CURating Science Literacy and Professional Identity Among Biology and Science Education Majors

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Abstract

In this article, we discuss a novel approach to course-based undergraduate research experiences (CURE) by exploring the impact of a near-peer configuration within three courses: the Elementary Science Education and Secondary Science Methods courses for education students and the Dimensions of Biodiversity course for students in the biological sciences. We were interested in understanding how students from education would benefit from partnering with students from the sciences and vice versa. We discuss our approach to designing and implementing the near-peer approach along with extended details regarding the process for research groups. We used a modified Undergraduate Research Student Self-Assessment (URSSA) to understand how science and science education majors influence one another in developing researcher identity, including scientific literacy and communication skills, after engaging in a near-peer structured CURE. Our results show that most science education students reported increased interest in conducting research in the future and some biology students reported an increased interest in teaching science. Logistical and interpersonal relationships were noted as the primary adverse challenges to implementation. Future programming and research efforts should expand to include other scientific disciplines and pay close attention to interpersonal dynamics, especially during the matchmaking phase.

Introduction

For science and science education majors, engaging in science or conducting research removes barriers to learning and professional success. Unfortunately, undergraduate students in science courses too often passively receive research findings rather than engage with science (Center for Engaged Learning, 2022; Glaze, 2018). This passive engagement trend affects science and science education majors in three key ways. First, past studies provide evidence that women and minority students who engage in field experiences graduate at a higher rate than their peers who do not (Huang et al., 2000). Designing learning experiences that engage science and science education majors in scientific discovery directly addresses retaining diverse talent in STEM disciplines. Second, calls to reform science education require attention to engaging preservice and inservice teachers in authentic research experiences (McLaughlin & MacFadden, 2014). Engaging science education majors in research effectively jumpstarts a cyclical process by modeling quality science learning design. Third, science teacher education reformers (Tan & Kim, 2012) and the Committee on Prospering in the Global Economy of the 21st Century and the Committee on Science, Engineering, and Public Policy (2007) have called for the development of innovative strategies to enhance scientific competencies in and out of the classroom. This call presents an opportunity to reconceptualize and integrate innovative practices to retain science and science educator talent and model science learning design that enhances learners' scientific competencies.

Research has shown that engaging undergraduate students in research positively influences professional identity formation and scientific thinking, among other benefits (Seymour et al., 2004). Indeed, the increased prevalence and wide variety of course-based undergraduate research experiences (CUREs) demonstrate how faculty have heeded the call Ballen et al., 2017). However, Corwin et al. (2015) noted that CUREs vary widely in design and implementation, resulting in diverse potential practices to consider based on the goals of the approach. When considering science and science education majors collectively, three overlapping expectations create a compelling area of interest. Both learner groups need to develop scientific literacy, a science identity, and communication skills for professional success. Thus, questions emerge regarding how to implement successful undergraduate research experiences that engage our future scientists and science educators. Further, given the two learner groups' similar needs, the potential arises to include peer mentoring as a component of the approach.

Seeking answers, we implemented an innovative CURE across three courses at a public university in the Inland Northwest United States: a biodiversity course offered through the Department of Biological Sciences and two preservice science teacher education methods courses, one elementary and one secondary. This collaboration engaged students in the biological sciences and science education preservice teachers (whom we refer to as science and science education majors) in an inquiry-based CURE facilitated through near-peer mentoring. Integrating the frameworks of CUREs (Ballen et al., 2017) and near-peer mentoring (Edgcomb et al., 2010), our design approach and outcomes offer practical insights for course designers and science education scholars seeking to adopt similar strategies or further investigate interactions integrating authentic educational frameworks.

Integrating Authentic Frameworks

By engaging in inquiry-based learning experiences, students assume a scientist's role in investigating topics of personal interest. This approach to authentic learning fosters students' self-autonomy, which in turn enhances confidence (Littlewood, 1996; Spronken-Smith & Walker, 2010). Further, coupling an inquiry-based research project with near-peer mentoring adds a mutually beneficial dimension to engagement. Unlike traditional apprenticeship or advising models, near-peer mentoring fosters a personal relationship that contributes to the persistence necessary for interest retention (Destin et al., 2018). Additionally, reducing the hierarchical nature of classroom structures by positioning science and education students as having something valuable to contribute to the endeavor creates an atmosphere of ownership in the pursuit of a shared goal. The trick, as we found, is to carefully facilitate such an atmosphere.

Students participating in this project were all working toward science and science education careers. We were particularly curious about how students might exchange skills or identities. For example, would the education majors' communication skills and understanding of how people learn assist science majors? Similarly, we wondered about the science majors' developing sense of researcher identity and scientific literacy benefitting education majors. Could the use of near-peer mentoring in a CURE facilitate an identity exchange?

Course-Based Undergraduate Research Experiences (CUREs)

CUREs improve scientific literacy, proscience attitudes, and evidence-based decision-making (Ballen et al., 2017). These situated learning experiences allow student researchers to "do the work that scientists do . . . in the context of a real scientific problem or question, in which the solution or answer is unknown" (Corwin et al., 2015, p. 2). The authentic context, answering real scientific questions with unknown answers, plays a vital role in the perception of legitimacy and expertise development (Lave & Wenger, 1991). Further, these experiences provide supportive opportunities to develop the skills necessary for assuming professional identity and success (Rodenbusch et al., 2016; Tenenbaum et al., 2014; Zaniewski & Reinholz, 2016).

Near-Peer Mentoring

Sharing relatively close attributes like age and experience level, students in near-peer mentoring relationships develop a sense of belonging, which directly contributes to science identity development (Chemers et al., 2011; Hazari et al., 2013; Trujillo et al., 2015). Used in computer science, engineering, medical, and science programs, near-peer mentoring models and undergraduate research opportunities hold potential for enhancing positive attitudes about STEM subjects and increasing scientific literacy. More specifically, benefits include understanding the nature of science, improved teamwork skills, increased comfort in adopting a scientific identity, and morale building (Akinla et al., 2018; Kunberger & Geiger, 2016; Pluth et al., 2015; Zaniewski & Reinholz, 2016). These benefits derive from emphasizing an exchange of sharing and acquiring knowledge (Tenenbaum et al., 2014) within affinity groups to create a sense of belonging (Gates et al., 1999). Much of the existing research with near-peer mentoring focuses on STEM learners exclusively, making applications in the social sciences and teacher education novel.

CURating With Near-Peer Mentoring

Near-peer mentoring studies frequently pair graduate students with undergraduate students, undergraduate students with secondary students, or upper secondary students with middle grades students. For example, Jett et al. (2006) noted increased self-confidence and excitement toward science when pairing undergraduate research interns with junior and senior high school students for summer experiments. Extending this work, Bradley University found great success with summer research immersion programs combining different near-peer mentoring relationships (Edgcomb et al., 2010). The Bradley programs engaged undergraduate through doctoral-level mentors to facilitate science research programs with K–12 teachers and secondary students interested in science. Additionally, Clarke-Midura et al. (2018) highlighted similar benefits of near-peer mentoring experiences between middle and high school students regarding computer science education. The benefits of near-peer mentoring apply to all these contexts.

However, few programs have reported on pairing undergraduate students in a near-peer relationship, and Tenenbaum et al. (2014) noted a need to determine if near-peer mentoring integrates effectively with different scientific settings. Further, Anderson et al. (2015) identified a strong correlation of success in near-peer mentoring when the experience included a laboratory or research experience. Thus, the current project paired undergraduate students across science and science education disciplines to extend these recommendations and address the limitations of previous studies. This project helped address questions related to the design of learning environments that pair traditionally separate student groups working toward a shared goal. In particular, we asked how biological sciences and science education students benefit from one another within such a context. In effect, we sought to foster identity exchanges contributing to effective science communication and enhanced content knowledge for both groups.

Coordination and Logistics

Context

The three courses involved in the project included two from the Department of Curriculum and Instruction and one from the Department of Biological Sciences. Elementary Science Education and Secondary Science Methods (collectively referred to as Methods) address the methods, research, curricula, and technology used in teaching elementary and secondary science. All undergraduate education majors seeking elementary education or secondary science teacher endorsement must take these courses, typically during their junior or senior year. Dimensions of Biodiversity (DoB) is an elective research-based biology course for sophomore- and junior-level students majoring in Biology or related fields, such as Ecology and Conservation Biology or Wildlife Resources. The course, part of an NSF CAREER Award education plan, introduced students to methodological approaches in biodiversity research, including how to survey the literature; develop testable research hypotheses; design a study; collect, interpret, and analyze data; and share results in writing and via a final oral presentation. A total of 77 students enrolled across the three courses during the 2 years of project implementation. Table 1 summarizes enrollment figures by course and within each semester.

Table 1
Project Participation and Course Enrollment

	Fall 2018	Fall 2019	Total
DoB	7	4	11
Elementary	10	31	41
Secondary	13	12	25
Total	30	47	77

Team Formation

Method 1: Ranked Choice

During fall 2018, we tasked DoB students with generating a project description that included a study organism (primary species to be researched), a general research question and leading hypothesis, potential or recommended data sources to answer the question, a possible research design plan, and the perceived broader impacts. Methods students reviewed these descriptions in a publicly available Google Drive folder and submitted a preferences survey that included their name and their top three choices in ranked order. We did not consider student identity or physical location when forming teams. Table 2 summarizes student research topic preferences and the final number of team members.

Table 2
Fall 2018 Inquiry Research Projects and Methods Student Preferences

Topic	1st preference	2nd preference	3rd preference	Final number of team members
Birds of Prey	5	6	1	4
Chinook Salmon	0	4	5	5
Diversity & Pollution	5	5	3	5
Land Snails	2	0	5	4
Moth Diversity	1	2	3	4
Newt Morphology	1	3	2	4
Tick Diversity	9	3	4	4

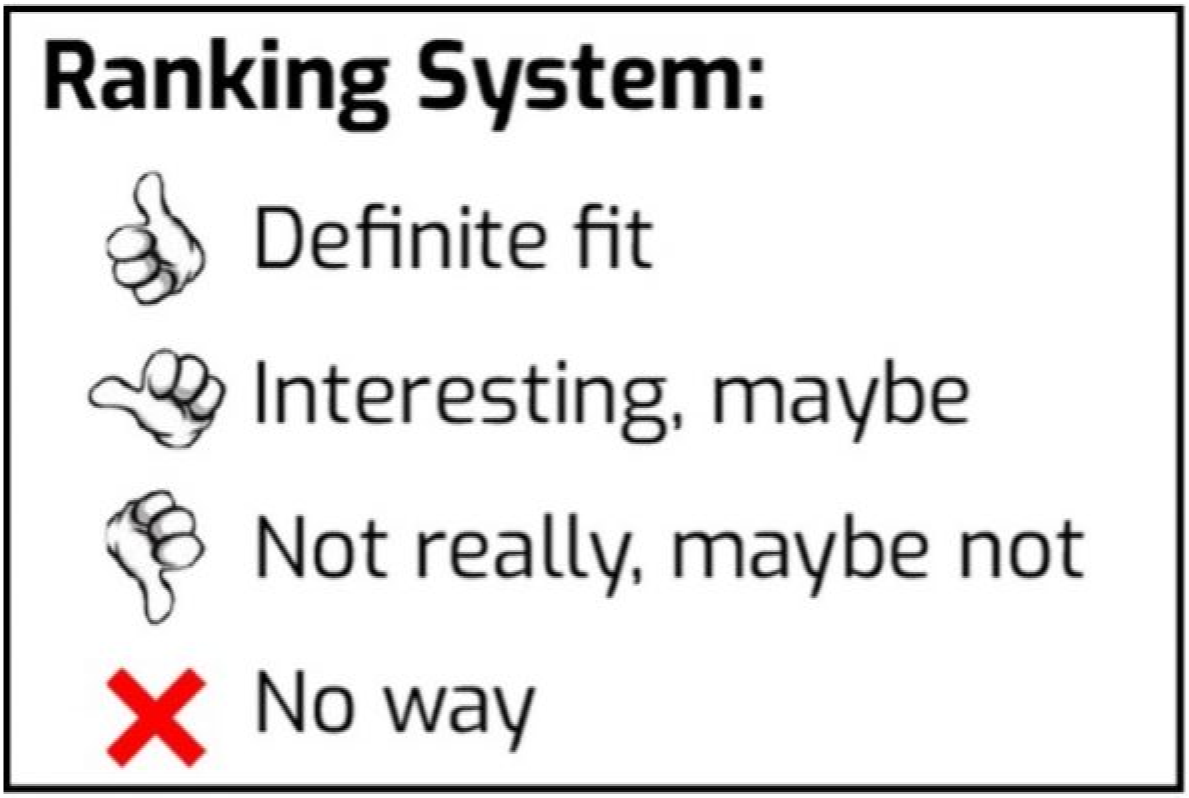
We started by forming teams for projects receiving fewer first-choice rankings and immediately assigned any student who indicated a first or second choice for a low-interest project to that team. We then assigned the remaining team members using students' third-choice preferences. We repeated this process for creating the remaining project teams in order of increasing interest. This approach allowed us to ensure that all students worked on a project of their choice. Each team had four or five members, and the student from DoB served as the research project leader.

Based on instructor observations and student responses, two key challenges with the ranked-choice method emerged. First, science education students felt left out of the decision-making process and struggled to identify personal relevance in the research. Second, DoB students expressed uncertainty about the research abilities of the science education students. Thus, we redesigned team formation during the second iteration of the project in 2019.

Method 2: Matchmaking

To address the concerns identified, we designed a matchmaking strategy to help students get to know one another better and coconstruct the research questions. An unexpected increase in enrollment in the Elementary Science Education course in fall 2019 resulted in a need to reconsider the near-peer relationship so as to not overwhelm the limited number of science majors. Thus, we first divided the students into two groups (Secondary/DoB and Elementary) with a faculty mentor overseeing each group's process. Next, each faculty mentor split their students into two groups and asked them to sit across from one another. In 90-second rotations, we asked students to introduce themselves to the person opposite, including research interests, personal interests, and work habits. We also provided each student with a card on which they could write the person's name and a 4-point visual scale to rate their potential pairing on a team. The bottom of the card included a legend for the scale (see Figure 1): a thumbs up to indicate a *definite fit*; a sideways thumb to mean *interesting, maybe*; a thumbs down to show *not really, maybe not*; and a red X to indicate *no way*. Both groups of students rotated through all available research team members until they had an opportunity to meet with everyone and reflect on the potential to conduct collaborative research with each person. Students kept the cards confidential and handed them in to the instructors. The instructors formed a total of 18 teams by considering all *definite fit* and *interesting, maybe* matches.

Figure 1
Visual Scale From the Matchmaking Cards



Each of the four Secondary/DoB teams had four members, and the 14 Elementary teams varied from two to four members. Within the 14 elementary teams, half consisted of only two students each due to an unexpected scheduling constraint from the required education field experiences of these students. To preserve a near-peer relationship with at least one student being experienced or highly interested in conducting research, the faculty member overseeing the formation of Elementary research teams asked students to indicate their interest in serving as project lead. Secondary/DoB research teams all selected the DoB student to serve as project lead, making it a coconstructed decision.

CURE Facilitation

During fall 2018, the courses were offered on different days of the week and at different times. Thus, primary research tasks occurred outside of course instructional time, and faculty mentors scheduled two joint meeting times to facilitate team communication and mitigate potentially detrimental team dynamics. Students overwhelmingly indicated a preference for more in-class meeting opportunities in feedback received after the first implementation. This change increased the number of direct consultation meetings from two to five, facilitating feedback and mitigating team dynamics.

Supporting the inquiry-based projects included helping students identify research questions, promoting team dynamics, and structuring documentation for data collection and analysis. During fall 2018, most teams demonstrated fractured communication strategies, and some groups expressed a lack of clarity around individual roles. Team formation conversations during matchmaking in the second implementation mitigated these challenges. Students in the first implementation struggled with generating appropriate and realistic research questions, often developing questions that could be quickly answered with a simple search for information or overly complicated questions without a viable data collection mechanism.

To address these issues, faculty mentors scheduled field experiences for fall 2019. The first experience brought all students to an outdoor field campus to engage in inquiry and outdoor learning activities for a 3-day weekend. We divided students into DoB/Secondary and Elementary groups to facilitate guided activities and prepare them for later team formation. The second experience engaged DoB/Secondary students in a 2-day weekend research project simulating their team projects. Using Google Drive to organize files and research tasks allowed the instructors to monitor ongoing efforts with biweekly check-ins of data collection progress and directed comments that guided students' next steps.

Expectations

Student expectations varied slightly between the courses. Within their research groups, students engaged in an inquiry research experience, beginning with generating a research question and following the scientific process to identify, collect, and analyze data to answer the question. At the conclusion of the project, DoB students generated a full written research summary and gave a 15–20-minute presentation in front of classmates and instructors. The scheduling accommodations made for fall 2019 facilitated Methods team members' involvement in these presentations. All Methods students followed identical expectations: produce a lesson or unit plan, write an abbreviated research report, and generate a written reflection on the value of engaging in research as a future teacher. We challenged the science education majors to practice effectively translating their research findings into an anticipated learning activity with appropriate context (grade level and scientific discipline) and alignment with the *Next Generation Science Standards* (NGSS Lead States, 2013). The reflection prompt challenged preservice teachers to address shifts in their understanding of the nature of science and philosophy of or strategies for teaching science. The research reports provided an opportunity to practice different forms of science communication, exercising judgment in deciding between writing to a scientific audience (instructors) and explaining the process and findings to laypersons. Table 3 summarizes some of the research topics undertaken by students.

Table 3
Sample of Peer Inquiry Research Topics

Topic	Participating students		
	Elementary	Secondary	DoB
Impact of forest fires on biodiversity of birds of prey in the Pacific Northwest	X	X	X
Impact of dam construction on Snake River	X	X	X
Chinook Salmon population density	X	X	X
Effect of microplastics on coastal microorganisms in the Redwood Coast	X	X	X
Predicting ecological niches of land snail genera *Oreohelix* and *Anguispira*	X	X	X
Relationship between moth diversity and habitats in Idaho	X	X	X
Relationship between rough-skinned newt morphology and latitudinal gradient	X	X	X
Relationship between deer tick population, Lyme Disease prevalence, and climate patterns in the northeastern and central U.S.	X	X	X
Fish species diversity based on lake size and nutrition gradients		X	X
Impact of negative artificial selection in mule deer		X	X
Perceptions of barriers facing first-generation college students	X		
Effects of mindfulness activities on student behavior	X		
Impact of dams on salmon populations in the Colorado River	X		
Longitudinal biodiversity of palm species	X		

Outcomes

To assess the outcomes of this project, we drew upon the student artifacts described above and a survey completed by students at the conclusion of the course. This survey contained 35 items from the Undergraduate Research Student Self-Assessment (URSSA; Weston & Laursen, 2015), which were rated on a 4- or 5-point Likert-type scale. Five additional open-ended questions allowed students to explain their perspectives on the near-peer research experience, the impact of the experience on career plans, other gains made, and ways to improve the near-peer and overall research experience. Two additional demographic questions were included to categorize responses by class and cohort. See the Appendix for a simplified overview of the modified URSSA statements and scale.

Impact on Learners

A total of 77 science and science education majors participated in our near-peer CURE project: 11 from DoB, 41 from elementary science education, and 25 from secondary science education. This project sought to better understand how science and science education majors influence one another in developing researcher identity, including scientific literacy and communication skills, after engaging in a near-peer structured CURE. Of the participating students, only 35 completed the survey. (Note that participants were not required to respond to all items.) Responses to the URSSA items indicated a variety of experiences across the groups of students. Refer to Table 4 for a sample of survey responses related to science literacy and science identity and Table 5 for responses to statements about experience quality and participation impact broken down by major.

Table 4

Sampling of Science Literacy and Science Identity as Self-Reported on URSSA Items

	Major		
	Science	Secondary science education	Elementary science education
	Thinking and working like a scientist (Item 1f)		
Great or good gain	4 (57.1%)	5 (35.7%)	2 (15.4%)
Moderate or little gain	3 (42.9%)	6 (42.9%)	8 (61.5%)
No gain	0 (0%)	3 (21.4%)	3 (23.1%)
Total	7	14	13
	Personal gains (Item 2b)		
Great or good gain	4 (57.1%)	6 (40.0%)	6 (46.2%)
Moderate or little gain	3 (42.9%)	4 (26.7%)	4 (30.8%)
No gain	0 (0%)	5 (33.3%)	3 (23.1%)
Total	7	15	13
	Skill gains (Item 3f)		
Great or good gain	5 (71.4%)	3 (25.0%)	3 (25.0%)
Moderate or little gain	2 (28.6%)	6 (50.0%)	5 (41.7%)
No gain	0 (0%)	3 (25.0%)	4 (33.3%)
Total	7	12	12
	Feelings of inclusion (Item 4h)		
A fair amount or great deal	6 (85.7%)	2 (13.3%)	2 (15.4%)
A little or some	0 (0%)	8 (53.3%)	5 (38.5%)
No inclusion	1 (14.3%)	5 (33.3%)	6 (46.2%)
Total	7	15	13

Note. Participants (N = 35) were not required to respond to all statements, so the total number of responses for each question may differ from the number of science (n = 7), secondary science education (n = 15), and elementary science education majors (n = 13). Response categories are collapsed due to lack of use of some categories (Van Dusen & Nissen, 2019).

Table 5

Research Experience Quality and Participation Impact as Self-Reported on URSSA Items

	Major		
	Science	Secondary science education	Elementary science education
	Research experience quality (Item 8)		
Excellent/good	3 (42.9%)	4 (28.6%)	2 (15.4%)
Fair	2 (28.6%)	3 (21.4%)	4 (30.8%)
Poor	2 (28.6%)	7 (50.0%)	7 (53.8%)
Total	7	14	13
	Peer support (Item 12d)		
Very/somewhat satisfied	4 (66.7%)	9 (60.0%)	5 (45.5%)
Very/somewhat dissatisfied	2 (33.3%)	6 (40.0%)	6 (54.5%)
Total	6	15	11
	Interest in enrolling in a science graduate program (Item 9a)		
Extremely/much more likely	5 (71.4%)	1 (7.1%)	1 (7.7%)
Somewhat/a little more likely	1 (14.3%)	6 (42.9%)	1 (7.7%)
Not more likely	1 (14.3%)	7 (50.0%)	11 (84.6%)
Total	7	14	13
	Interest in teaching science (Item 9b)		
Extremely/much more likely	2 (33.3%)	5 (50.0%)	6 (75.0%)
Somewhat/a little more likely	3 (50.0%)	2 (20.0%)	0 (0%)
Not more likely	1 (16.7%)	3 (30.0%)	2 (25.0%)
Total	6	10	8

Note. Participants (N = 35) were not required to respond to all statements, so the total number of responses for each question may differ from the number of science (n = 7), secondary science education (n = 15), and elementary science education majors (n = 13). Response categories are collapsed due to lack of use of some categories (Van Dusen & Nissen, 2019)..

On the survey, the science majors indicated gains in all areas of scientific literacy. Among the science education cohorts, only a quarter of students indicated *no gains* in scientific literacy skills, and more students indicated *great* or *good gains* when it comes to discussing scientific concepts with others. Additionally, nearly two thirds of the science education majors indicated feeling included in the scientific community after this experience, with most of these responses indicating a little or some (n=13) and a few indicating a fair amount or a great deal (n=4). Most students indicated gains in understanding connections among scientific disciplines overall. Differences between cohorts among science education majors provide insight into the potential impacts of changes in the design of the experience from fall 2018 to fall 2019, which included changes in the way that groups were formed and the addition of five scheduled in-class meeting opportunities. Science education major responses varied a little between cohorts regarding skills gains, such as understanding journal articles or using statistics to analyze data, with fewer students indicating *no gain* at all in fall 2019 than in fall 2018.

Few differences emerged between the secondary and elementary science education majors. Secondary majors were more likely to indicate being *very* or *somewhat satisfied* with the peer support than elementary majors, even though both groups felt less inclusion and indicated a *fair* to *poor* research experience overall. More secondary majors indicated an interest in enrolling in a science graduate program than elementary majors; however, this finding may stem from fewer elementary majors directly interacting with science majors during the fall 2019 experiences.

One of the open-ended questions asked students to explain any impacts on future career and education plans. Responses to this question revealed that science and science education majors confirmed their existing career plans and want to explore more career options after seeing science and teaching through new experiences. For example, Methods students noted that doing research opened their eyes to many other jobs and careers and piqued their interest in doing research during graduate study. DoB students expressed that doing research in the ways facilitated through the courses confirmed their intentions to continue on to graduate school and conduct research. One DoB student said:

> It reinforced the idea that I love doing research on topics and subjects that I find interesting and that can contribute to the real world. This experience helped me understand my passion for science and an excitement to want to contribute to it by discovering and experiment[ing] new ways to better it.

Science majors also commented that the near-peer CURE solidified their love of science and research interest. Science education majors commented on different aspects of how they want to implement similar inquiry-based experiences. Although the two groups highlighted various aspects of impact, their responses indicate reciprocal benefits. Science majors could visualize how their research manifests in the classroom, and science education majors found personal value in using scientific research as a stimulus for curiosity and engagement.

Lessons Learned

We asked students to rate the quality of their near-peer research experience to ascertain the impact of such an activity and help with the integrated near-peer CURE design. Perspectives of quality varied depending upon cohort. More students rated the near-peer experience as *excellent* or *good* in fall 2019. Additionally, students were more likely to rate peer support higher in fall 2019. These attitude differences demonstrate the importance of careful attention to how we formed research teams, facilitating more choice and responsibility, and structuring schedules to provide dedicated work time. The modifications made to the CURE based on these comments resulted in improved logistics, positive interactions with students, and overall satisfaction.

Student comments from across both cohorts reflected on challenges and opportunities related to the overall near-peer CURE structure. The fall 2018 cohort primarily noted a need to address time conflicts, establish clear project expectations, and improve communication and leadership. Other comments left by these students addressed gains in confidence in expressing doubt and a better understanding of collaboration. Student comments in fall 2019 focused on further defining team roles and requesting more time to codevelop lesson plans based on the research findings. Student comments from this cohort also revealed a rift, as highlighted in this quote from a student in the Secondary Science Methods course:

> I think that, in theory, this is a very meaningful experience; however, I do not think that the biology students were super confident in our ability to help. It felt at times that they did not believe we were able to help in a productive way and [thought that] it was better for them to do it themselves

This quote points to the reality of mentorship and the requisite investment of time and energy. It is key to seek and secure buy-in from participants so the reciprocity of the near-peer interactions can be realized.

Discussion

This project highlights better ways to leverage the near-peer concept. Design changes implemented between cohorts allowed us to respond to student concerns and modify the experience to address weaknesses. By infusing field experiences, students formed stronger relationships, sharing stories about current challenges and plans. The field experience's collegiality provided a shared bonding experience, and the near-peers exchanged goals and aspirations across disciplines. When asking students how much more likely they were to teach science or enroll in a science graduate program after engaging in this near-peer CURE, we found an unexpected result. A third of the science education majors expressed interest in science graduate programs, and more than two thirds of the science majors expressed interest in teaching science.

Bonding influenced professional identity development within the future teachers. The science education students took advantage of downtime during data analysis on the 1-day miniproject to coplan lessons based on their research context and findings. The activity emerged organically out of peer discussion, and the Methods instructor granted permission for the students to continue. Though the future teachers did not realize it, the curricular coplanning they initiated created an authentic working experience, mirroring their future roles. The science majors, who were synthesizing data analysis nearby, occasionally contributed to the conversation as they brainstormed lesson components. This collaborative curriculum design involving preservice science educators and emerging scientists provided a rich experience for all students.

Limitations and Future Directions

Although this project only involved 77 science and science education students and one science discipline, the findings bear further exploration. The DoB partnership naturally restricted participation to students in the biological sciences. Future cohorts need to partner with other disciplines to facilitate science education majors working in an area closely aligned to their endorsement area or interests (e.g., chemistry, physics, or earth/space science). Additional research should also include more participants in general. The potential exists to construct similar inquiry experiences across subject disciplines, mirroring the professional expectations of each or building interdisciplinary teams to engage in inquiry-based research.

Future efforts come with challenges though. First, expectations must be clarified and agreed upon at the outset. Implementing the project and managing logistics in real-time with flexible expectations causes anxiety among students. Further, faculty should purposefully engage science and science education majors in coplanning lessons. Second, motivating science education majors to conduct research may require special attention. Despite faculty enthusiasm and support, DoB students noticed that “It seemed like there was a lack of interest in conducting research from some of the education students.” Third, funding may be necessary to support research needs. For example, sampling kits for testing water or specimen collection require funding to pay for needed supplies. Additionally, extended weekend field experiences require funding to cover transportation, lodging, and meals for the students and faculty.

Conclusion

Near-peer mentoring within a CURE approach holds intriguing possibilities based on our initial research findings. Although further research is needed, creating a space to explore a question, leveraging the interests and abilities of two disciplinary disparate student groups, and letting the scientific process play out in all of its beautiful and challenging ways points to a necessary shift in undergraduate STEM education for both budding scientists and preservice teachers. The idea of promoting near-peer identity exchanges between science and science education majors may be an indispensable design consideration for undergraduate education.

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Supplemental Files

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