Foundations of Phenomenon: Building Teacher Efficacy for NGSS Integration in Agriscience Education

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Introduction/need for innovation

A key instructional shift within Next Generation Science Standards (NGSS) is the use of phenomena to provide a real-world context for science learning (National Research Council, 2012). This innovation, the *Foundations of Phenomenon* course, is designed to increase school-based agricultural education (SBAE) agriscience teachers' efficacy related to phenomenon-driven instruction. This innovation is timely given the increasing efforts to integrate the NGSS into SBAE courses (Ray et al., 2024; Barrick et al., 2018). Within lesson design, phenomena are contextualized, measurable, real-world examples driving inquiry and understanding (Next Gen Science, 2016) through sequenced learning. While the application of phenomena-driven instruction to SBAE may be relatively new, its theoretical foundations trace back to educational leaders like Dewey (1938). SBAE may realize the benefits of NGSS integration, but Chumbley et al. (2019) found many agriscience teachers lack confidence in integrating science concepts into their courses alongside Agriculture, Food and Natural Resources (AFNR) standards. Additionally, feedback from the field indicates a need for support in identifying relevant phenomena, incorporating them into lessons, and designing phenomenon-driven units (Author et al., 2023). We hope that the Foundations of Phenomenon course can help address these gaps.

How it works/methodology/program phases/steps

The course is facilitated through the Canvas Free Learning Management System. The course includes a welcome, four modules, and a reflection/feedback survey. Users, including SBAE preservice teachers, practicing teachers, and teacher educators, can follow these steps to engage with the online course: *Step 1*: Users use the link [web address] to complete the informed consent and request to be added to the Canvas Course. *Step 2:* Users complete the modules. *Step 3:* Users who have completed all modules and an approved capstone project are provided with a micro badge issued by STEAM in Agriculture.

Within the course modules (Table 1), participants experience learning through the 5E rhythm (Bybee, 2015), starting with an authentic problem (engage); followed by opportunities to learn through reading, videos, and research (explore); then a pause for reflecting on learning either individually or with peers (explain); then a deeper dive into the content of the module (elaborate); and finally an opportunity to reflect on the learning of the module (evaluate).

Table 1

Foundations of Phenomenon Online Course Modules and Activities

Module Title	Module Activities
1: What is a phenomenon?	• Explore examples and non-examples of phenomena and how they can fit within units and lessons.
2: Why should I use phenomenon?	• Explore the benefits of phenomenon-driven instruction for learners, including relatability, relevance, and thought-provoking ability.
3: What is a quality?	• Explore criteria to determine the fitness of a phenomenon.
4: Let's make one! Capstone Project	• Identify a NGSS-aligned phenomenon, create a plan for the launch of the phenomenon, and identify/create at least one student sensemaking activity/lab related to the phenomenon.

Results to date/implications

This grant-funded project has $750 stipends for 100 teachers who complete the pilot course, which includes submitting an approved capstone project and completing the pre- and post-course surveys. To date, there are 150 participants enrolled. Currently, two Foundations of Phenomenon micro badges have been issued through Canvas Badge, with 22 additional projects currently under review. Of the 94 participants who have completed the course pre-assessment, their responses on the phenomenon efficacy scale indicate they "neither agree nor disagree" with the efficacy statements, indicating a need for professional learning in this area. Of the 23 participants who completed the course, their retrospective pre-post phenomenon efficacy scale responses shifted from means of *disagree* and *neither agree nor disagree* to levels of *agree* across all statements on the phenomenon efficacy scale. We believe that while the sample size of completers is still low, this suggests possible increased efficacy in the area of phenomenon-driven instruction as a result of course participation.

The intended benefits to course participants are discussed within the goals of the introduction, and preliminary data suggest the course is supporting movement toward the objective of increased self-efficacy of SBAE teachers in phenomenon-driven instruction. Beyond the benefit to individual course users, the addition of high-quality agricultural phenomena to the [project name] database is occurring as participants complete their badging requirements, making them available on the internet. Realizing the capacity to increase efficacy related to the topic, we suggest that professional learning programmers and teacher educators for SBAE consider utilizing this course to support professional learning efforts. We also suggest that there may be practical applications for post-secondary educators as well.

Future plans/advice to others

Future project team plans are to: A) continue reviewing pilot testing data and make updates to the course based on participant feedback; B) evaluate the course through the lens of the goals; C) develop future courses to offer an open-source suite of resources for agriscience teachers to use relating to interdisciplinary agriscience; E) promote the online course and the growing database of agricultural phenomenon outside of the agriculture community of SBAE teachers, to include science teachers who could promote agriculture literacy within their classes with the use of agricultural phenomenon; and F) given SBAE teachers' use of social media for professional learning (Ray et al., 2022), look for opportunities to share resources created as a result of teachers' participation in the course through existing online networks where teachers are engaged in professional learning. *Researchers* should consider the benefits of a variety of research methods to explore the impacts of the use of the Foundations of Phenomenon course. *Practitioners,* including teacher educators and their students, might consider completing the course to build their knowledge and skills around using phenomena in lesson design.

Costs/resources needed

Direct costs are limited, as the course is currently free for users and only requires access to materials that are reasonably accessible to educators, including, but not limited to, a device capable of interacting with the Canvas course. *Indirect costs* associated with utilizing the phenomena module are the user's time, approximately 15 hours (valuation varies with experience and role). While not a requirement for participation, participants can opt to purchase a semester unit from Fresno Pacific University.

References

Barrick, R. K., Heinert, S. B., Myers, B. E., Thoron, A. C., & Stofer, K. (2018). Integrating disciplinary core ideas, the agriculture, food and natural resources career pathways and next generation science standards. *Career and Technical Education Research*, *43*(1), 41-56.

Bybee, R. W. (2015). *The BSCS 5E instructional model: Creating teachable moments*. Arlington, TX: NSTA Press, National Science Teachers Association.

Chumbley, S., Hainline, M. S., Russell, M., & Ruppert, D. E. (2019). Teachers' Confidence to Integrate Biology in Agriscience Courses. *Journal of Agricultural Education*, *60*(1), 145-157.

Dewey, J. (1938). *Experience and Education.*

Drape, T. A., Lopez, M., & Radford, D. (2016). Teacher efficacy and professional development needs of mid-career agriculture educators integrating the Next Generation Science Standards and other content areas. *Career and Technical Education Research*, *41*(1), 33-48. https://doi.org/10.5328/cter41.1.33

National Research Council. (2012). A *framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. National Academies Press.

Ray, N., Gorter, E., Giononni, L. (2024). Interdisciplinary Agriculture, Food and Natural Resources with Next Generation Science Standards. In R. K. Barrick, A. C. Thoron, *Emerging Research in Agricultural Teacher Education* (pp. 249-279). IGI Global. 10.4018/979-8-3693-2766-1.ch013

Ray, N., Strong, R., & Meyers, C. (2022). Measuring the perceived usefulness of social media professional learning networks to elevate agricultural development. *Advancements in Agricultural Development*, *3*(4), 43–56. https://doi.org/10.37433/aad.v3i4.275