PURM
Perspectives on Undergraduate Research and Mentoring

Simplify-Guide-Progress-Collaborate: A Model for Class-Based Undergraduate Research

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The first purpose of this article is to show how undergraduate research, independently designed and conducted by students, may be embedded in courses, even as early as in the first year. Undergraduate research is an engaging educational practice that highlights the intrinsic interest of course subject matter and builds students' academic self-efficacy (Hunter, Laursen, & Seymor, 2007). As such, we believe it is important to involve students in undergraduate research as early, and as often, as possible. We believe that it is realistic to do so at the very beginning of undergraduate education, within the structure of first-year courses, and we will demonstrate how this structure may be implemented. The second purpose is to show evidence that this endeavor is likely to be successful, not only for students in general, but specifically for historically underrepresented students.

The Benefits of Undergraduate Research

Undergraduate research provides a number of academic benefits for both the students and their research mentors. As such, undergraduate research is considered a high impact educational practice (Kuh, 2008). For students, participation in undergraduate research has been documented to improve their ability to think analytically and learn independently (Ishiayama, 2002). Indeed, the students themselves perceive their participation in undergraduate research as positively affecting their engagement (Hunter, Laursen, & Seymour, 2007), persistence (Bauer & Bennet, 2003), personal and intellectual growth (Bauer & Bennet, 2003, Hunter, Laursen, & Seymour, 2007; Kardash, 2000), and satisfaction in higher education (Bauer & Bennet, 2003). Subsequently, it is of no surprise that there is a strong link between undergraduate research and enrollment in graduate school (Bauer & Bennett, 2003; Hathaway, Nagda, & Gregerman, 2002; Lopatto, 2007). Students participating in undergraduate research are not only more likely to enroll, but are often more successful in graduate school (Hathaway et al., 2002). Further, their research mentors not only gain the personal and professional rewards of students' acceptance into graduate school, but findings indicate that faculty members who mentor students in research experience professional development gains, including improving their teaching abilities and communication skills as a result of their mentoring experiences (Dolan & Johnson, 2010).

Of special interest are the benefits of undergraduate research specific to minority students. This is especially relevant given the underrepresentation of minorities and women in STEM disciplines (i.e., science, technology, engineering, and math). According to the National Science Foundation, individuals qualify as underrepresented if "they constitute smaller percentages of science and engineering degree recipients and of employed scientists and engineers than they do of the population" (2013). Therefore, underrepresented populations in STEM disciplines include women,

persons with disabilities, Blacks, Latinos/as, and Native Americans (National Science Foundation [NSF], 2013). This underrepresentation is attributed to several barriers and challenges specific to minority students that hinder their success and often lead to attrition in STEM majors and graduation. These challenges or barriers to success in college and STEM disciplines include beginning college less equipped for science and mathematics courses (Vetter, 1994; Schneider, 2000) and having less financial support and resources (NSF, 2013) than majority students. If underrepresented students do finish their bachelor's degrees, their GPAs are often lower than those of their majority peers (Wilson, 2000). With lower GPAs these underrepresented students are less likely to pursue and gain acceptance into graduate school (Wilson, 2000). These barriers extend beyond the academic domain, with underrepresented students being particularly vulnerable to social isolation (Murguia, Padilla, & Pavel, 1991; Tinto 1993; Wilson, 2000). Indeed, researchers have suggested that to combat social isolation there needs to be an essential number of students from a similar race, ethnic group, or socioeconomic background (Murguia, Padilla, & Pavel, 1991; Tinto 1993; Wilson, 2000). These peers are needed for students to create strong social and academic networks (Murguia, Padilla, & Pavel, 1991; Tinto 1993). Creating these social and academic networks helps students feel a sense of institutional identification, a factor especially crucial for the retention of Black students (Astin, 1982; Tracey & Sedlacek, 1987). It may be possible to create these networks through undergraduate research involvement.

Academic institutions across the nation have created and implemented various programs to address these barriers and to increase the number of underrepresented students in STEM majors (and to increase these students' potential for success in graduate school and science careers). Efforts were first made to socially support underrepresented students; however, research on minority student attrition suggests that these efforts needed to move beyond "the staff of student affairs" (Tinto, 1993, p. 71) to include interaction and integration with faculty and academic life. Therefore, as aforementioned, we are especially interested in the specific benefits of undergraduate research for underrepresented students.

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Research has found that involvement in undergraduate research and undergraduate research programs increases students' academic achievement and retention rates, especially for students from underrepresented racial and socioeconomic groups (Adedokun, Bessenbacher, Parker, Kirkman, & Burgess, 2013; Cole & Espinoza, 2008; Ishiyama, 2002; Nagda, Gregerman, Jonides, von Hippel, & Laurensen, 1998). For example, Kuh, Cruce, Shoup, Kinzie, and Gonvea (2008) found engagement with undergraduate research within the context of an undergraduate research program had positive effects on grades and persistence in college for all students; however, underrepresented students benefited more from participating than did their majority peers. Similarly, Nagda et al., (1998) found that participation in an undergraduate research program increased retention rates for students, but especially for Black students. Likely related to the increased retention rates, underrepresented students have also reported an increase in their confidence in doing research from interaction with their research mentors (Thiry & Laursen, 2011). Further, participation in undergraduate research has been associated with increased graduation rates for underrepresented students (Barlow & Villarejo, 2004) as well as with their increased pursuits of higher degrees (i.e., PhD) in STEM disciplines (Carter, Mandell, & Maton, 2009; Eagan, et al., 2013; Pender, Marcotte, Domingo, & Maton, 2010). Finally, involvement in undergraduate research serves to attract these students to careers in science (Lopatto, 2007). Indeed researchers have noted that undergraduate research serves as a pathway for underrepresented students to science careers (e.g., Lopatto, 2007). We sought to extend this

extant research on the benefits of undergraduate research by developing a class-based undergraduate research opportunity within the context of a first-year learning community in the hopes that this experience would provide a starting point for this pathway to successful undergraduate, and ultimately science careers, for underrepresented students.

The Benefits of Learning Communities

Learning communities serve as a potential vehicle in which students can gain the benefits of undergraduate research. Learning communities are characterized by integrated programs or classes that often share a common theme, subject, or goal (Brower & Dettinger, 1998). The purposes of learning communities vary; however, learning communities are all designed to provide a means of supporting students and increasing their feelings of connectedness. Similar to the benefits of undergraduate research, specifically those for underrepresented students, benefits of involvement in learning communities include increased student engagement in the classroom, involvement on campus, satisfaction with the college experience, and persistence in higher education beyond the first semester (Engstrom, & Tinto, 2008; Stassen, 2003; Tinto, 1997; Tinto & Russo, 1994). Furthermore, research indicates that learning communities enhance academic performance, as measured by grades, and improve the study habits of the students involved (Lord, Coston, Davis, & Johannes, 2012; Zheng, Saunders, Shelley, & Whalen, 2002). At a more interpersonal level, learning communities allow students to form more friendships and gain a greater sense of community (Jaffee, Carle, Phillips, & Paltoo, 2008). This increased involvement in both the classroom and in social activities enables students to better integrate their academic and personal lives (Johnson, Johnson, & Smith, 1998). Finally, the benefits extend beyond the four walls of the learning community classroom; for instance, better career preparation has also been linked to students' involvement in these experiences (Engstrom & Tinto, 2007; Lord et al., 2012; Rocconi, 2012; Stassen, 2003; Taylor, Moore, MacGregor, & Lindblad, 2003; Zhoa & Khu, 2004).

As demonstrated from the aforementioned research, learning communities have the ability to provide a structure that combats many of the barriers and challenges faced by underrepresented students (e.g., social isolation and lack of integration into academic life) as well as reach more students than can be provided in one-on-one faculty-student research mentor relationships (see also Woodzicka, Ford, Caudill, & Ohanmamooreni, 2015). In addition to reaching more students than would a one-on-one faculty-student research mentor relationship, learning communities provide other forms of support (e.g., social networks), that do not necessarily come from involvement in undergraduate research and that are crucial for underrepresented students retention. Our purpose was to assimilate the undergraduate research experience into a learning community setting to provide a powerful and meaningful introduction to college for first-year students, several of whom were women and/or students of color.

The Structure of the Learning Communities at Kansas State University

Kansas State University is a large state research institution with an enrollment of more than 24,000 undergraduate students. To facilitate students' transition to college and to help those students succeed in their undergraduate education, a group of Kansas State University faculty and administrators created and manage a first-year experience program called K-State First. One of the components of K-State First is its learning community program. The learning communities within this program share a common structure and other defining characteristics. Each learning community consists of a set of three interconnected courses. Two of these courses are introductory general education courses, and are often courses with relatively large enrollments (*N*s > 100). The third course is a smaller "connections" course that explores a more specialized topic that in some way connects and synthesizes the information from the larger general education courses. The connections course is limited to a maximum enrollment of approximately 20 students (each of whom has also enrolled in both of the general education courses), and is usually taught by one or both of

the instructors of the general education courses. The connections course meets once a week for 50 minutes. Thus, the learning community consists of a small number of students who, together, take a set of three courses that combine to provide an interrelated academic experience, locally referred to as a "CAT" (Connecting Across Topics) community.

Beyond this common structure, each learning community in the K-State First program shares other defining features. Each learning community has an undergraduate peer mentor/learning assistant (LA) who attends and assists in the connections course. These LAs work with students in the learning community not only with academic issues specific to the courses comprising the learning community, but also with issues the students may be having socially, emotionally, and/or professionally with the adjustment to college life. These LAs are often students who had participated in the learning community in a previous semester. Each learning community emphasizes a holistic college experience in which learning happens both within and beyond the classroom. Accordingly, learning communities engage in a common reading program and attend co-curricular events (e.g., field trips, talks by authors visiting campus) together. Further, each learning community emphasizes a set of four common student learning outcomes (SLOs) that guide the academic structure and experience that it provides. These SLOs are critical thinking, communication skills, community building, and application of learning.

We believed that the mission pursued by the K-State First learning communities, and their defining structural characteristics and student learning outcomes, made a learning community an optimal academic environment in which to introduce first-year students, especially those that qualify as underrepresented, to the undergraduate research experience. Further, we elected to do so in a learning community whose connections course attracted a relatively high proportion of students of color.

The Psychology of Prejudice Learning Community

One of the first-year, first-semester, learning communities among K-State First's connections courses is "The Psychology of Prejudice". The Psychology of Prejudice connections course provides a thematic academic experience by connecting larger introductory courses in psychology and sociology. The Psychology of Prejudice connections course is advertised by making specific reference to its inclusion of undergraduate involvement in research, as illustrated by the short description of the course used to describe it to prospective students and their families during enrollment: *"Prejudice affects all of us in daily life-- here's your chance to identify how. Discover how stereotypes develop and are perpetuated in society. Participate in events that highlight issues of social justice. Explore the research of faculty and other students, and then conduct your own research project about prejudice and stereotypes."* The content of the course includes discussion of the cognitive, affective, and behavioral components of bias and its functions; how expressions of bias have changed over time; strategies for measuring explicit and implicit prejudices; how bias manifests against individuals on the basis of race, gender, sexual orientation, religion, and physical appearance; strategies used to attempt to reduce bias including their theoretical foundations and general rates of effectiveness; how the target-focused perspective differs from the perceiver-focused perspective in prejudice research; what stigma is and how targeted individuals experience prejudice (e.g., stereotype threat, outgroup favoritism); and how to design, conduct, and report the results of a research project on stereotypes, prejudice, and discrimination. This is a course that has traditionally attracted greater proportions of both female students and students of color (both of whom are underrepresented in STEM disciplines) than would be expected based on Kansas State University's student body demographics, and this appears due to the students' attraction to the topics covered in the Psychology of Prejudice connections course.

The Structure of the Undergraduate Research Experience

As a connections course, the Psychology of Prejudice course meets for only 50 minutes, once a week, for the duration of the semester. This presented a challenge in terms of our ability to provide the first-year students with the information, skills, and support to conduct their own independent research projects successfully. Consequently, we were inspired to develop a model for the structure of this experience that can be implemented more broadly to allow for the research process to be an engaging feature of their courses. This model, which we refer to as the Simplify-Guide-Progress-Collaborate (or SGPC) Model, is based on four key elements we believe to be necessary to maximize the value of the research experience.

Simplify

The first element of our model for the undergraduate research experience in the context of a first-year experience learning community required that we simplify the research process. Starting a research project is a daunting endeavor for anyone, and may be overwhelming for first-year students without any background in research. Accordingly, the research process must be refined to fit the abilities of these researchers so that their skills and self-efficacy in the endeavor will be consequently built. Instructors of courses that will immerse their students in the undergraduate research experience must bring the research to the students' level. In doing so, the research projects that undergraduates will design and conduct will be approximations of the types of research that more senior students and faculty conduct, but will generally be less sophisticated. Given that the students' objectives in this particular undergraduate research experience are to learn the research process as a vehicle toward academic engagement and self-efficacy, and generally not to produce research worthy of publication in peer-reviewed journals, this is an acceptable loss.

There are several specific ways that we simplified the undergraduate research experience for use in the Psychology of Prejudice. First, we provided a common theoretical framework as the basis for the research projects the undergraduates would design and conduct. We chose the justification-suppression model of prejudice (JSM; Crandall & Eshleman, 2003). This theory predicts that individuals generally possess some level of genuine prejudice toward members of outgroups, but that this prejudice is not always expressed. Suppression factors inhibit the expression of genuine prejudice, and these suppression factors may be internal (e.g., egalitarian beliefs) or external (e.g., social norms prohibiting the expression of prejudice). However, justification factors may disinhibit the expression of genuine prejudice, and these justification factors similarly may be internal (e.g., perceptions of threat or intrusion by outgroup members) or external (e.g., absence of outgroup members). The JSM is an intuitive theory explaining when prejudice is more or less likely to emerge in behavior, allows for hypotheses to be easily developed (e.g., regarding the effects of manipulations of participants' awareness of suppression versus justification factors on their subsequent expressions of prejudice), and may be applied to explain expressions of prejudice in many domains of social behavior (e.g., helping; Saucier, Miller, & Doucet, 2005). We provided this common theoretical framework to our students in the Psychology of Prejudice, created short assignments related to the model's use early in the semester, and had students' locate and retrieve the Crandall and Eshleman (2003) article introducing the JSM using library research tools.

A second way that we simplified the undergraduate research experience for the Psychology of Prejudice class was to offer students a choice between two research objectives for the studies they

would design and conduct. One objective available was to compare the expressions of prejudice toward different groups. Students choosing this option would identify a method of measuring prejudice and then apply that method to measuring prejudice toward two or more social groups. Their hypothesis would predict the similarity or difference expected between or among those levels, and the hypothesis would be tested by comparing the levels. The other objective available was to reduce the expression of prejudice toward one group. Students choosing this option would identify a method of measuring prejudice and then apply that method to measuring prejudice toward one social group on two occasions, once before and once after some manipulation (e.g., of justification or suppression factors). Their hypothesis would predict an expected increase or decrease of the prejudice levels from the pretest to the posttest, and this hypothesis would be tested by comparing the pretest and posttest levels.

Thus, the choice of the research objective also provided the outline for the subsequent study's design and analysis. This allowed the students to spend their time puzzling over the creativity of their projects within bounded constraints. They may therefore be creative, but have enough structure to do so such that they enjoyed greater likelihoods of working on research projects that were theoretically relevant and suited to the course content and material. Further, and not trivially, simplifying the projects in this way makes it easier for instructors to supervise the students in their research, to provide guidance and mentoring, and to maximize the positivity of the mutual experience.

Guide

The second element of our model required that we provide explicit and realistic guidelines for the students at each stage of the design, development, proposal, collection, and report of their independent research projects. Research necessarily involves ambiguity. As an activity whose purpose is to do innovative things that result in novel findings, there will always be questions about what researchers should be doing and how they should be doing it. To the extent that we could anticipate, we tried to answer as many of these questions pre-emptively in the guidelines and grading rubrics we provided to our students. Each assignment was created with a specific product in mind that would take a set form. These guidelines and rubrics provided explicit and detailed information for how to structure the various elements of their research. We aimed to be comprehensive in alleviating the ambiguity of the logistics of research that would be common for all students so that the students would be able to focus their creativity on the specific elements of their individual research studies. Because the first-year students were unlikely to have any prior research training, we included guided information about each part of the research process for assignments we created. For example, we provided information about how to phrase the research objective (e.g., use the form, "the purpose of this research study is to examine the effects of (insert independent variable) on (insert dependent variable)"), the specific types of demographics to include in the Participants section of the proposal and report, and the verb tenses that should be used in a research proposal (i.e., future) versus a final research report (i.e., past). We also clearly indicated formatting guidelines for the assignments, including those related both to the physical document's appearance (e.g., font size, page length, APA format for citations and references) and content (e.g., number of references, where the hypotheses would be reported).

Progress

The third element of our model required that we structure the Psychology of Prejudice course intentionally around a gradual and progressive timeline during which the students made incremental progress toward the eventual completion of their independent research projects. Research is not a process that can, or should, be done hastily. Accordingly, we created a semester-long plan over which we scheduled assignments that built progressively on each other to allow students to accomplish smaller goals along the way to the overall completed research project. By formalizing

these assignments and this timeline, we were able to build in several opportunities to provide feedback to the students and mentor them more effectively through the undergraduate research experience.

This progressive timeline is illustrated in Table 1. Having some foundation in psychological research methods was an early priority, and this was a topic covered in the introductory psychology course in the first two weeks. Meanwhile, the students were introduced to and discussed theories, processes, and manifestations of stereotypes, prejudice, and discrimination in the early class meetings of the Psychology of Prejudice connections course. As the students' familiarity and comfort with the prejudice content increased, the Psychology of Prejudice connections course moved its focus to the measurement of prejudice, and then to issues related to conducting research specifically to study prejudice, building upon the foundations provided in general research methods in the introductory psychology course. During this time, the students also applied their learning in several out of class "missions" in which they completed assignments related to observing prejudice as it occurs in their social worlds.

Table 1. Sixteen-Week Semester Timeline for the Psychology of Prejudice Course Research Activities

Week	Topics and Assignments*
1 to 2	Scientific method applied to psychology (discussed in introductory psychology)
1 to 6	Theories of stereotyping, prejudice, and discrimination
7	Measurement of prejudice
8	Ethics and design issues in prejudice research
1 to 8	"Missions" to observe prejudice in the social world*
9	Prejudice study design worksheet due*
	Office hour meeting and assignment due*
10	Library resources workshop
	Explanation of project idea's connection to JSM due*
	Questions about the research proposal idea assignment due*
11	Library assignment with primary sources due*
	In-class work day with Q&A session
12	Formal research proposal ideas due*
13 to 15	Data collected and organized
16	Final research project reports due*

This first half of the semester culminated with the students' completing a prejudice study design worksheet on which they provided their choice of research objective, target groups to study, preliminary measurement strategy, and initial thoughts on the project's theoretical connection to the justification-suppression model. At this time, the students also completed an office hour assignment during which each student met individually with the Psychology of Prejudice connections course instructor. This provided a formal occasion for each student and the instructor to discuss the students' individual research study plans, exchange ideas, and share feedback.

As the second half of the semester began, the Psychology of Prejudice connections class focused on providing content and assignments designed to facilitate transitioning the preliminary research ideas developed by the students into their actual projects. This included a library workshop, assignments created to allow students to more formally contextualize their research ideas within the extant literature and to identify areas of confusion or concern, and an in-class workday in which the students presented their research ideas and proposed methods to each other for peer review as well as to the instructor and learning assistant. Their formal submission of their research proposals followed, and, upon instructor approval, data collection began. With the schedule we devised, students then had approximately one month in which to collect and organize their data, and to prepare their research reports.

This timeline made the students' independent research projects the emphasis of many of their activities, both in terms of class content and the assignments they completed. The natural progression of the assignments, and the tailoring of the class content to meet the needs of the project at the various time points during the semester, provided students with skills and resources at the times that they needed them to make their completion of an independent research project a more realistic venture. Further, the use of assignments to harvest and grow the research ideas from initial thought to a finalized research report allowed for many iterations of communication and feedback. We believe that this structure was essential for allowing the first-year students, none of whom had previous research experience, to design and conduct successful independent projects and enjoy positive subjective experiences.

Collaborate

The fourth element of our model required that we identify and pursue opportunities for others on campus to provide the students with training and access to resources necessary for them to successfully conduct their independent research projects. Of most importance was our establishing a collaboration with our campus's library resources. We discussed our undergraduate research plan with a representative of our campus library, who subsequently created a workshop tailored to our students' research needs in which they learned how to access library services generally (e.g., navigating the library's website, interacting with the online help desk), use academic databases for literature searches (e.g., PsycINFO), screen and narrow search results for relevant materials (e.g., peer-reviewed journal articles), and retrieve relevant materials (e.g., downloading PDFs of articles, making requests on interlibrary loan). The librarian also created a website specifically for the Psychology of Prejudice course through which our students could directly access many of these library research tools. Collaborating with our campus's library resources made the research process much more manageable and efficient, and much less intimidating, for our students than it would have been otherwise.

The Fall 2013 Semester Cohort

The Psychology of Prejudice learning community consisted of 19 first-year students in the Fall semester of 2013. We have chosen to highlight this group of students because this group consisted of a majority of women (12 of the students were women) and approximately half of the students

were students of color (2 were Black, 1 was Latino/a, 1 was Asian, 5 were bi/multiracial, and the remaining 10 students were White). All of the students were ages 17 to 19, and their mean ACT score was 24.00 (*SD* = 4.06; ranged from 19 to 32).

In designing their research projects, all but one of the students chose to design and conduct projects to compare the expressions of prejudice toward different groups; the remaining student chose to design and conduct a project to reduce the expression of prejudice toward one group. The students were diverse in their selection of social groups to examine as the targets of prejudice in their research studies. Collectively, and creatively, the research projects examined prejudice toward gay men and/or lesbians, transgendered individuals, Whites, Blacks, Native Americans, racial minorities in general, Americans who are not White versus non-Americans who are White, men, women, individuals with Autism Spectrum Disorder, individuals who are fit versus fat, women who are in versus not in sororities, and people who do versus do not smoke.

The students submitted their final research reports at the final meeting of the Psychology of Prejudice connections course. At that time, they also completed a confidential assessment of their experiences related to their independent research projects. They reported the score they expected to receive on the project (from 0 to 100%). The reported their agreement with 8 items, using response scales from 1 (strongly disagree) to 9 (strongly agree) to indicate their subjective experiences of completing the research projects. Two of the items assessed the students' perceptions of the degree to which they felt the research projects were challenging and the degree to which they felt they had the skills to complete the research projects successfully. Three of the items assessed the students' perceptions of how much the research projects allowed them to apply knowledge about prejudice, research methods, and library resources, respectively. Three of the items assessed how valuable the students found the research experience to be, how genuinely interested they were in their research questions, and how much they would recommend that next year's class also complete research projects. The students also provided free responses to items asking them to report the best thing about completing the research project, the worst thing about completing the research project, and the one thing they would change about the research project.

Students' Performances on Their Independent Research Projects

Three of the students, unfortunately, failed to submit final research reports. The 16 students who did submit final research reports did well collectively. Their average score on the research project reports was 85% (*SD* = 12%; ranged from 48% to 98%). There were no sex or race differences on the scores on the final research project reports. These performances indicate that the students who completed the independent research projects did so with a high degree of success. While it was unfortunate, and unexpected, that 3 students would fail to complete their research reports, those who did complete research reports demonstrated that they had learned how to design, conduct, and report their activities as independent undergraduate researchers effectively.

The students also expected to do well on their final research reports. Their responses for their expected scores on the research report were also generally high, with an average expected score of 84% (*SD* = 11%; ranged from 50% to 94%). There were no sex or race differences on the expected scores on the final research project reports. These expectations that they would do well demonstrated that, along with the actual ability to conduct and report research that their performances on the final research reports indicated, the students developed high levels of both self-efficacy and actual efficacy in their research abilities. Interestingly, the students' actual scores and expected scores on the final research reports were highly correlated, $r = .75$, $p = .001$, suggesting that they were aware of their research abilities and performances.

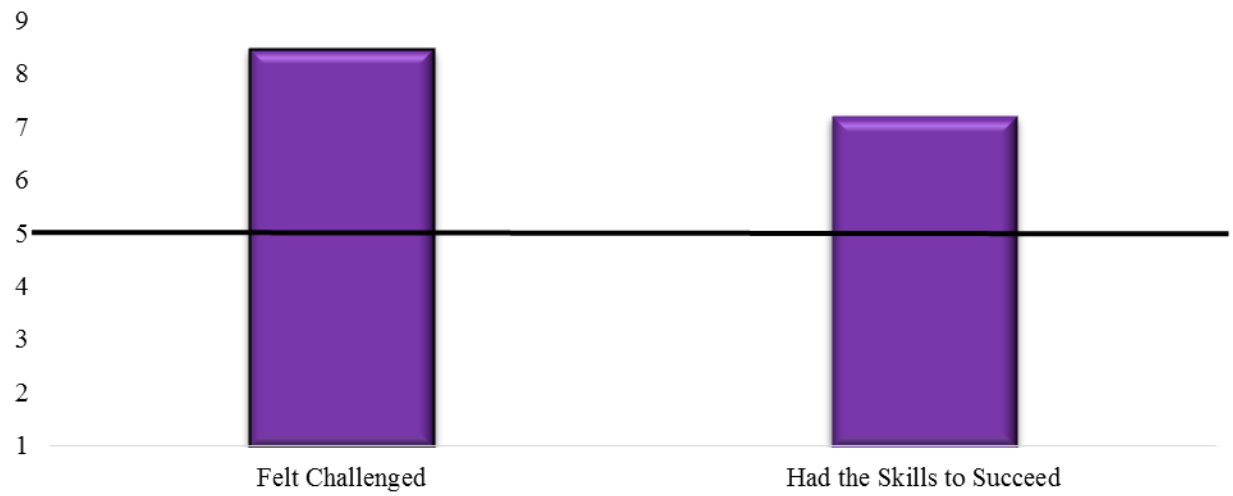

Figure 1. Perceived Challenge and Skills

Students' Experiences Completing Their Independent Research Projects

Overall, students generally expressed that they found the experience of completing the independent research projects to be challenging, but worthwhile experiences. We compared the students' mean responses to each of the items for which they rated their agreement from 1 to 9 to the midpoint of the response scale value of 5. Students felt the research projects were challenging, $t(17) = 15.85$, $p < .001$, but that they had the skills to complete the projects successfully, $t(17) = 4.12$, $p = .001$ (see Figure 1). They felt the research projects allowed them to apply their knowledge about prejudice, $t(17) = 9.97$, $p < .001$, research methods, $t(17) = 6.02$, $p < .001$, and library resources, $t(17) = 2.08$, $p = .053$ (see Figure 2). Perhaps most importantly, the students reported that completing the research projects was a valuable experience, $t(17) = 4.75$, $p < .001$, they were genuinely interested in the research questions they investigated in their research projects, $t(17) = 6.14$, $p < .001$, and they would recommend that the following year's class also conduct their own independent research projects, $t(16) = 5.35$, $p < .001$ (see Figure 3).

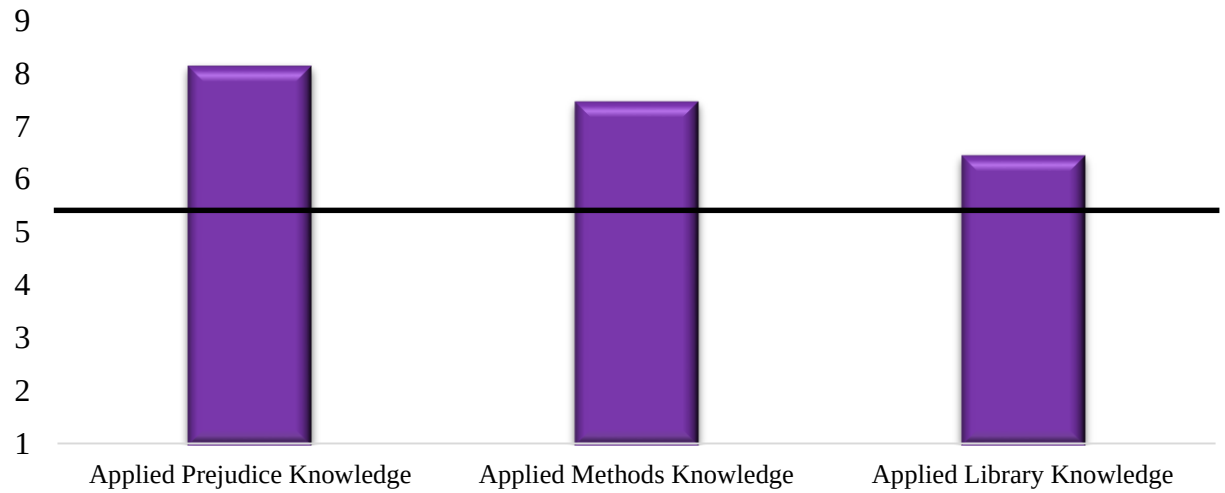

Figure 2. Perceived Applied Knowledge

We also examined the students' free responses asking them to report the best thing about completing the research project, the worst thing about completing the research project, and the one thing they would change about the research project. The themes that emerged in the students'

responses are listed in Table 2. In terms of the best things about completing their research projects, students reported their pride in accomplishing something worthwhile and their general excitement about the research experience. In terms of the worst things, students referred to their difficulties in navigating and enduring the research process and, interestingly, a common response specifically referred to their difficulty in staying within the two page (single-spaced) limit on the research report's length. In terms of the things they would change, the most common specific response was to increase the page limit of the research report. Other responses referred to desires for more time and guidance at certain stages of the research process. Three of the students stated they would change nothing about this experience for the future.

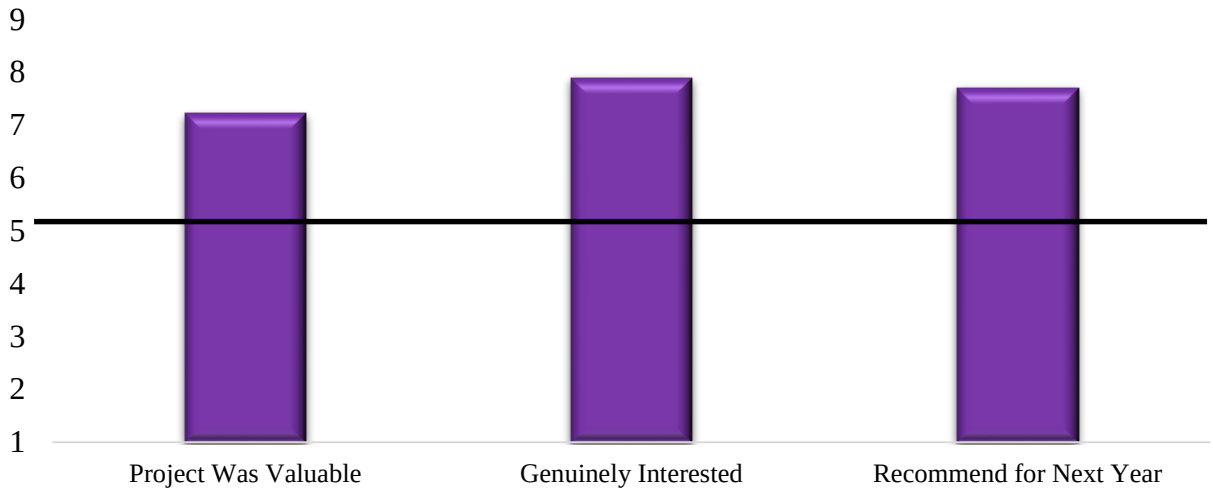

Figure 3. Overall Perceptions of the Project

Table 2. Students' Free Responses About the Best, Worst, and Things They Would Change

Best Things About the Research Projects

Got to develop a study (*n* = 2)

I got to meet new people

Learned interesting things and gained experience (*n* = 5)

Applying knowledge in real life (*n* = 2)

Seeing my results (*n* = 3)

Supporting my hypotheses with my results

Helped me become more mature in my beliefs

Feeling like I did something worthwhile (*n* = 2)

I did it! (*n* = 4)

Table 2 continued Students' Free Responses About the Best, Worst, and Things They Would Change

Worst Things About the Research Projects

Didn't understand how to do everything at first

Took a lot of time

Waited too long

It was stressful

Having to collect data from people (*n* = 2)

Figuring out how to show results and their importance (*n* = 2)

Being uncertain about accuracy

Using library resources

Working with software (one student used Qualtrix and SPSS)

Staying in the two page limit (*n* = 5)

Things They Would Change About the Research Projects

Increase the page limit (*n* = 6)

Have more diverse participants

Do more things in class

Give more time to collect data and write the report

Better way to show results

Have more examples of past projects

Less use of library resources

Nothing (*n* = 3)

Overall Recommendations and Conclusion

Our results overall demonstrate that it is possible to have students successfully complete independent research projects in their first semester of college. We achieved this objective in the context of a first-year experience learning community with a cohort comprised of relatively high proportions of students from groups underrepresented in the STEM disciplines (i.e., women, students of color). Our method of tailoring the students' research experience with the goals of simplifying, guiding, progressing, and collaborating within the structure of that experience created a learning environment in which we could both challenge and support our students. We simplified the research experience by providing explicit structure and choices, thus allowing our students to be creative within a manageable, less overwhelming framework. We guided our students with realistic

and explicit directions, assignments, and rubrics to allow them to spend their cognitive energy completing their research tasks without having to ruminate over needless vagaries. With clear intention, we mentored our students through the research experience over the course of a semester-long timeline in which the course content and accompanying assignments gradually progressed from early research ideas to the design of studies to the report of results. Finally, we collaborated with library resources to provide our students with the skills necessary to found their research projects on, and to contextualize their research projects within, the extant literature. The result was the successful achievement of independent undergraduate research, verified by both high levels of performance on the final research project reports and highly positive reports of the students' subjective experiences.

As demonstrated, our program has the ability to create strong academic (e.g., with faculty, fellow students, peer mentors, and campus resources) and social networks (e.g., peers of similar backgrounds in a small class size and co-curricular events together), factors previously identified as crucial to the retention of underrepresented students (Astin, 1982; Tracey & Sedlacek, 1987). Furthermore, as we suggest engaging students in research as soon as possible (e.g., in the first semester) and present a method of how to do so, many of the challenges related to the attrition (i.e., social isolation and poor GPAs) of underrepresented students, will have not yet occurred. Thus, this program has the ability to serve as a preventive measure to the attrition of underrepresented students. A potential limitation to this model is that it does not have the ability to combat all barriers that have been linked to attrition of underrepresented students (e.g., less financial support than majority students) that other programs (e.g., scholarship or fellowship assistance) may include. We believe, however, that participating in this type of research early in students' college experience will draw them to more research opportunities and subsequently make students more competitive for scholarships and graduate school later in their careers. Other learning community programs' goals have included the retention of underrepresented students; however, they have been criticized for their inability to integrate underrepresented students into the larger college community (which then leads to attrition) because the programs often have not included faculty (Nagda et al., 1998; Tinto, 1993). Not only does our structure include faculty involvement, but it has the ability to involve more students (e.g., an entire class) in research than a one student-to-one faculty research program (e.g., summer research programs). Thus, we believe this program is ideal for attracting underrepresented students to research majors and careers.

We believe that our structure of this undergraduate research experience can be easily modified for use in undergraduate classes beyond those that are learning communities, as well as in research laboratories in which students collaborate in research. For example, this method could be implemented into upper level courses by modifying the structure to allow for more autonomy, creativity, and a project more appropriate to their greater levels of knowledge and experience. Assignments, guidance, and the progress timeline could also be adjusted to fit the appropriate level. For instance, having students locate and retrieve only one article central to the theoretical framework using library tools may not be appropriate for upper level courses. Instead, students could be given a list of appropriate journals from which to draw sources from. Similar to our course (i.e., The Psychology of Prejudice), this method could also easily be implemented into existing courses that have a history of attracting minority or underrepresented students and are relatively small (e.g., class sizes of fewer than 30 students). This endeavor may admittedly be more challenging as the class size increase, but we believe the structure of our method could be modified to make projects even further defined for students (e.g., selecting among even more explicit research topic ideas, or providing only one explicit research topic idea to pursue) or to allow for the projects to be completed by teams of students rather than by individual students. Further, as class size increases, developing networks and relationships with peers and faculty, and the structure of our method may need to be similarly modified. Finally, we would also recommend that faculty who employ our method embrace

the opportunity to work with their students' creative ideas and make these ideas operational. Students should be encouraged and supported to be creative within the guidelines given, and we strongly suggest working within theoretical models for which the faculty has high degrees of knowledge and enthusiasm.

It should be noted that our implementation of this method did occur in the context of a learning community. While this context provided several advantages that aided in its implementation (e.g., small class size, peer networks), other classes may be adapted to pursue these same educational goals. The research experience itself may be used a common experience to forge a sense of community among students and faculty, and potentially increase the likelihood of success in those research endeavors.

Overall, we believe our model for undergraduate research experience is suitable and adaptable to a variety of class settings across virtually every academic discipline in which research is conducted. Our model of simplifying, guiding, progressing, and collaborating may therefore produce successful and positive experiences in undergraduate research, especially for those students underrepresented in research-based careers. These experiences may increase undergraduate students' engagement in their own educations, and may even inspire the next generation of faculty researchers, whose ranks will benefit from including more women and people of color.

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