Investigating Agriscience Teachers' Knowledge and Comfort of IBI and STEM Integration

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Introduction

A major focus of school-based agricultural education is the hands-on, experiential learning opportunities provided within classroom instruction. The career ready skills attained through this type of instruction are often possible due to the use of inquiry-based instruction (IBI) and the integration of science, technology, engineering, and math (STEM) concepts (Knobloch, 2003). Colburn (2006) defined IBI as the occasion when "students are engaged in (essentially) open-ended, student-centered, hands-on activities" (p. 2). IBI includes the use of students' background knowledge to problem solve and create answers (Colburn, 2006). The importance of STEM in education has been thoroughly researched and is a continued priority of the national government for the future of education, especially within Career and Technical Education fields (NSTC, 2018).

Theoretical Framework

Teachers' self-efficacy has been found to influence student outcomes of success and motivation. Self-efficacy can affect a teacher's perception of content knowledge areas, their ability to employ a teaching method, or their skill at utilizing technologies within the classroom (Barni, 2019). There is a recognized need for teacher professional development (PD) to not only support the content knowledge of teachers and success of students, but also make meaningful reform over time within classrooms. PD can aid teachers in adjusting to new educational goals which can often include imploring new or unfamiliar teaching methods (Borko, 2004). There is an understood support of teachers in the value of illuminating STEM concepts within the agriscience curricula (Ferand et al., 2020a; Ferand et al., 2020b). However, past research indicated general weariness of fully incorporating STEM within agriscience classrooms along with a lack of understanding of what truly is encompassed when one integrates STEM within their curricula (Stubbs & Myers, 2016). Similar findings exist with IBI in that many teachers affirm the value and benefits of utilizing IBI but had low confidence in their ability to implement IBI consistently(Blythe, et al. 2015). Stubbs and Myers (2016) also noted confusion regarding how to properly [find] inquiry within pre-existing lessons when teachers sought to increase their use of IBI whichbrought into question their knowledge of IBI as a teaching method.

The purpose of this research was to evaluate the PD program as a method of increasing teachers' perceptions of their knowledge and comfort utilizing IBI and integrating STEM concepts within agriscience curricula. During a three-day virtual PD conference, we investigated both the knowledge and comfort of agriscience teachers. The PD program modeled the use of IBI and STEM integration within agriscience curricula to enhance participant's self-efficacy.

Methodology

This study's population was composed of agriscience teachers (N = 18). who participated in a three-day virtual conference during the summer of 2021 Researcher created instruments were distributed via Qualtrics to participants before and after the conference. Both instruments utilized a 10-point, Likert-type scale to rate participant knowledge and comfort in teaching utilizing IBI and integrating STEM into their curricula (1 = no knowledge, 10 = extremely knowledgeable and 1 = not at all comfortable, 10 = extremely comfortable). Microsoft Excel was used to calculate mean and standard deviation of the population.

Results/Findings/Conclusions

Pre and post-test findings from the three-day PD program are depicted in Tables 1 and 2. Agriscience teachers' (N = 18) mean scores of knowledge of IBI increased by 0.73 points, while their mean scores of comfort with IBI increased by 0.78 pre to post test (Table 1). For STEM integration their mean scores of knowledge and comfort increased by 1.67 and 1.39 points, respectively (Table 2).

Table 1
Agriscience Teachers' Knowledge and Comfort of Inquiry-based Instruction (N = 18)

		Mean	Standard Deviation	Minimum	Maximum
Knowledge	Pre-test	5.94	1.73	3.00	8.00
	Post-test	6.67	1.75	3.00	10.00
Comfort	Pre-test	5.22	2.18	1.00	10.00
	Post-test	6.00	2.06	3.00	10.00

Table 2
Agriscience Teachers' Knowledge and Comfort of STEM Integration (N = 18)

		Mean	Standard Deviation	Minimum	Maximum
Knowledge	Pre-test	5.50	1.47	3.00	8.00
	Post-test	7.17	1.47	4.00	10.00
Comfort	Pre-test	5.33	1.57	2.00	8.00
	Post-test	6.72	1.84	4.00	10.00

The minimum pretest scores for both knowledge and comfort of IBI was 2.00 compared to a posttest maximum average of 10.00.The average of the minimum pre scores for both knowledge and comfort of STEM integration was 2.50 compared to a post maximum average of 10.00. We concluded the PD program was effective in increasing both the knowledge and comfort of participants to utilize IBI and integrate STEM within the agriscience curricula.

Implications/Recommendations/Impact on Profession

The findings highlight the need for PD programs to utilize content to model IBI to help increase teacher self-efficacy. There is an apparent need to assess both teachers' knowledge and comfort of new concepts. The two factors do not always mirror each other but are both necessary to elicit change (Barni, 2019; Borko, 2004). We recommend expanding this line of inquiry to determine correlation between, and barriers faced in integrating STEM and utilizing IBI for both in-service and preservice teachers. PD that investigates participant self-efficacy will positively impact teacher's knowledge and comfort in using IBI and integrating STEM concepts.

References

Barni, D., Danioni, F., & Benevene, P. (2019). Teachers' self-efficacy: The role of personal values and motivations for teaching. *Frontiers in Psychology*, *10*. https://doi.org/10.3389/fpsyg.2019.01645

Ferand, N. K., DiBenedetto C. A., Myers, B. E., & Barry, D. M. (2020a - In review). Implications of science illumination on student motivation to learn science in agriculture. *Journal of Agricultural Education*.

Ferand, N. K., DiBenedetto C. A., Myers, B. E., & Barry, D. M. (2020b - In review). Implications of science illumination on student content knowledge of technical floriculture and core scientific ideas. *Journal of Agricultural Education*.

Blythe, J. M., DiBenedetto, C. A., & Myers, B. E. (2015). Inquiry-based instruction: Perceptions of National Agriscience Teacher Ambassadors. *Journal of Agricultural Education*, *56*(2), 114-119. https://www.doi.org/10.5032/jae.2015.02110

Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher, 33*(8), 3-15. https://doi.org/10.3102/0013189X033008003

Colburn, A. (2006). What teacher educators need to know about inquiry-based instruction. In *annual meeting of the Association for the Education of Teachers in Science*, Akron, OH. www.csulb.edu/~acolburn/AETS.htm.

Knobloch, N. A. (2003). Is experiential learning authentic? *Journal of Agricultural Education*, *44*(4), 22-34. https://www.doi.org/10.5032/jae.2003.04022

National Science and Technology Council (NSTC) (2018). Charting a course for success: America's strategy for STEM. https://trumpwhitehouse.archives.gov/wp-content/uploads/2018/12/STEM-Education-Strategic-Plan-2018.pdf

Stubbs, E. A., & Myers, B, E. (2016). Part of what we do: Teacher perceptions of STEM integration. *Journal of Agricultural Education, 57*(3), 87-100. https://www.doi/10.5032/jae.2016.03087