

Preservice Agriculture Teachers' Science Content Knowledge Development through CASE

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Introduction/Need for Research

Over the last four decades, school based agricultural education (SBAE) programs have been integrating life science concepts into the curriculum (Dailey, Conroy, & Shelley-Tolbert, 2001). Agriculture provides a unique lens to learn science concepts and is beneficial to students by aiding them in making connections between scientific principles through real-world applications (Washburn & Myers, 2010). With Science, Technology, Engineering, and Mathematics (STEM) fields predicted to have around 20,000 job openings every year until 2021 (Carnevale, Smith, & Melton, 2011), it is essential that students are prepared with science knowledge.

One of the most important factors in student learning is teacher knowledge (Shulman, 1986). Teacher knowledge spans many areas including professional knowledge, pedagogical knowledge, content knowledge, and pedagogical content knowledge (PCK) (CAEP, 2013). For a teacher to be able to break content down for student understanding, a strong content knowledge base is needed (Ball, Thames, & Phelps, 2008). This is the foundation for developing PCK, a specific knowledge base possessed by teachers where content knowledge and pedagogical knowledge coalesce (Shulman, 1986). While much of agriculture teacher preparation is rooted in various areas of agriculture content knowledge (animal science, plant science, agricultural mechanics, etc.), it is also important that agriculture teachers incorporating science have a strong content knowledge base specifically in the life sciences (i.e. biology).

To address content knowledge and PCK needs of teachers, The Curriculum for Agricultural Science Education (CASE) was created to enhance the delivery of agricultural science in SBAE programs and aligns all lessons with national standards for agriculture, science, math, and English (CASE, 2019). The rigor of the curriculum stems from the utilization of science inquiry taught through the lens of agriculture. CASE is in its 12th year of implementation, and is commonly advertised as a way to enhance science comprehension in SBAE programs. However, there is little empirical research supporting the curriculum or the professional development training that is required of teachers to become certified. This study looked specifically at preservice agriculture teachers content knowledge development in science upon completion of the CASE Agriculture, Food, and Natural Resources (AFNR) integrated institute.

Conceptual Framework

The relationship between sources of content knowledge and PCK was utilized as the conceptual framework for this study (Rice & Kitchel, 2015). The seven sources of knowledge in the framework that impact a teachers' PCK include: teaching experience, high school agriculture experience, teacher preparation programs, agriculture jobs and internships, professional development, internet and other media, and years spent teaching. The CASE institute is an intensive professional development opportunity that exposes teachers to a year's worth of curriculum and allows for the application of lab-based activities. The integrated institute model is offered to students within teacher preparation programs as a component of their college curriculum. As both a professional development opportunity and a part of the teacher preparation program, CASE addresses two sources of content knowledge that could potentially impact a teacher's ability to deliver content effectively. The Rice and Kitchel (2015) framework was used to justify CASE as an input of content knowledge contributing to PCK and student learning.

Methodology

The accessible population for the study consisted of students (N=6) enrolled in the only section of the CASE integrated institute offered in the Fall of 2018 at the University of Arizona. Prior to the beginning of the integrated institute, students were administered a pre-science knowledge test. The 2009 Texas Assessment of Knowledge and Skills Exit Level Science test and was obtained with copyright permissions for the purpose of this research. This test was chosen for its science concepts that mirrored what is covered in the CASE AFNR curriculum, and each of the 55 questions were cross-walked with state standards for students exit level science knowledge. The test was graded using the released answer key. At the end of the semester, after completing the requirements to fulfill CASE certification, the same population of students were administered the test again as a post-science test. Using the data from the pre- and post- science test, a Cohen's D analysis was utilized to analyze the effect size between the two sets of tests.

Results/Findings

Findings included the average of the six preservice teacher's scores on the pre- and post-science test administered before and after the integrated CASE institute. The mean of the pre-test was 40.5 points out of a possible 55 points with a standard deviation of 9.23. The mean of the post-test was 45 with a standard deviation of 10.33. The Cohen's D effect size value was 0.46.

Table 1.

Scores, Means, and Standard Deviations of Participant Pre- and Post- Science Test

Assessment	Participant Pseudonyms						<i>M</i>	<i>SD</i>
	Payton	Shirley	Larry	Beatrice	George	Steve		
Pre- Test	34	52	43	48	24	42	40.5	9.23
Post- Test	39	55	47	53	25	51	45	10.33

Conclusions

The limitations of this study include the population size of six participants and the inability to generalize to other preservice teachers who attended other integrated CASE institutes. The effect size of 0.46 indicates a medium effect size. With a Cohen's D of 0.46, more than 66% of the treatment group will be above the mean of the control group (Cohen, 1977). There is enough of an effect size from the data to support that the integrated institute develops and reinforces the science concepts covered within the AFNR curriculum in preservice teachers.

Recommendations/Impact on Profession

Recommendations for further research include continuing a longitudinal study with the integrated CASE institute to see if patterns hold true for future participants. Additionally, other universities offering CASE institutes should pursue similar research opportunities to determine if CASE is indeed a contributing factor to preservice teachers' development of science content knowledge. With additional research support, CASE can better market their professional development institutes and curriculum to universities wishing to enhance their preservice teachers' knowledge of life science concepts in an agricultural context.

References

- Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education*, 59(5), 389-407. doi:10.1177/0022487108324554
- Carnevale, A. P., Smith, N., & Melton, M. (2011). *STEM: Science, technology, engineering, and mathematics*. Georgetown University Center on Education and the Workforce. Washington, DC.
- Cohen, J. (1977). *Statistical power analysis for the behavioral sciences*. Routledge Publishers.
- Council for Accreditation of Educator Preparation. (2013). CAEP 2013 standards for accreditation of educator preparation. Retrieved from: <http://www.caepnet.org/standards>
- Curriculum for Agricultural Science Education (2019). Retrieved from <http://www.case4learning.org>
- Dailey, A. L., Conroy, C. A., & Shelly-Tolbert, C. A. (2001). Using agriculture education as the context to teach life skills. *Journal of Agricultural Education*, 42(1), 11-20. doi: 105032.jae.2001.01011
- Rice, A. H. & Kitchel, T. (2015). The relationship between agricultural knowledge bases for teaching sources of knowledge. *Journal of Agricultural Education*, 56(4), 153-168. doi:10.5032/jae.2015.04153
- Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4-14. doi:10.3102/0013189X015002004
- Washburn, S., & Myers, B. (2010). Agriculture teacher perceptions of preparation to integrate science and their current use of inquiry-based learning. *Journal of Agricultural Education*, 51(1), 99–112. doi:10.5032/jae.2010.01088