# Cultivating Efficacy: Investigating Professional Learning for NGSS-Aligned Phenomenon-Based Agriscience Instruction

Nicole Ray, Assistant Professor
California Polytechnic State University, San Luis Obispo
nray04@calpoly.edu

Erin Gorter, Assistant Professor
California Polytechnic State University, San Luis Obispo
ekthomps@calpoly.edu

Hannah C. Parker, Assistant Professor
California Polytechnic State University, San Luis Obispo
hparke07@calpoly.edu

Xavier Higginbotham Vendig, Undergraduate Student
Agricultural Education and Communication
California Polytechnic State University, San Luis Obispo
xhigginb@calpoly.edu

Lauren MacDonald, Lecturer
Agricultural Education and Communication
California Polytechnic State University, San Luis Obispo
lggianno@calpoly.edu

Cameron Standridge, Teacher
Elk Grove High School
cstandri@egusd.net

Kaitlynn Linderholm, Teacher
Chowchilla High School
Linderholmk@chowchillahigh.org

Department of Agricultural Education & Communication
College of Agriculture, Food and Environmental Sciences
California Polytechnic State University
1 Grand Avenue
San Luis Obispo, CA 93407

This work is supported by the Agriculture and Food Research Initiative – Professional Development for Agricultural Literacy, project award no. 2021-67038-36256, from the U.S. Department of Agriculture's National Institute of Food and Agriculture. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and should not be construed to represent any official USDA or U.S. Government determination or policy.

# Cultivating Efficacy: Investigating Professional Learning for NGSS-Aligned Phenomenon-Based Agriscience Instruction

## Introduction/need for research

Interdisciplinary approaches to instruction within school-based agricultural education (SBAE) have become increasingly important (Barrick et al., 2018). Focusing specifically on the intersection of SBAE and the Next Generation Science Standards (NGSS), literature notes low teacher efficacy related to science instruction (Chumbley et al., 2019). Barrick et al. (2019) recommend professional learning to address this need. This research is part of a larger research project that examines professional learning at the intersection of the NGSS and SBAE agriscience teachers. This research is to explores SBAE teachers' efficacy an online course designed to build skill in NGSS aligned, phenomenon driven agriscience.

## Conceptual Framework

Bandura's (1977) theory of self-efficacy guided our study. A teacher's belief in their ability plays an important role for educators in SBAE (McKim & Velez, 2016), as teachers who are self-efficacious often have increased student outcomes because of their ability to provide more individualized instruction and greater student engagement (Mojavezi & Tamiz, 2012). SBAE teachers with higher confidence in integrating core content (McKim et al., 2016) may be better poised to implement NGSS.

## Methods

This study consisted of 22 out of 150 enrolled participants who completed the course at the time of this preliminary research. This study utilized a descriptive survey methodology. Participants completed the Foundations of Phenomenon Canvas course consisting of 4 modules, followed by completing a Qualtrics survey. To reduce bias where participants may overestimate their current understanding and implementation of a topic, we utilized a retrospective pre-post design (Bursal, 2015). The phenomenon efficacy scale items were reviewed by a panel of experts, and field tested prior to use. Participants responded utilizing a Likert (1932) scale of agreement. SPSS version 30.0.0.0 software was utilized for data analysis. Data was coded as shown in the footnote of Table 1. A Paired T sample test was conducted to compare mean phenomenon scale scores for the pre and post course efficacy following guidance from Field (2013), and effect size is reported using Cohen's d as suggested by Field (2013). Cronbach's Alpha was utilized for scale reliability (Field, 2013). The scale had 7 items, $\alpha = .96$ for Pre Course, and $\alpha = .83$ for Post course; both being above .8 and considered acceptable (Field, 2013). Respondents ranged from preservice teachers to 14 years of teaching completed ($M = 5.52$, $SD = 4.02$), most were traditionally ($n = 18$) compared to alternatively credentialed ($n = 3$).

## Results/findings

Within the teachers' Phenomenon Efficacy Scale mean score, participants showed a gain between the pre ($M = 2.99$, SE .22) and post ($M = 4.55$, SE = .08), this difference, -1.56, BCa 95% [-2.00, -1.11], was significant $t(21) = -7.29$, $p = < .001$, and represented a large effect, $d = 1.00$. Table 1 shows that prior to taking the course, respondents showed disagreement or neutrality with all efficacy statements. Responses after taking the course, reflect agreement with all efficacy statements, each represented a significant difference, with a large effect size.

**Table 1**
*Teacher Pre Post Instructional Phenomenon Efficacy (N=22)*

| | Pre | | Post | | | | | |
|---|---|---|---|---|---|---|---|---|
| Item | *M* | *SD* | *M* | *SD* | *df* | *t*(21) | p | Cohen's *d* |
| I can plan lessons that are started with and driven by phenomena | 3.27 | 1.20 | 4.55 | .60 | -6.61 | -6.06 | <.001 | .99 |
| I can explain what phenomenon is in the context of an classroom. | 3.23 | 1.10 | 4.77 | .43 | -6.58 | -6.58 | <.001 | 1.02 |
| I can give examples of agricultural phenomena in the classroom. | 3.14 | 1.17 | 4.64 | .49 | -5.75 | -5.75 | <.001 | 1.10 |
| I teach lessons that are driven by phenomenon. | 2.86 | 1.25 | 4.23 | .75 | -5.63 | -5.63 | <.001 | 1.14 |
| I can give examples of how I use phenomenon in my daily teaching in the classroom. | 3.09 | 1.19 | 4.41 | .67 | -5.69 | -5.69 | <.001 | 1.09 |
| I can coach another teacher/student teacher to use phenomenon in the classroom. | 2.86 | 1.68 | 4.50 | .51 | -6.76 | -6.76 | .003 | 1.14 |
| I can list examples of sources of where to find phenomenon for my classroom. | 2.50 | 1.26 | 4.77 | .73 | -7.51 | -7.51 | <.001 | 1.42 |

*Note*. Overall Pre *M* = 2.99 and Post *M* = 4.55. Items coded as *strongly disagree* = 1, *disagree* = 2, *neither agree or disagree* = 3, *agree* = 4, *strongly agree* = 5.

## Conclusions

Within this sample, the intervention has shown to increase teachers' efficacy related to finding phenomenon sources, giving examples, explain the uses, planning lessons, and even coaching other educators. While the sample size is small, the early field test results indicate that Foundations of Phenomenon in Agriscience Instruction shows promise in its ability to significantly increase SBAE teachers' efficacy related to phenomenon driven instruction.

## Implications/Recommendations/Impact

The impact of this research relates to the identification of ways to meet the professional learning needs of SBAE educators surrounding NGSS aligned professional learning (Barrick et al., 2018, Chumbley et al., 2019). Researchers should continue to study course completers to determine how course outcomes may vary in respect to variables of interest like years of teacher, credential type, gender association, and other variables of interest. Researchers should also follow up with participants to determine to what extent they are making changes in their classroom practice. Practitioners should consider to what extent this course could be used for their own personal development, especially teacher educators who are responsible for teaching methods courses, and the supervision of preservice teachers in their clinical practice, and how the course may benefit stakeholders they serve.

## References

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review, 84(2), 191-215.

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.

Bursal, M. (2015). A comparison of standard and retrospective pre-post testing for measuring the changes in science teaching efficacy beliefs. Journal of Baltic Science Education, 14(2), 275-283.

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

Bybee, R. W., Taylor, J. A., Gardner, A., Van Scotter, P., Powell, J. C., Westbrook, A., & Landes, N. (2006). The BSCS 5E instructional model: Origins and effectiveness. *Colorado Springs, Co: BSCS*, *5*(88-98).

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.

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

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of psychology*.

McKim, A. J., Sorensen, T. J., & Velez, J. J. (2016). Exploring the role of agriculture teachers in core academic integration. *Journal of Agricultural Education*, *57*(4), 1-15.

McKim, A. J., & Velez, J. J. (2016). An evaluation of the self-efficacy theory in agricultural education. *Journal of Agricultural Education*, *57*(1), 73-90.

Mojavezi, A. (2012, March). The Impact of Teacher Self-efficacy on the. Theory and Practice in Language Studies, 2(3), 483-491.

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