New Mexico agriculture teachers' perceived self-efficacy to teach science content

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Introduction

Teaching science within an agricultural context has greatly contributed to students' ability to achieve academic success in science (American Association for the Advancement of Science, 1990). The Science, Technology, Engineering, and Mathematics (STEM) field is predicted to have nearly 20,000 job openings annually between 2015-2020 (Carnevale, Smith, & Melton, 2011). Due to the success of science integration in agriculture classrooms, agriculture teachers need to align their curriculum with science to prepare the future of the workforce. However, agriculture teachers do not have enough experience to support high self-efficacy scores for teaching science (McKim & Velez, 2015). Preservice agriculture teachers saw a need to integrate more science into their curriculum, but also stated the greatest barrier to science integration was their lack of science content knowledge (Thoron & Myers, 2010). This study aligns with AAAE's national research agenda (Roberts, Harder, & Brashears, 2016) priority 4, meaningful and engaged learning in all environments, by investigating New Mexico (NM) agriculture teachers' self-efficacy to teach science content.

Conceptual and Theoretical Framework

Rice and Kitchel's (2015) conceptual framework, derived from an extensive literature review, illustrated the relationship between sources of agriculture content knowledge (CK) and pedagogical content knowledge (PCK). Application of this conceptual model has transferability to agriculture teachers' science CK and PCK. This model described seven distinct sources of CK that contribute to PCK including: (1) teaching experience, (2) high school agriculture experience, (3) teacher preparation program, (4) agriculture jobs and internships, (5) professional development, (6) internet and other media, and (7) years spent teaching (Rice & Kitchel, 2015).

Bandura's (1977) theory of self-efficacy was the theoretical framework that guided this study. Self-efficacy is defined as one's belief in their ability to accomplish set goals. Confidence is mirrored through self-efficacy by the capacity of one to exercise control over motivation, behavior, and social environment (Bandura, 1997). Woolfolk (2007) coined the term teacher self-efficacy to describe one's confidence to help even the most difficult student to learn. Teacher self-efficacy is positively associated with student achievement (Woolfolk, 2007).

Methodology

The purpose of this study was to describe the relationship between sources of science CK, and the perceived self-efficacy to teach science content among practicing NM agriculture teachers using quantitative methods. The following objectives were: (1) describe sources of science content knowledge, (2) describe perceived self-efficacy to teach science content and (3) describe the relationship between sources of science CK and perceived self-efficacy to teach science content.

The design for this study was descriptive correlational research (Ary, Jacobs, & Sorensen, 2010). The target population was NM agriculture teachers teaching at least one science course during the 2016-2017 school year (N = 102). Data were collected from a pilot study used to establish reliability of the questionnaire instrument. Sources of science content knowledge served as the independent variable and Next Generation Science Standards (NGSS) served as the dependent variable. Content and face validity were established by a panel of six experts comprised of professionals within the agricultural education field. Dillman, Smyth, and Christian's (2009) tailored design method was used to maximize responses. Cronbach's alpha was calculated to determine the internal consistency of the instrument; composite reliability coefficients were .88 or above. The response rate was 41.2% (n = 42).

Respondents answered questions developed from effective sources of science CK (Rice & Kitchel, 2015) on a Likert scale; 1 being "extremely ineffective" and 5 being "extremely effective." Life science NGSS strands were specifically chosen to analyze teacher's self-efficacy to teach nationally benchmarked standards. Strands included Structure and Function (SF), Matter and Energy in Organisms and Ecosystems (MEOS), Interdependent Relationships in Ecosystems (IRE), Inheritance and Variation of Traits (IVT), and Natural Selection and Evolution (NSE) (National Research Council, 2012). Respondents rated their confidence to teach each strand on a Likert scale; 1 being "extremely unconfident" and 5 being "extremely confident." Data were analyzed using SPSS® for means, standard deviations, and Pearson's correlation coefficient.

Results/Findings

Objective 1: The average number of years teaching agriculture was 11.63 (SD = 9.74). Mean effectiveness for sources of science CK were 4.38 for teaching experience (SD = 0.63), 4.36 agriculture jobs and internships (SD = 0.63), 4.08 internet and other media (SD = 0.62), 3.94 high school agriculture experience (SD = 1.04), 3.82 for professional development (SD = 0.85), and 3.56 for teacher preparation program (SD = 1.20). *Objective 2*: Self-efficacy means to teach Life Science NGSS were broken down into individual strands. NSE strand had the highest self-efficacy of 3.81 (SD = 0.96). IRE (μ = 3.78, SD = 0.89) and MEOS (μ = 3.79, SD = 0.85) followed respectively. The lowest means were IVT at 3.69 (SD = 0.93) and SF 3.61 (SD = 0.84).

Objective 3: Davis' (1971) correlation coefficient was used to interpret the strength of the relationship between sources of science CK and NGSS strands. Teaching experience was the only source of knowledge that had a moderate association between NGSS strands SF (r = 0.50), MEOS (r = 0.30), and IVT (r = 0.34). Correlation coefficients were negligible association for teacher preparation programs between strands SF (r =- 0.01), MEOS (r = 0.01), IRE (r = 0.09), and IVT (r = 0.07) and low association for NSE (r = 0.20). High school agriculture program experience, previous agriculture related jobs or internships, professional development, and internet, textbooks, or other media ranged from negligible to low association. Number of years teaching showed a negative association theme for all strands; SF (r = -0.03), MEOS (r = -0.17), IRE (r = 0.23), IVT (r = 0.25, and NSE (r = 0.35).

Conclusions, Implications, and Recommendations

Caution should be taken when applying the findings beyond NM agriculture teachers. Results of this pilot study suggest that teaching experiences contributed slightly to confidence levels. Although conflicting, years spent teaching suggested a negative relationship with sources of science CK; experienced NM agriculture teachers are less confident to teach science. Potentially, the quality of teaching experiences better prepared agriculture teachers to teach science as compared to years spent in the classroom.

Other sources of science CK were insignificant to teachers' confidence levels, specifically teacher preparation programs. Thoron and Myers (2010) reported teachers are receptive to integrating science within their curriculum, but also indicated the need for additional science related courses. Potentially incorporating Curriculum for Agricultural Science Education (CASE) into the preservice curriculum could be another source of CK to increase self-efficacy to teach science. Further research should be conducted to establish best practices for teaching science during teacher preparation programs, potentially using qualitative methods.

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