Oh Deer! A Lesson in Data Visualization and Mathematical Thinking

Kendrick L. Spencer
Virginia Polytechnic Institute and State University
214 Litton-Reeves Hall Blacksburg, VA 24061
(540) 231-6836
kendrickls@vt.edu

D. Brett Milliken
Virginia Polytechnic Institute and State University
214 Litton-Reeves Hall Blacksburg, VA 24061
(540) 231-6836
bmilliken@vt.edu

Oh Deer! A Lesson in Data Visualization and Mathematical Thinking

Introduction

Classes within the natural resource pathway of agriculture, food, and natural resources (AFNR) curriculum provide students with an opportunity to explore ecological, environmental, and societal challenges through an applied and regional lens (Hartmann & Martin, 2021; McKim et al., 2019). Many of the objectives that apply to natural resource classes in AFNR also apply to science courses such as environmental and ecological science. The Next Generation of Science Standards (NGSS) asks students to be able to analyze and interpret data to provide evidence of the effects of resource availability on organisms and populations in an ecosystem (NGSS Lead State, 2013). Additionally, the National Council of Teachers of Mathematics (NCTM) states that students in grades 9-12 should be able to understand various statistical measures, parameters, and ways to display data, as well as, develop inferences and predictions based on various forms of data (National Council of Teachers of Mathematics, 2023). Similar to the requirements of GSS and NCTM standards and expectations, the environmental service systems career pathway for AFNR requires students to analyze the factors that affect population density and dispersion in natural resource systems (The National Council for Agricultural Education, 2015).

Project WILD is a national educational resource program created by the Association of Fish and Wildlife Agencies that serves students in kindergarten through 12th grade in both formal and non-formal programs (Association of Fish & Wildlife Agencies, 2022). One activity provided by Project WILD is Oh Deer, which is a simulation game that demonstrates how animal populations increase and decrease depending on the availability of resources. Through this game, students are able to examine environmental conservation concepts. Additionally, agricultural science teachers can integrate mathematical thinking into the activity through the calculation of birth rate, death rate, carrying capacity, and using data to identify limiting factors which would help students ing standards and expectations set by NGSS and NCTM.

How It Works

Within a class of 28 high school students, an agricultural science teacher (AST) divided the students evenly into three groups. The Oh Deer! lesson stated that one group of students acted as “deer” and the other two groups of students acted as “resources' ' such as food, water, and shelter. The AST identified one student from each group to serve as the “statistician” to record the amount of resources available and the amount of deer during each round of the activity

Each group served as the “deer” four different times, making for a total of 12 rounds for each game. The AST designated which of the three major resources (food, shelter, water) that each student in the resource group represented. Then, the AST determined which of the major resources each student in the “deer” group needed. Students then played a game of tag to retrieve their desired resource. If students in the “deer” group were unable to find their resource they would “die” and become a resource for the next round. If a student was able to capture their resource, the student representing the resource would become a part of the deer group for the next round.

After each round the statisticians were required to record the number of students who represented deer and the number of students who represented each resource. After the 12 rounds were played, students examined the data for each resource and the deer population. Students

were then required to create graphs and charts to display the changes in resources and population over the course of each round. Additionally, students calculated the birth rate, death rate, and identified which of the resources was the limiting factor in their group. .Students then compared data between each of the groups in order to calculate the carrying capacity of the different groups.

Results to Date

Students were engaged in mathematical thinking over the course of three class periods. Students were first challenged to use their knowledge of graphs and charts to create a diagram of the change in natural resources and the deer population over time. Students had to determine which graph would best represent the change and allow them to analyze which of the natural resources served as the limiting factor. Secondly, students were required to use their understanding of mathematics to decide how to calculate the birth and death rates of their populations. Students shared their results with other group members over the duration of the lesson. Finally, students had to ascertain the carrying capacity of their environment. Throughout the course of the game, students discussed the differences between line and bar graphs. Students learned the formulas for calculating birth rate and death rate of a population, and had to explain each of the steps in their analysis. A school administrator stated that this lesson was one of the most engaging STEM lessons they had witnessed.

Advice to Others

The ability to push basic concepts of agriculture, food, and natural resources beyond skills acquisition and into transferable skills is essential for all school-based agricultural science programs. Project WILD's Oh Deer! provided an opportunity for the AST to plan a lesson with an interactive game that was outside, physically engaging, and did not require the use of technology. The lesson was able to connect topics such as natural resources, limiting environmental factors, animal populations, and data visualization and interpretation to wildlife management while simultaneously meeting AFNR, NGSS, and NCTM standards. This lesson will be created into a formal lesson plan that other ASTs can access through the state database.

Other agricultural science teachers can use games and physically engaging interactions to increase students' ability to reason mathematically and present data. Teachers must become familiar with standards such as NGSS and the NCTM standards. They must also critically evaluate their curriculum for opportunities to highlight concepts of mathematics and science that are essential to agricultural science curriculum. While STEM integration has a large focus in the research literature base, teacher education programs should model how to incorporate NGSS, NCTM, and other curricular standards into AFNR curriculum. Teachers should be open to using tangible and real world cases to serve as examples and models for students to analyze. Project WILD's Oh Deer! serves as one example of how a simple interactive game can become a lesson in mathematics, science, and data visualization within AFNR.

Costs and Resources Needed

The Project WILD activity book is available through the Association of Fish and Wildlife website for approximately $21.00. The complete activity requires space for students to run and play tag, paper, pencils, markers, rulers, and calculators. The time necessary to prepare for this activity is similar to the time spent planning and coordinating daily classroom lessons or activities.

References

Association of Fish & Wildlife Agencies. (2022). *Project WILD K12 Guide*. https://www.fishwildlife.org/projectwild/project-wild

Hartmann, K., & Martin, M. (2021). A critical pedagogy of agriculture. *Journal of Agricultural Education*, *62*(3). https://doi.org/10.5032/jae.2021.03051

McKim, A., Raven, M., Palmer, A., & McFarland, A. (2019). Community as context and content: A land-based learning primer for agriculture, food, and natural resources education. *Journal of Agricultural Education*, *60*(1), 172–185. https://doi.org/10.5032/jae.2019.01172

National Council of Teachers of Mathematics. (2023). *Data Analysis and Probability*. https://www.nctm.org/Standards-and-Positions/Principles-and-Standards/Data-Analysis-and-Probability/

NGSS Lead State. (2013). *Next Generation Science Standards: For States, By States*. https://www.nextgenscience.org/standards