

An Innovate Course: Learner Centered Teaching in Integrated STEM through AFNR

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Introduction

A three-credit graduate course was developed and taught to help graduate students, who are interested in becoming educators, in a college of agriculture learn how to teach science, technology, engineering and mathematics (STEM) through agriculture, food, and nature resources (AFNR). Typical courses might feature STEM integration, but few include a focus on AFNR. We framed this innovative course as interdisciplinary learning (Ivanitskaya, Clark, Montgomery, & Primeau, 2002) for the development of integrated STEM lessons. The course consisted of 150-minute weekly sessions for 15 weeks. In the course, the instructors introduced learner centered teaching pedagogies, such as project-based and inquiry-based teaching. Students developed STEM integrated lesson plans through AFNR, and they taught and implemented the lesson plans with elementary students in an afterschool program. Although the instructors introduced students with basic knowledge of learner-centered teaching strategies, the students were instructed that no one existing integrated model is the best model to teach STEM through AFNR. The students had freedom to develop their STEM integrated lesson plans by using what they believed is the best integrated model and practices for teaching STEM through AFNR.

Implementation of LCT Strategy

To help educators integrate STEM and agricultural lessons into their curriculum, graduate students in a course titled “Teaching STEM through AFNR” were tasked with creating a short unit (3-5 lessons) to present to elementary students. The lessons could be created in teams or as a solo project and were presented to either elementary level Girl Scout Troops or elementary students attending an immersive classroom experience at a local historical farm located. Once students selected to whom they wished to present their lessons to, the development process began. Guidelines for the project included STEM integration in an intentional manner, avoiding superficial insertion, having sequential lessons that fit state standards for the targeted grade, and for those that selected the farm, a historical connection. Students were required to write all lesson plans and instruct at least one lesson from the unit to their target audience. Our lesson plan focused on sheep and their byproducts and was presented to two classes of fourth-grade students at the historical farm.

Lesson Integration

The unit consists of five lessons; the first is an introduction, which includes a basic understanding about sheep anatomy, the sheering process and why sheep are sheered, and common byproducts from sheep, explicitly focusing on wool. In the second lesson, math takes the lead as students calculate how many products can be created from one sheep or a small flock. This lesson provides a historical understanding of agriculture and life in the 1800’s and integrates math and technology ideas. The third and fourth lessons introduce students to the scientific method, as students explore why wool would be a valuable commodity now and then. Students test the bleachability and flammability of wool to gain a further understanding of the chemical and structural composition. The fifth lesson ties everything together and provides students an opportunity to create a woven product loom built from popsicles sticks right in the

classroom. Students will gain an understanding of the engineering design process as they weave strands of wool, creating a piece of art or usable product.

Results and Implications

The unit was found to have engaged the student participants in all areas of science, technology, mathematics, engineering, and history. In some cases, students were exposed to multiple areas at once. Using the historical site, allowed for the lesson plan to fully engage students in the learning process. They would receive general lesson information within the classroom, but then it would be reinforced by connecting it to history. For example, students would be exposed to the wool product making process and then taken on a historical tour that explained why citizens wore extensive wool clothing in the past or the process by which that clothing was made. Another example would be the describing of the anatomy of sheep to students through electronic means, and then providing them with real-world interaction with the sheep. Providing the lesson information to the students in a variety of formats seem to have encouraged the reinforcement of the lesson material within the student's mind. The implications of integrating STEM and history into the agriculture, forestry, and natural resources context are large. We are able to expose students to the connections between their STEM interest and AFNR as they progress into academic and professional careers.

Plans for the unit include standardization, increasing STEM+history integration, and expansion to other settings. The standardization of the project will include ensuring the lesson plans accurately and consistently reflects the required state standards of the grade level it is being implemented within and the ability for others to replicate the unit. The level of STEM integration across the unit will be increased to avoid superficial integration (Wang & Knobloch, 2018) within each lesson and not just across the general unit. Lastly, we hope to expand the unit to be used in other settings. In its current state, the unit most closely aligns with the offering available at a local historical tourism site. Expansion of the unit and its standardization will make implementation outside of this site easier, therefore making the unit more accessible to other instructors.

Advice to Others

The mini-unit was designed to use classroom items that are typically readily available, with minimal additional financial input cost. The standard classroom items used include an overhead projector, internet access, white/chalkboard and markers, and access to printing. An approximate total of \$30.00 was used to purchase all supplies used for the implementation of the project outside of standard items. These supplies include raw wool, multiple skeins of 100% wool yarn, an extended lighter, bleach, paper for printing, small plastic cups, popsicle sticks, and sealable plastic bags. Items that should also be considered for inclusion, but that are not required include a bucket of water for safely putting out any flames, gloves for the instructor, tongs for holding the wool, and safety goggles. The most critical resource related to the implementation of this project was access to the historical site used to build the history connection piece of the lesson. Access to the site and students were free from transportation or facilitation cost.

References

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