Integrating Agriculture into STEM Education through Immersive Experiences

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Introduction and Need for Strategy

Youth are reluctant to participate in agricultural professions because of limited skills, lack of training and funding, and dismal future prospects (Dhakal et al., 2018; Nankervis et al., 2017). Youths' lack of agricultural exposure can influence their future career decisions (Mallory & Sommer, 1986). Students and their teachers should be exposed to agriculture in the classroom and immersive experiences to encourage understanding of agricultural practices and career opportunities. However, there are only approximately 11,000 agriculture teachers in the United States (National Association of Agricultural Educators, 2024). This deficit makes it impossible for current school-based agriculture teachers to serve every student. One way to target every student is the integration of agriculture into science classes. Every student from kindergarten to 12th grade takes science classes with over 1 million science teachers in the United States (Zippia, 2021). Children Learning through Outdoor Experiences (ChLOE) is a national program focused on bringing together people who engage educators and students in experiential learning opportunities around agriculture and the outdoors. The Ohio State University's (OSU) implementation of ChLOE offers science teachers opportunities to gain agricultural experiences to practically apply science in their classes. ChLOE can advance public knowledge of agriculture, food, and natural resources systems.

Connection to Literature

Science, technology, engineering, and math (STEM) and agriculture have routinely been intertwined. Current literature has focused on how to integrate STEM into agriculture (Swafford, 2018; Wang & Knobloch, 2018). STEM integration in agriculture classrooms often uses agricultural topics to underscore science topics and is dependent on agriculture teachers' comfort with science topics (Swafford, 2018; Wang & Knobloch, 2018). Integrating agriculture into STEM classrooms and experiences can foster interdisciplinary learning for both teachers and students (McKim et al., 2018; Pauley et al., 2019; Wang et al., 2020). Interdisciplinary methods have benefits for students and teachers (Hubert, 2021; Ivanitskaya et al., 2002). Interdisciplinary learning can increase students' beliefs, critical thinking ability, engagement, self-efficacy, and metacognitive skills (Hubert, 2021; Ivanitskaya et al., 2002). Through interdisciplinary teaching, teachers can become more productive and successful in the classroom, increase their skills, and create active learning communities (Hubert, 2021; Ivanitskaya et al., 2002; Pauley et al., 2019; Wang et al., 2020). Curriculum integration of STEM in agriculture can foster student and teacher achievement (Hubert, 2021; Ivanitskaya et al., 2002; Pauley et al., 2019; Wang et al., 2020).

How it Works & Implementation of Strategy

The ChLOE program at OSU aims to increase inclusion of agriculture and natural resources within science, technology, engineering, and math (STEM) topics and provide teachers and students with concrete experiences to stimulate learning. Teachers begin to engage with ChLOE at OSU's Waterman Agricultural and Natural Resources Laboratory by participating in a pre-experience training on science pedagogy principles before they can register for ChLOE experiences. After the training, the teachers work with the ChLOE programmers to select a date for a field trip with immersive experiences that will best fit their students and curriculum. The teachers can select from 17 immersive options in the fall and 14 options in the spring. For each immersive experience, the teacher collaborates with an OSU field expert to deliver the

curriculum to their students at Waterman Agricultural and Natural Resources Laboratory. The field trip lasts for one school day including lunch and up to four immersive experiences. The program was funded by Ohio Soybean Council which covered the cost of the teacher training, field trips, and lunch.

Results to Date and Implications

A total of 20 teachers participated in the science pedagogy training in April 2024. Of those teachers, five of them have completed the entire ChLOE program and attended 11 of the available immersive experiences as of spring 2024. Teachers brought a total of 172 students on a field trip. All five teachers completed the online questionnaire at the end of their program and two opted-in to the interview. The surveyed teachers reported that they *agreed* that the science pedagogy training was beneficial (M = 3.90, SD = 0.53). Some teachers did report using aspects from the training in their pre-experience teaching before the field trip. They also *agreed* that the planning experience with ChLOE programmers was effective (M = 4.35, SD = 0.50), and the students were engaged during the field trip (M = 4.43, SD = 0.29).

Two follow-up interviews illuminated teachers' motivations for engaging in the ChLOE program, their experiences with it, and their future plans for their students. One teacher said they participated in the program because *"it gets students outside."* Another mentioned the kids *"need to have hands-on activities."* In regard to their experiences, one commented, *"I enjoyed the fact that the students were engaged. They took away from this experience just some more knowledge maybe a little bit of curiosity on how science is used outside of the classroom."* The other teacher said, *"I think the students had no idea that there were different kinds of plants in monocots and dicots, and so just the fact that she had picked dozens and dozens and dozens of flowers, and then they were able to sort through them and figure that all out was really helpful for them."* The teachers' future plans included applying for a grant to do a farm tour field trip for their students, soil testing, and building a school greenhouse.

The teachers perceived high engagement among their students, especially during the immersive experiences during the field trip. The teachers found the pre-experience training beneficial, and reported using the practices within their own classroom before and after the field trip. This highlights the importance of the science pedagogy training as a tool for teachers to be prepared and prepare their students for the immersive experiences.

Future Plans and Advice to Others

Engaging students and science teachers in the ChLOE program at OSU can address community knowledge gaps across agriculture, environment, and natural resources topics. Filling these gaps could increase informed engagement in community, regional, and national food systems. The program should continue to monitor and evaluate teacher experiences in conjunction with student experiences. The involvement of Ohio Soybean Council allowed for this program to be fully funded, which opened the program to teachers and schools across the state regardless of their own resources. The ChLOE program should also consider involving non-science teachers to promote cross-disciplinary learning. Expanding this program to reach more students and teachers may help increase youth and adult interest in agricultural careers echoing the findings of Dabney et al. (2012). Increasing student knowledge of agricultural practices and careers could increase students' propensity for careers that blend science and agriculture.

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