funding to public colleges and universities is at least partially dependent on student outcomes. UGR participation can be implemented as part of a comprehensive student success program to increase student persistence and degree completion rates, especially for those from underserved backgrounds. Broadening UGR participation obviously requires resources but it can also be considered an investment in improving student outcomes that can also yield financial returns.

Conclusion

Our data show that mentored UGR conducted over one or more academic years, where students are allowed to design and conduct their own research projects with help and guidance from faculty/staff mentors, can positively impact persistence and 6-year graduation rates for students, especially for those from demographics traditionally considered academically at-risk. Beginning students helping mentors with their research agendas are also significantly more likely to persist in college than their counterparts not participating in research. While UGR cannot be identified as the sole factor driving student persistence and success, it can provide essential tangible academic skills and intangible benefits, such as a sense of belonging to the discipline and the university, a support network of fellow researchers, one-on-one mentoring from faculty/staff, and the self-efficacy necessary for academic success, and ultimately it can reduce the equity gap.

Acknowledgments

The authors would like to thank the Provost's Office at the University of Wisconsin-Whitewater for providing financial support to the URP and RAP. The pilot phase of the RAP was supported by a campus Strategic Initiatives Grant. We also thank all UW-W Undergraduate Research Program staff and staff/faculty mentors who help make undergraduate research a HIP, and the Office of Institutional Research and Planning for providing campus-level student demographic data. Finally, we appreciate the thoughtful feedback from an anonymous peer reviewer.

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