

**Searching for Seeds of Phenomenon: A Content Analysis of Phenomenon in
NGSS and Agriscience**

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Introduction

Many school-based agricultural education (SBAE) programs offer courses aligning with both the Next Generation Science Standards (NGSS) and Career Technical Education (CTE) standards (Barrick et al., 2018; Scherer et al., 2019). As efforts continue nationwide to integrate NGSS within SBAE (Chumbley et al., 2019), one key pedagogical shift is the emphasis on phenomenon-driven instruction, which provides opportunity for learners to explore contextualized events (National Research Council, 2012). While constructivism and phenomenon-driven instruction called by the NGSS offer a powerful framework for science learning (National Research Council, 2012), limited research exists within SBAE. This study investigated how phenomenon driven instruction is being realized in practitioner assessable peer reviewed SBAE literature.

Conceptual Framework

Phenomenon driven instruction is grounded in constructivist learning theory, which leverages experiences as opportunities for learners' knowledge construction. Early agricultural education leaders like Dewey (1938) emphasized the importance of experiential learning and inquiry, others like Piaget (1952) stressed the role of individuals. Vygotsky (1978) expanded these ideas to include the consideration that learners connect and view experiences through their existing life experiences. Collectively, these ideas are also supportive of Kolb's Experiential Learning Model (1987) and Bybee's (2009) 5E learning model.

Methodology

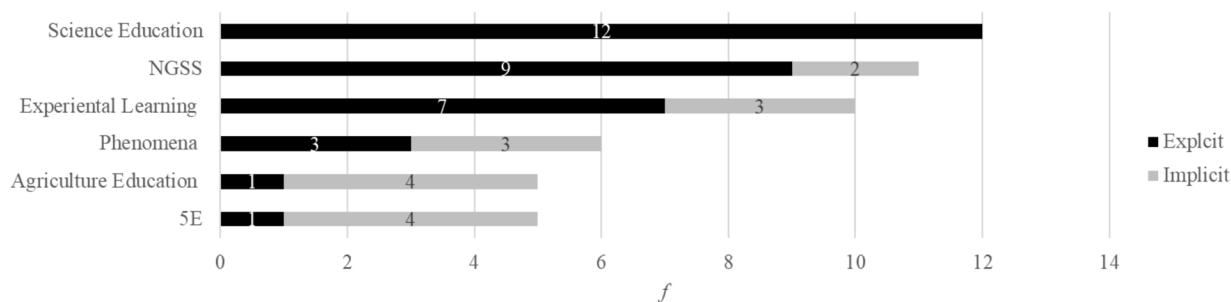
A qualitative content analysis method (Creswell & Creswell, 2017) was used to identify literature using Google Scholar with the Boolean search operators of ("NGSS" OR "Next Generation Science Standards") AND ("phenomenon" OR "phenomena") AND ("agriculture" OR "agricultural"). Twenty-five articles were identified, in screening 10 articles were eliminated because they were not accessible, were not relevant, or were a book chapter. Initially, no article included all three original search terms; criteria were revised to allow for term variation. Considering the Science Framework (National Research Council, 2012), and existing literature with SBAEs related to NGSS (Ray et al., 2013), researchers created five codes (listed in Table 1) and reviewed each article again. Experiential learning and 5E lesson design share a constructivist learning foundation as part of their learning experience, and considering phenomenon is intended to provide context for learning environments, they were both added as codes. Each article was coded as explicit, meaning it clearly states the term; or implicit, something alluded to the term and/or demonstrates the term under a different name. Five articles were then removed as they did not include at least 1 implicit or explicit big idea, leaving 12 articles. Trustworthiness was established through intercoder reliability; due to small sample size, all items were coded by two coders independently. Intercoder reliability, using Gwet's (2014) agreeability coefficient, was considered "good" to "substantial" (Wongpakaran et al., 2013); all categories reached adequate and acceptable levels of reliability (0.61 to 0.84). Coding disagreements were negotiated and revised for the sake of analysis.

Results/ Findings

No articles were found that explicitly combined all three concepts of NGSS, agriculture, and phenomenon. Figure 1 shows the frequency of explicit and implicit big ideas within the articles. All sources that discussed phenomena, either explicitly or implicitly mentioned NGSS. While 100% explicitly mentioned science education, only 75% explicitly addressed NGSS, 58% experiential learning, 25% phenomena, and 8% 5E. Three articles explicitly mentioned both science education and phenomena together; however, no articles explicitly mentioned both agricultural education and phenomena together.

Figure 1

Frequency of Explicit and Implicit Big Ideas of NGSS Phenomenon-Driven Instruction



Note. Frequency shown in each corresponding bar.

Conclusions

Integration of phenomenon-driven instruction is serving as powerful practice within science education (National Research Council, 2012), but SBAE literature available on Google Scholar has not yet leveraged phenomenon driven instruction based on the absence of articles explicitly stating phenomenon and agriculture. Beyond this, within science education, there were limited examples of how science educators were using phenomenon within their classrooms.

Implications/Recommendations/Impact

Efforts to align NGSS science content with SBAE exist (Barrick et al., 2018), but there is an absence of accessible literature regarding the pedagogy related to phenomena-based learning. Failing to embrace phenomenon-driven instruction is a missed opportunity to develop critical thinking and inquiry promoted within the constructivist learning methodologies offered in the Science Framework (National Research Council, 2012). As suggested by Chumbley et al. (2019), SBAE teachers will need support with professional learning to implement NGSS, given the absence of literature in this area, it is unknown what efforts are in progress to support phenomenon driven instruction with the NGSS aligned SBAE. First, teachers and teacher educators should look to science education literature to reflect on their pedagogy and make shifts that will move toward embracing what is outlined in the Science Framework (National Research Council, 2012). Second, considering the limitations of Google Scholar as a database, researchers should conduct similar studies in other databases and consider what additional terms may be used to describe this approach, including but not limited to inquiry-based instruction. Third, researchers should explore the effectiveness of professional learning resources and methods to support phenomenon driven instruction within SBAE.

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/https://doi.org/10.5328/cter43.1.41>
- Bybee, R. W. (2009). The BSCS 5E instructional model and 21st-century skills. The National Academies Board on Science Education.
- 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. <https://doi.org/10.5032/jae.2019.011445>
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed). Sage publications.
- Dewey, J. (1938). *Experience and Education*. New York: Macmillan Company.
- Gwet, K. (2014). *Handbook of inter-rater reliability*. Advanced Analytics Press.
- Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.
- National Research Council. 2012. *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Washington, DC: The 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>.
- Piaget, J. (1952). *The origins of intelligence in children*. (M. Cook, Trans.). W W Norton & Co. <https://doi.org/10.1037/11494-000>
- Ray, N., Moules, J., Standridge, C., Pheasant, S., Vanscoy, S., Linderholm, K. (2023). How phenomenal are we at agriscience phenomenon? An Instrument for Reflection on Phenomenon Based Instruction in Agriscience [Poster Presentation]. Proceedings of the 2023 Western Region American Association for Agricultural Education conference, Logan, UT.
- Scherer, H. H., McKim, A. J., Wang, H.-H., DiBenedetto, C. A., & Robinson, K. (2019). Making sense of the buzz: A systematic review of "STEM" in agriculture, food and natural resources education literature. *Journal of Agricultural Education*, 60(2). <https://doi.org/https://doi.org/10.5032/jae.2019.02028>
- Vygotsky, L. S. (1978). *Mind in Society: Development of Higher Psychological Processes* (M. Cole, V. Jolm-Steiner, S. Scribner, & E. Souberman, Eds.). Harvard University Press. <https://doi.org/10.2307/j.ctvjf9vz4>
- Wongpakaran, N., Wongpakaran, T., Wedding, & Gwet, K. L. (2013). A comparison of Cohen's Kappa and Gwet's AC1 when calculating inter-rater reliability coefficients: a study conducted with personality disorder samples. *BMC Medical Research Methodology*, 13(61). <https://doi.org/10.1186/1471-2288-13-61>