Are We Hitting Our Target? An Instrument of Evaluation for Agriscience Phenomena

Kaitlynn M. Linderholm
California State University, Fresno

Dr. Nicole Ray
California Polytechnic State University, San Luis Obispo

Cameron Standridge
Next Generation Agricultural Science

Jonathan Moules
Next Generation Agricultural Science

Stacy VanScoy
California State University, Fresno

Dr. Avery Culbertson
California State University, Fresno

Primary Author:
Kaitlynn M. Linderholm
5241 N Maple Ave, Fresno, CA 93740
(559) 760-4010
kaitlynnlinderholm@mail.fresnostate.edu

Are We Hitting Our Target? An Instrument of Evaluation for Agriscience Phenomena

Introduction/need for innovation

With the foregoing establishment of the Next Generation Science Standards (NGSS), there is a demand to create and develop scientific phenomena curriculum that can be implemented in high school agriscience classrooms. Phenomena can be described as “any object or event that can be experienced, and that can be observed and/or measured either directly or by one's senses or by use of technological devices” (National Science Teachers Association, 2017, p. 1). The agricultural education community will need to embrace phenomena, and to do so, it should support teachers by identifying examples and developing resources to support the implementation of phenomena. Ray et al. (2023) found that California Agriculture teachers expressed a need to have access to finding agriscience phenomena. This finding established a need for criteria to assist with phenomena development and an evaluation tool that teachers could use to help to build their skill in identifying high quality phenomena.

While a variety of practitioner tools exist to support teachers' development of phenomena for instruction (Lum & Lucido, 2015; McKenna & UConn Mentoring Collaborative, 2016; NextGen Science Exemplar System, n.d.; NGSS, 2016; National Research Council, 2012; National Research Council, 2013), there are fewer resources for evaluating the fitness of a phenomenon (National Science Teachers Association, 2017), and none could be located in existing literature in the area of agriscience instruction. As a result, the Next Generation Agricultural Science (NGAS) grant program (Vaughn, 2021-2024) developed the agriscience phenomena evaluation tool, which can be used by any agriscience teacher to evaluate and develop their own agriscience phenomena and implement the NGSS standards to their full potential. To initially field test and refine the tool, it is being used by grant staff to evaluate and develop agriscience phenomena that will be integrated into the NGAS database. The tool is not limited to the NGAS grant program but will assist agricultural science teachers nationwide in developing phenomena that meet the established disciplinary core ideas of the AFNR Career Pathways and NGSS Standards (Barrick et al., 2018).

How it works/methodology/program phases/steps

The criteria are formatted using dichotomous judgment (yes/no) responses, allowing evaluators/users to engage in reasoning quickly (Meida, 2021). The five criteria are: (1) the phenomena addresses the entire or part of a NGSS Disciplinary Core Idea. (2) the phenomena is observable to students, (3) the phenomena is comprehensible to students, at grade level or not too complex, (4) the phenomena is thought-provoking and requires an explanation, and (5) the phenomena is interesting and relevant to a sector of the Agriculture Industry. For the NGAS (Vaughn, 2021-2024) database review, each criterion within the tool is individually evaluated; when a criterion is not met, rather than disregarding the phenomena in its entirety, the evaluator/user can reflection on possible revisions, or choose to explore alternative phenomenon.

Results to date/implications

The Agriscience Phenomenon Evaluation tool was field tested in the evaluation of agriscience phenomena that will be integrated into the NGAS grant phenomenon database. Teachers who made submissions for consideration were asked to utilize the checklist before submitting. After submission, the grant staff then utilized the evaluation tool to review each submission and found that many agriculture teachers who believed their phenomena met the

checklist criteria did not meet them. Of the agriscience phenomena evaluated (N =72), 29% of the phenomena (n = 21) did not meet the Agriscience Phenomenon Evaluation tool criteria. A benefit for agriculture teachers whose phenomena did not meet the criteria is that they are able to update their phenomena according to the feedback provided from the checklist.

Implications of field testing of this tool have resulted in refining the tool/process that can be used by secondary agricultural educators/teacher candidates to identify and revise phenomena for use in their classroom.

Future plans/advice to others

Future plans for the Agriscience Phenomenon Evaluation tool involve (A) *Revision* - after an initial review of the phenomena in the database, a takeaway was that the first iteration of the tool examined only one dimension of the three-dimensional NGSS model (disciplinary core ideas), which is the content dimension of the standard, and didn't result in phenomena submissions that allowed for student centered learning. According to the Science Framework, phenomena must incorporate science and engineering practices, which are used to identify how students are supposed to demonstrate their understanding of science concepts within the context of the phenomenon (National Research Council, 2012). Additionally, some criteria were found to be overlapping or too vague. As a result, the tool has been modified to the current criteria of: (A) Standards Aligned: Capacity to support student-centered learning objectives through sensemaking grounded in one or more AFNR/CTE standards and/or NGSS Disciplinary Core Idea. (B) Real World Context: Contextualized within specific observable real-world agricultural applications. (C) Promotes Equity: Relatable, relevant, and thought-provoking for the learner. (D) Allows for Engagement in Practices: Capacity for learners to engage in active sensemaking of the phenomenon through one or more NGSS Science and Engineering Practice (SEP) to explore/explain the phenomenon being studied. Moving forward, the grant staff will use the revised tool to provide feedback on phenomena submissions for the NGAS grant (Vaughn, 2021-2024). (B) Providing *professional learning opportunities* through conference sessions to further develop teachers' skills around identifying and evaluating phenomena for their classrooms using this tool. *Advice* as individuals and teams of teachers utilize the tool, it's important to note that this is an opportunity to engage in collaborative conversations or for individual reflection to work toward identifying and/or revising agriscience phenomena that are aligned with the NGSS and agriculture standards in a way that is meaningful to students in their communities.

Costs/Resources needed

Direct costs associated with utilizing the agriscience phenomenon evaluation tool relate to the duplication of hard copies (if used) for evaluation. Additional costs may be associated with internet packages to access the digital version of the evaluation tool. There is no licensing cost to use the agriscience phenomenon evaluation tool. *Indirect costs* associated with utilizing the agriscience phenomenon evaluation tool can include time to evaluate the phenomenon. With only four criteria to consider, with a minimum of five minutes per criterion, an individual will take a minimum of twenty minutes per evaluation. This work is supported by the USDA National Institute of Food and Agriculture, AFRI Professional Development For Agricultural Literacy Priority Area, award #2022-67038-36256. The findings and conclusions in this preliminary publication have not been formally disseminated by the U. S. Department of Agriculture and Should not be construed to represent any agency determination or policy.

References

Barrick, K. R., 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 the Next Generation Science Standards. Career and Technical Education Research, 43(1), 41-56. https://doi.org/10.5328/cter43.1.41

Criteria for Evaluating Phenomena. (2017, July 11). National Science Teachers Association. https://static.nsta.org/ngss/docs/Criteria%20for%20Evaluating%20a%20Phenomenon.pdf

Lum, N., & Lucido, K. (2015). *How to Come Up with an Engaging Phenomenon to Anchor a Unit* [Document].

McKenna, T. J., & UConn Mentoring Collaborative. (2016). *NGSS Phenomena: A Heuristic for Coming up with Academically Productive Phenomena* [Document].

Mieda, T., Taku, K., & Oshio, A. (2021). Dichotomous thinking and cognitive ability. Personality and Individual Differences, 169, 110008. https://doi.org/10.1016/j.paid.2020.110008

National Research Council. (2012). A framework for K-12 science education: Practices, Crosscutting Concepts, and Core Ideas. National Academies Press. https://doi.org/10.17226/13165

National Research Council. (2013). Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press. https://doi.org/10.17226/18290.

National Science Teachers Association. (2017). *Criteria for Evaluating Phenomena*, from https://static.nsta.org/ngss/docs/Criteria%20for%20Evaluating%20a%20Phenomenon.pdf

NextGen Science Exemplar System. (n.d.). *Storyline Tool #1: Anchoring Phenomenon Routine* [Document].

NGSS. (2016). *Using Phenomena in NGSS-Designed Lessons and Units*. *NGSS*, from https://www.nextgenscience.org/sites/default/files/Using%20Phenomena%20in%20NGSS.pdf

Ray, N., Moules, J., Standridge, C., Linderholm, K., VanScoy, S., & Pheasant, S. (2023, September 20) *Are we phenomenal at agriscience phenomenon? An instrument for reflection on phenomenon based instruction in agriscience.* [Poster presentation]. Western Region AAAE, [Logan, Utah]. http://dx.doi.org/10.13140/RG.2.2.36252.05760

Vaughn, R. (Principal Investigator). (2021-2024). Next Generation Agricultural Science: Elevating Todays and Tomorrows Teachers (Project No. #2022-67038-36256) [Grant]. USDA National Institute of Food and Agriculture, AFRI Professional Development For Agricultural Literacy Priority Area. https://portal.nifa.usda.gov/web/crisprojectpages/1027745-next-generation-agricultural-science-elevating-todays-and-tomorrows-teachers.html