Assessing the Importance and Competence of Undergraduate Agricultural Education Students Related to Teaching Sustainable Bioenergy

Christopher J. Eck
Oklahoma State University
458 Agricultural Hall
Stillwater, OK 74078
239-340-8533
chris.eck@okstate.edu

J. Shane Robinson
Oklahoma State University
304B PIO Building
Stillwater, OK 74078
405-744-3094
shane.robinson@okstate.edu

Assessing the Importance and Competence of Undergraduate Agricultural Education Students Related to Teaching Sustainable Bioenergy

Introduction

School-based agricultural education (SBAE) teachers have been identified as an important source for addressing science and math literacy through STEM integration (Haynes, Robinson, Edwards, & Key, 2012; Myers & Washburn, 2008; Myers, Washburn, & Dyer, 2004; Smith, Rayfield, & McKim, 2015). Integrating STEM in a familiar context to improve science literacy is an important endeavor, as Miller (2010) found that only 17 percent of United States adults who participated in his study were scientifically literate. Therefore, the need for SBAE teachers to highlight STEM concepts is evident (Stripling & Ricketts, 2016). However, are SBAE teachers ready to meet the challenge? Scales, Terry, and Torres (2009) found that although SBAE teachers considered themselves to be competent at teaching science, their actual performance on a science knowledge examination revealed they were technically incompetent.

The purpose of this study was to identify the perceived level of importance and personal competence of pre-service agricultural education teachers at Oklahoma State University (OSU) related to teaching a science-based curriculum on sustainable bioenergy to high school students. Three research objectives guided this study: (1) Describe the personal and professional characteristics of the pre-service agricultural education students; (2) Identify the importance of teaching the bioenergy curriculum in SBAE programs; and (3) Determine student's competence level to teach the bioenergy curriculum in SBAE programs.

Theoretical Frame

Bandura's (1986) social cognitive theory framed the study through motivation and self-efficacy. Glynn and Koballa (2006) identified that providing students with meaningful, worthwhile content serves as a great motivator for learning. Self-efficacy on the other hand, deals with the beliefs people have regarding their abilities to perform a given task (Bandura, 1997). Therefore, an individual with low self-efficacy might be expected to have a lower level of performance than one with high self-efficacy (Bandura, 1997). For this study, motivation was linked with pre-service teachers' importance ratings, and self-efficacy is linked with their competence ratings.

Methodology

The population of interest was pre-service agricultural education teachers enrolled in the teaching methods course at OSU (N = 35*).* Eighty percent (n = 28) of the students participated in the study, where they were asked to evaluate their perceived level of importance and competence related to the five areas of sustainable bioenergy (i.e., bioenergy, bioplastics, plant growth, ethanol and fermentation, and oil extraction), as defined by the curriculum used. The importance/competence ratings were provided on a four-point Likert-type scale of agreement (i.e., 1 = extremely unimportant/incompetent, 2 = somewhat unimportant/incompetent, 3 = somewhat important/competent, and 4 = extremely important/competent). In addition, students identified their perceived level of importance and competence related to the scientific method. In total, there were 19 statements evaluated by students for both importance and competence, aligning with the curriculum developed for the sustainable bioenergy workshop at OSU. Further, seven questions aimed to address the students' personal and professional characteristics. The complete instrument was evaluated for face and content validity by four faculty members before

being distributed electronically via Qualtrics. Three of the faculty members are teacher educators in Agricultural Education at OSU with a combined 28 years of SBAE experience. The fourth faculty member is a professor of Research Methods and focuses on psychometric and developing instruments.

Results/Findings

Objective one sought to describe the personal and professional characteristics of the participants. The pre-service agricultural education teachers who participated in the study ranged in age from 21 to 23 years old, and were predominately female (n = 18, 64%). Ninety-six percent (n = 27) of the participants were involved in agricultural education and FFA in high school. Eighty-six percent (n = 24) of the participants planned to teach SBAE after graduation, three were undecided, and one did not plan to pursue a SBAE career. Research objective two sought to determine the importance of teaching bioenergy curriculum, of which mean scores ranged from 2.93 to 3.52 on a four-point scale of agreement. Although, all of the items resulted in an important mean score, the items deemed most important by participants were understanding the scientific method, preparing students to develop a scientific research project, preparing student to participate in the science fair, conducting a laboratory with yeast to test different substances for their ability to promote fermentation, and identifying areas in the United States where crops are grown to produce ethanol. Research objective three investigated the competence of participants related to teaching the bioenergy curriculum. Mean scores ranged from 1.89 to 3.17 for competence, resulting in somewhat incompetent to somewhat competent perceptions of teaching bioenergy curriculum. Participants were least competent in conducting a laboratory to make biodiesel, conducting a laboratory to create various bioplastics from common plant starches, and conducting a laboratory to test properties of plastic. They were most competent in understanding the scientific method and preparing students to develop a scientific research project.

Conclusions

The personal and professional characteristics found in this study not only align with the current demographic in the agricultural education program at OSU, but also align with the demographics and entrance rates of SBAE teachers, based on the supply and demand of SBAE teachers nationwide (NAAE, 2018). Participants deemed all 19 items at least somewhat important based on mean scores, aligning with previous studies (Myers et al., 2004; Smith et al., 2015) emphasizing the importance of STEM integration in SBAE. Although participants deemed all 19 items important, they felt less than competent in teaching the majority of the bioenergy concepts presented, which is similar to the findings reported by Scales et al. (2009).

Implications/Recommendations

The need for STEM integration in SBAE is evident (Haynes et al., 2012; Myers & Washburn, 2008); however, the training needed to equip and prepare SBAE teachers to deliver the content remains an issue. It is recommended that bioenergy curriculum and laboratory demonstrations be integrated into the agricultural education teacher preparation program at OSU. Peer institutions with similar demographics and needs should consider the same recommendation. Additionally, post integration data should be collected to determine the impact of the STEM integration in the teacher preparation program on future SBAE teachers importance and competence of STEM in SBAE programs.

References

Bandura, A. (1986*). Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Glynn, S. M., & Koballa, T. R. (2006). Motivation to learn in college science. In J. J. Mintzes & W. H. Leonard (Eds.), *Handbook of college science teaching*, 25–32. Arlington, VA: National Science Teachers Association Press.

Haynes, J. C., Robinson, J. S., Edwards, M. C., & Key, J. P. (2012). Assessing the effect of using a science-enhanced curriculum to improve agriculture students' science scores: A causal comparative study. *Journal of Agricultural Education, 53*(2), 15–27. doi:10.5032/jae.2012.02015

Miller, J. D. (2010). The conceptualization and measurement of civic scientific literacy for the twenty-first century. In J. Meinwald & J. G. Hildebrand (Eds.), *Science and the educated American: A core component of liberal education.* Cambridge, MA: American Academy of Arts and Sciences

Myers, B. E., Washburn, S. G., & Dyer, J. E. (2004). Assessing agriculture teachers' capacity for teaching science integrated process skills. *Journal of Southern Agricultural Education Research, 54*(1), 74–85. Retrieved from http://www.jsaer.org/pdf/vol54Whole.pdf

Myers, B. E., & Washburn, S. G. (2008). Integrating science in the agriculture curriculum: Agriculture teacher perceptions of the opportunities, barriers, and impact on student enrollment. *Journal of Agricultural Education, 49*(2), 27–37. doi:10.5032/jae.2008.02027

National Association of Agricultural Educators (NAAE). (2018). *Ag ed supply and demand.* Retrieved from https://www.naae.org/teachag/2018%20Nationwide%20Profile.pdf

Scales, J., Terry Jr., R., & Torres, R. M. (2009). Are teachers ready to integrate science concepts into secondary agriculture programs? *Journal of Agricultural Education, 50*(2), 102–113. doi:10.5032/jae.2009.02102

Smith, K. L., Rayfield, J., & McKim, B. R. (2015). Effective practices in STEM integration: Describing teacher perceptions and instructional method use. *Journal of Agricultural Education, 56*(4), 182–201. doi:10.5032/jae.2015.04183

Stripling, C. T., & Ricketts, J. C. (2016). Research priority 3: Sufficient scientific and professional workforce that addresses the challenges of the 21st century. In T. G.Roberts, A. Harder, & M. T. Brashears (Eds), *American Association for Agricultural Education national research agenda: 2016-2020* (pp. 29-35). Gainesville, FL: Department of Agricultural Education and Communication