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Evaluating Interdisciplinary Teaching: Curriculum for Agricultural Science Education

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Abstract

Interdisciplinary learning experiences (i.e., experiences which illuminate learning of, and connections among, multiple disciplines) are essential to building a more robust understanding of the interconnections of multiple systems. Having an interdisciplinary understanding positively influences the ability of learners to contribute to solving wicked problems (e.g., soil degradation, climate change), most of which fall within the realm of agriculture, food, and natural resources (AFNR). Therefore, within AFNR Education, preparing learners via interdisciplinary experiences could empower the next generation of problem solvers. The Curriculum for Agricultural Science Education (CASE) has emerged as a potential method for teaching AFNR and science in an interdisciplinary way. However, research has yet to evaluate the impact of CASE on teachers' intentions to teach science within curricula. In this study, intentions to teach science were compared between CASE-certified and non-CASE-certified educators via a national survey of 212 randomly sampled teachers, 81 of whom were CASE-certified. Within four of the eight courses evaluated, CASE-certified teachers intended to teach more science than non-CASE-certified teachers, while non-CASE-certified teachers intended to teach more science in the remaining four courses. The findings suggest opportunities to enhance the interdisciplinary structure of CASE curriculum and/or explore alternative models for facilitating interdisciplinary learning within AFNR Education.

Keywords: curriculum for agricultural science education; science teaching; interdisciplinary; perceived science knowledge; teaching intentions

Introduction

Comparing traditional education systems to the expectations of professionals and society members yields more discrepancies than similarities. For example, upon completing formal education, very few individuals operate within distinct disciplinary (e.g., math, science, reading) silos (Berg, Hrabowski, & Zerhouni, 2016). This calls into question traditional education systems

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which, evidence suggests, ardently support knowledge and skill building within these silos (Boix Mansilla, Miller, & Gardner, 2000; Stember, 1991). As an alternative to traditional approaches, a burgeoning trend is to break down disciplinary silos and offer educational experiences which illuminate how multiple disciplines converge when solving authentic problems or issues (Chettiparamb, 2007; Newell, 2007). As expected, myriad methods exist for melding disciplines. To provide a reference for how disciplines can be combined, the authors created a *continuum of disciplinary melding* (see Table 1).

Table 1

Continuum of Disciplinary Melding

Terminology	Definition
Intradisciplinary	Work occurring within a discipline.
Crossdisciplinary	Analyzing work that occurs within a discipline from the perspective of a different discipline.
Multidisciplinary	Work to solve a problem or issue that requires the perspectives of multiple, distinct disciplines.
Interdisciplinary	Work to solve a problem or issue in which components of existing disciplines are integrated into a new discipline or solution.
Transdisciplinary	Work to solve a problem or issue transcending traditional disciplines.

Note. Continuum based on research by Boix Mansilla et al. (2000), Stember (1991), and Nikitina (2006).

As educators shift learning experiences from intradisciplinary into more multidisciplinary, interdisciplinary, and transdisciplinary spaces, students and society benefit (Chettiparamb, 2007). Among the most salient benefits is preparing students to understand and operate within complex systems (Chettiparamb, 2007; Newell, 2007). The ability to negotiate complex systems is an essential outcome of agriculture, food, and natural resources (AFNR) education (Culhane, Niewolny, Clark, McConnell, & Friedel, 2016). In fact, many do not view AFNR as distinct disciplines, but applied disciplines; most commonly AFNR as applied sciences (Dyer & Osborne, 1999; Thompson & Warnick, 2007). Although differences exist in how the connection between AFNR and science is framed, there is agreement in the value of learning experiences which illuminate the relationship between AFNR and science (McKim, Velez, Lambert, & Balschweid, 2017). As an example, learning experiences which connect AFNR and science can empower students to identify, investigate, and implement solutions to agricultural practices which damage the environment (McKim, Pauley, Velez, & Sorensen, 2018).

The importance of multidisciplinary, interdisciplinary, and transdisciplinary learning experiences in AFNR necessitates more research exploring educational models linking AFNR and science. One such model is the Curriculum for Agricultural Science Education (CASE), which combines professional development and curriculum with the intention of empowering school-based AFNR educators to offer both multidisciplinary and interdisciplinary AFNR and science learning experiences. A review of CASE curriculum suggests the use of both multidisciplinary and interdisciplinary teaching; however, to conserve space, the remainder of the manuscript will use the term *interdisciplinary*. Currently, a lack of research exploring the relationship between CASE and the science teaching intentions of AFNR educators limits understanding the efficacy of CASE regarding the establishment of interdisciplinary learning opportunities. Therefore, the current analysis explores science teaching intentions, science knowledge, and CASE certification(s) among school-based AFNR educators.

Theoretical Framework

The *Model of Teacher Change* (MTC; Guskey, 2002) serves as the theoretical framework for the current study. The MTC suggests change in student learning outcomes, as opposed to professional development, is the direct precursor to meaningful change among teachers (see Figure 1). This perspective contrasts alternative models of teacher change, which suggest teacher change is a direct result of professional development. Within the MTC, professional development should encourage teachers to try out an intervention within their classroom instead of attempt to change teacher beliefs and attitudes (Guskey, 2002). Trying out an intervention allows teachers to observe student outcomes, which subsequently influences teacher beliefs and attitudes. Within the MTC, evaluating the impact of professional development requires exploring the relationship between professional development and intentions to enact a specified classroom practice. In the current study, this relationship was operationalized by exploring perceived science knowledge, intentions to teach science (i.e., classroom practice), and teacher engagement in CASE (i.e., professional development).

The Model of Teacher Change

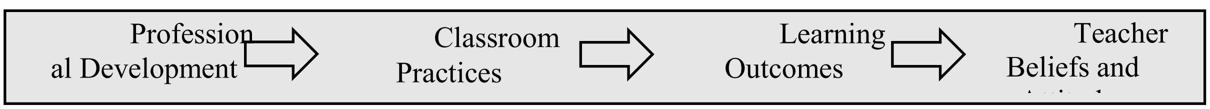

Figure 1. The *Model of Teacher Change* (Guskey, 2002).

Literature Review

The current study sought to add to existing scholarship by exploring CASE certification(s), perceived science knowledge, and intentions to teach science across CASE certifications and AFNR curriculum. Acquisition of this knowledge will serve as a foundation in which to inform future research exploring the relationship between CASE certification(s) and interdisciplinary teaching, as well as inform practitioner decisions regarding the potential interdisciplinary value of CASE to their teaching and student learning.

CASE Curriculum

Established by the National Council for Agricultural Education, CASE provides curriculum and professional development emphasizing the interdisciplinary nature of AFNR and science (CASE, 2017b). At the point of data collection, CASE offered curriculum for eight courses (i.e., Introduction to Agriculture, Food, and Natural Resources; Principles of Agricultural Science – Animal; Principles of Agricultural Science – Plant; Agricultural Power and Technology; Natural Resources and Ecology; Animal and Plant Biotechnology; Food Science and Safety; and Agricultural Research and Development [CASE, 2017b]). The alignment of each CASE course to national AFNR Common Career and Technical Core Content Standards, Next Generation Science Standards, and Common Core High School Mathematics and Grades 9-10 English Language Arts Standards (CASE, 2017a), ensures various opportunities for students to establish connections between disciplines and enhance problem-solving skills.

To assist AFNR educators in the implementation of interdisciplinary curriculum, CASE requires 50-100 hours of professional development, after which course-specific certification is received (CASE, 2017b). The purpose of the professional development is to provide AFNR educators with a deep understanding of course format, pedagogy, and content as well as "confidence in teaching STEM-related concepts" (CASE, 2017b, p. 1). Improved STEM teaching confidence through CASE is supported in a study by Ulmer et al. (2013), which found an increase in AFNR educator science teaching self-efficacy after participation in the CASE institute. Additionally, AFNR educators in a study by Lambert, Velez, and Elliott (2014) indicated positive outcomes of the CASE curriculum in relation to perceptions of preparation, effectiveness, and efficiency. While existing research has identified positive outcomes associated with engagement in CASE, there is a lack of research exploring CASE certification(s) and science teaching intentions.

Perceived Science Knowledge

Essential to the effectiveness of interdisciplinary teaching is knowledge of multiple disciplines. The importance of the relationship between knowledge of multiple disciplines and interdisciplinary teaching is evident in various studies identifying high levels of perceived science knowledge as a positive predictor of science teaching intentions (Hamilton & Swortzel, 2007; Scales, Terry, & Torres, 2009; Wilson, Kirby, & Flowers, 2001). The emphasis on understanding course content during CASE professional development (CASE, 2017b) may provide an opportunity for AFNR educators to increase science knowledge perceptions; however, no prior research has studied the relationship between CASE certification and perceived science knowledge.

Science Teaching Intentions

The illumination of science within AFNR curriculum is critical to the advancement of interdisciplinary education. Two studies were identified which address the degree AFNR educators intended to teach science within their curriculum. A study by McKim et al. (2018) identified AFNR educators intended to include science concepts and practices in nearly 40% of the total curriculum, though intentions ranged across pathways from 18% in agribusiness systems to 57% in plant systems. Specific to the relationship between science teaching intentions and CASE, Carraway, Ulmer, Burris, and Irlbeck (2015) identified overwhelming intentions of preservice AFNR educators to teach science with CASE curriculum after completion of a semester-long CASE certification course. This study, however, did not address the amount of science pre-service educators intended to teach within the curriculum nor did it explore intentions to teach science across curricular offerings.

Purpose and Objectives

The purpose of this study was to explore CASE certification(s), perceived science knowledge, and intentions to teach science among a national sample of AFNR educators. This study was guided by two objectives; (a) explore perceived science knowledge among AFNR educators with varying CASE certification(s), and (b) explore intentions to teach science among AFNR educators with varying levels of CASE certification.

Methods

The current exploration of perceived science knowledge and intentions to teach science among AFNR educators with varying levels of CASE certification(s) was completed using survey research distributed through Qualtrics®. Selected methods afforded data collection from a large breadth of respondents to inform practice and research relating to science knowledge, science teaching intentions, and CASE certification(s).

Instrumentation

Data were collected as part of a larger research project modeling AFNR educator intentions to teach leadership, mathematics, and science. Two constructs and one demographic question were leveraged from the larger dataset. The first construct of interest, perceived science knowledge, was adapted from Diamond, Maerten-Rivera, Rohrer, and Lee (2013). The perceived science knowledge construct included eleven items, corresponding with themes in the Next Generation Science Standards (e.g., Energy, Earth's Systems, and Ecosystems Interactions). Respondents rated themselves either 1 *(Not Knowledgeable)*, 2 *(Somewhat Knowledgeable)*, 3 *(Knowledgeable),* or 4 *(Very Knowledgeable)* for each of the eleven items. Responses on the eleven items were summated, with findings reporting the average perceived knowledge across the eleven items.

The second construct of interest was intentions to teach science, a researcher-developed construct. Intentions to teach science were sought within different courses; therefore, identification of courses familiar to the teacher was required. To accomplish this, respondents identified courses they had taught, were teaching, or planned to teach. If courses met one of these criteria, they were deemed familiar enough to teachers, allowing respondents to report intentions to teach science based on familiarity with the curriculum. In total, the AFNR pathways (e.g., Animal Systems) and General Agriculture were included in the list. For familiar courses, respondents reported the percentage of curriculum in which science content/practices were intended. Responses were not summated across courses, as interest was in understanding science teaching intentions within different courses.

The demographic variable of interest was CASE certification(s). Respondents were asked to report their CASE certification(s) across the eight available CASE certifications (e.g., Principles of Agricultural Science – Animal; Agricultural Power and Technology) with an option to report no CASE certifications.

A panel of experts, including four faculty in AFNR Education, were used to evaluate face and content validity. Reliability was evaluated via a pilot test of the instrument among 31 preservice teachers at Utah State University and Oregon State University. The summated construct utilized in the current study (i.e., perceived science knowledge) met the threshold for reliability among the pilot population (Cronbach's Alpha = .85) as well as among respondents to the current study (Cronbach's Alpha = .88) via a *post hoc* analysis (Warmbrod, 2014).

Population, Sample, and Data Collection

The population of interest included all school-based AFNR educators during the 2015-2016 school year. The frame utilized was the National FFA Organization list of AFNR educators. Appropriate sample size was determined by requirements of structural equation modeling (Kline, 2005), selected to accomplish objectives of the broader study. In total, a request was made for names and contact information of 950 school-based AFNR educators, randomly selected from the National FFA population frame. Due to frame error (e.g., bounced emails), the list of potential respondents was reduced to 828. Data were collected using Dillman's (2007) tailored design method in November through December 2015. A total of 212 respondents provided useable data (n = 212), resulting in a 25.60% useable response rate. A lack of alternative contact information (e.g., phone numbers) required non-response bias be analyzed by comparing on-time respondents (i.e., those responding within the first three points of contact; n = 168) to late respondents (i.e., those responding after the last two points of contact; *n* = 44) within the variables of interest, with no evidence of statistically significant differences, indicating non-response bias was not an issue in the current analysis (Lindner, Murphy, & Briers, 2001; Miller & Smith, 1983).

Data Analysis

The first research objective, exploring perceived science knowledge among AFNR educators with varying CASE certification(s), was analyzed by comparing descriptive statistics of perceived science knowledge for teachers reporting no CASE certifications as well as those reporting certifications within each of the eight areas of CASE certification. The second objective, exploring intentions to teach science among AFNR educators with varying levels of CASE certification, was initiated by identifying three levels of CASE certification. The three levels of CASE certification were (a) no CASE certification, (b) CASE-certified educator teaching a course outside their area of CASE certification, and (c) CASE-certified educator teaching a course within their area of CASE certification. Identifying the three levels required that researchers "link" CASE certifications to the list of courses/pathways in which respondents were asked to report science teaching intentions (see Table 2). Descriptive statistics corresponding to science teaching intentions for the three identified groups were reported across each CASE certification/pathway linkage. Importantly, inferential statistics were not used to compare groups due to small in-group sizes (e.g., 10 CASE Animal and Plant Biotechnology certified educators teaching within the Biotechnology Systems pathway).

Table 2

CASE Certifications Linked to Course(s)/Pathway(s)

CASE Certification	Linked Course(s)/Pathway(s)
Introduction to AFNR	General Agriculture
Principles of Agricultural Science – Plant	Plant Systems
Principles of Agricultural Science – Animal	Animal Systems
Agricultural Power and Technology	Power, Structure, and Technical Systems
Natural Resources and Ecology	Environmental Service Systems & Natural Resource Systems
Animal and Plant Biotechnology	Biotechnology Systems
Food Science and Safety	Food Products and Processing Systems

Note. The CASE certification area "Agricultural Research and Development" and the pathway "Agribusiness Systems" did not have a corresponding link.

Findings

Research objective one sought to compare the perceived science knowledge of AFNR educators by CASE certification (see Table 3). On average, AFNR educators perceived their science knowledge between "somewhat knowledgeable" and "knowledgeable." Comparisons revealed highest perceived science knowledge amongst AFNR educators certified in the *CASE Natural Resources and Ecology* and *Agricultural Research and Development* courses. Teachers certified in the *CASE Animal and Plant Biotechnology* course perceived the lowest knowledge of science, just below AFNR educators with no CASE certification.

Table 3

Comparing Perceived Science Knowledge by CASE Certification

CASE Certification	*F*	*M*	*SD*	Minimum	Maximum
No CASE Certification	127	2.77	0.48	1.64	4.00
Introduction to AFNR	40	2.80	0.52	1.64	4.00
Principles of Agricultural Science – Plant	36	2.85	0.47	2.00	3.73
Principles of Agricultural Science – Animal	34	2.82	0.47	2.00	3.73
Agricultural Power and Technology	23	2.83	0.41	2.00	3.55
Natural Resources and Ecology	23	2.93	0.42	2.00	3.64
Animal and Plant Biotechnology	19	2.74	0.51	2.00	3.64
Agricultural Research and Development	18	2.93	0.50	2.00	4.00
Food Science and Safety	17	2.91	0.42	2.00	3.55

Note. Frequencies represent the number of teachers with specified CASE certification. Perceived science knowledge was measured on a four-point scale from 1 *(No Knowledge)* to 4 *(Very Knowledgeable).*

The second objective was to compare intentions to teach science among AFNR educators by CASE certification. For comparisons between CASE and non-CASE courses, CASE certified courses were aligned to AFNR pathways. Findings are displayed in tables represented by these course/pathway alignments.

Within a General Agriculture course, educators certified in *CASE Introduction to AFNR* intended to teach more science (*M* = 45.95, *SD* = 17.98) than their peers (see Table 4). However, educators certified in a CASE area other than *Introduction to AFNR* intended to teach the least amount of science (*M* = 37.16, *SD* = 14.43) among the three groups.

Table 4

Science Teaching Intentions by CASE Certification: Introduction to AFNR

	F	*M*	*SD*	Minimum	Maximum
No CASE Certification	114	43.21	19.52	0.00	100.00
CASE Certified, Non-CASE Course	38	37.16	14.43	10.00	70.00
CASE Certified, CASE Course	37	45.95	17.98	15.00	75.00

Note. Introduction to AFNR was aligned with intentions to teach science in a General Agriculture course.

AFNR educators lacking CASE certification intended to teach the most science within the Plant Systems pathway, reporting nearly 60% of Plant Systems curriculum (*M* = 58.18, *SD* = 19.60*)* would include science content and/or practices (see Table 5). Teachers certified in *CASE Principles of Agricultural Science – Plant* intended to teach the least science (*M* = 54.33, *SD* = 21.20). However, all AFNR educators indicated intentions to teach science in over half of the Plant Systems pathway curriculum.

Table 5

Science Teaching Intentions by CASE Certification: Principles of Agricultural Science – Plant

	F	*M*	*SD*	Minimum	Maximum
No CASE Certification	111	58.18	19.60	15.00	100.00
CASE Certified, Non-CASE Course	33	56.21	21.87	15.00	100.00
CASE Certified, CASE Course	30	54.33	21.20	0.00	90.00

Note. Principles of Agricultural Science – Plant was aligned with intentions to teach science in the Plant Systems pathway.

Similar to AFNR educators in the Plant Science pathway, those teaching within the Animal Systems pathway intended to teach science in over half of their curriculum (see Table 6). Additionally, non-CASE certified AFNR educators intended to teach the most science in the pathway (*M* = 56.89, *SD* = 19.30), while educators certified in *CASE Principles of Agricultural Science – Animal* intended to teach the least (*M* = 53.52, *SD* = 17.80).

Table 6

Science Teaching Intentions by CASE Certification: Principles of Agricultural Science – Animal

	F	*M*	*SD*	Minimum	Maximum
No CASE Certification	113	56.89	19.30	10.00	100.00
CASE Certified, Non-CASE Course	39	53.85	19.55	15.00	90.00
CASE Certified, CASE Course	27	53.52	17.80	20.00	80.00

Note. Principles of Agricultural Science – Animal was aligned with intentions to teach science in the Animal Systems pathway.

Within the Power, Structure, and Technical Systems pathway, AFNR educators had similar intentions to teach science, with educators certified in *CASE Agricultural Power and Technology* (*M* = 30.53, *SD* = 18.02) reporting intentions to teach just 0.20% more science than non-CASE certified educators (*M* = 30.33, *SD* = 18.43). Whereas, lowest science teaching intentions were reported by educators certified in a CASE area other than *Agricultural Power and Technology* (*M* = 25.31, *SD* = 15.75).

Table 7

Science Teaching Intentions by CASE Certification: Agricultural Power and Technology

	F	*M*	*SD*	Minimum	Maximum
No CASE Certification	86	30.33	18.43	0.00	100.00
CASE Certified, Non-CASE Course	36	25.31	15.75	0.00	65.00
CASE Certified, CASE Course	19	30.53	18.02	0.00	65.00

Note. Agricultural Power and Technology was aligned with intentions to teach science in the Power, Structure, and Technical Systems pathway.

Within the Environmental Service Systems pathway, AFNR educators certified in *CASE Natural Resources and Ecology* intended to teach the most science (M = 55.00, SD = 18.95) (see Table 8). However, AFNR educators certified in a CASE area other than *Natural Resources and Ecology* reported the lowest intentions to teach science (M = 49.32, SD = 19.54).

Table 8

Science Teaching Intentions by CASE Certification: Natural Resources and Ecology

	F	*M*	*SD*	Minimum	Maximum
No CASE Certification	66	52.92	19.66	10.00	100.00
CASE Certified, Non-CASE Course	22	49.32	19.54	15.00	90.00
CASE Certified, CASE Course	12	55.00	18.95	25.00	90.00

Note. Natural Resources and Ecology was aligned with intentions to teach science in the Environmental Service Systems pathway.

In addition to the Environmental Service Systems pathway, *CASE Natural Resources and Ecology* was aligned to the Natural Resource Systems pathway (see Table 9). Within this pathway, science teaching intentions among AFNR educators were similar, with non-CASE certified AFNR educators (M = 52.23, SD = 21.33) intending to teach just 0.23% more science than teachers with the *CASE Natural Resources and Ecology* certification (M = 52.00, SD = 21.28).

Table 9

Science Teaching Intentions by CASE Certification: Natural Resources and Ecology

	F	*M*	*SD*	Minimum	Maximum
No CASE Certification	91	52.23	21.33	5.00	100.00
CASE Certified, Non-CASE Course	31	50.97	20.63	15.00	90.00
CASE Certified, CASE Course	15	52.00	21.28	20.00	90.00

Note. Natural Resources and Ecology was aligned with intentions to teach science in the Natural Resource Systems pathway.

Within the Biotechnology Systems pathway, science teaching intentions among non-CASE certified AFNR educators was highest (*M* = 58.15, *SD* = 21.26) (see Table 10). Non-CASE certified educators intended to teach over 10% more science in their curriculum than peers certified in *CASE Animal and Plant Biotechnology* (*M* = 47.00, *SD* = 20.58), who intended to teach the least science.

Table 10

Science Teaching Intentions by CASE Certification: Animal and Plant Biotechnology

	F	*M*	*SD*	Minimum	Maximum
No CASE Certification	54	58.15	21.26	20.00	100.00
CASE Certified, Non-CASE Course	22	51.36	19.47	15.00	80.00
CASE Certified, CASE Course	10	47.00	20.58	20.00	75.00

Note. Animal and Plant Biotechnology was aligned with intentions to teach science in the Biotechnology Systems pathway.

Within the Food Products and Processing pathway, AFNR educators certified in *CASE Food Science and Safety* intended to teach the most science (*M* = 50.56, *SD* = 17.58) (see Table 11). However, educators CASE certified in an area other than *Food Science and Safety* reported the lowest science teaching intentions (*M* = 45.22, *SD* = 17.42).

Table 11

Science Teaching Intentions by CASE Certification: Food Science and Safety

	F	*M*	*SD*	Minimum	Maximum
No CASE Certification	63	49.17	20.09	10.00	100.00
CASE Certified, Non-CASE Course	23	45.22	17.42	15.00	75.00
CASE Certified, CASE Course	9	50.56	17.58	25.00	80.00

Note. Food Science and Safety was aligned with intentions to teach science in the Food Products and Processing pathway.

A comprehensive review of science teaching intentions across AFNR pathways revealed highest science teaching intentions among AFNR educators teaching CASE certified courses in four of the eight pathways (i.e., General Agriculture; Power, Structure, and Technical Systems; Environmental Service Systems; and Food Products and Processing). Alternatively, highest science teaching intentions for the remaining four pathways (i.e., Plant Systems, Animal Systems, Natural Resource Systems, and Biotechnology Systems) were identified among AFNR educators with no CASE certifications. Additionally, across all pathways, non-CASE certified educators never reported lowest science teaching intentions.

Conclusions, Implications, and Recommendations

In conjunction with the research objectives, findings lead to two main conclusions. First, CASE certified AFNR educators generally perceive slightly higher science knowledge than non-CASE certified educators. Second, the science teaching intentions of CASE certified educators were typically lower than their non-CASE certified counterparts. These conclusions are inconsistent with prior research that links higher perceived science knowledge with higher intentions to teach science (Hamilton & Swortzel, 2007; Scales et al., 2009; Wilson et al., 2001).

As a purpose of CASE is to provide AFNR educators with curriculum which illuminates science (CASE, 2017b), findings are counterintuitive and prompt an interesting discussion as to why CASE certified educators generally reported less intention to teach science than their non-CASE certified counterparts. One plausible explanation addresses the ability of CASE certified AFNR educators to perceive, more accurately, all that science is and entails. After completing a substantial professional development focused on inquiry-based education and course content (CASE, 2017b), CASE certified educators may be more cognizant of the various scientific content and skills which inform effective science instruction. With a heightened scope of scientific content and skills, CASE certified educators may have a more accurate determination of their science teaching intentions.

Though there was potential for CASE to influence perceived science knowledge and science teaching intentions, it is important to recognize the current study was not experimental in nature; thus, current data cannot document a causal relationship between CASE certification, perceived science knowledge, and intentions to teach science. The current analysis simply describes the perceptions and intentions of AFNR educators at the time of data collection, potentially documenting perceptions and intentions that were set prior to CASE engagement. Longitudinal research measuring the science teaching intentions of AFNR educators before and after CASE workshops would help unpack these variables. It is recommended future research measure the perceived science knowledge of educators and their intention to teach science pre- and post- CASE trainings to determine more accurately the effect, if any, of CASE professional development on the perceptions of AFNR educators. Additionally, scholarship on the interdisciplinary effects of CASE could be strengthened by an exploration of number of CASE certifications held by an AFNR educator and the length of time he or she has been certified in relation to science perceptions.

An additional limitation of this study is an incomplete evaluation of the beliefs and attitudes of AFNR educators as suggested by the MTC. The current study sought to explore the perceived science knowledge and science teaching intentions of AFNR educators with and without CASE certification, which is directly aligned to the first two steps (i.e., professional development and classroom practices) of teacher change (Guskey, 2002). Future research should measure student learning outcomes derived from changes in perceived science knowledge and science teaching intentions among AFNR educators with and without CASE certification to determine the more holistic effect of CASE certification(s) on the attitudes, beliefs, and actions of AFNR educators regarding interdisciplinary learning opportunities.

While the impact of CASE certification on interdisciplinary teaching and learning requires further research, the current study prompts discussion which may be beneficial to current and pre-service AFNR educators and teacher educators. First, due to limitations of the current study, a definitive recommendation on whether or not AFNR educators should pursue CASE certification cannot be made. However, with the intent of increasing interdisciplinary learning experiences for students, authors recommend educators engage in purposeful reflection on how their curriculum, regardless of source, contributes to an interdisciplinary learning environment for students within specific courses, within the AFNR program, and throughout course offerings within the educational institution. Importantly, teacher education programs should take a leadership role in empowering future educators to be reflective practitioners regarding interdisciplinary teaching and learning.

The impetus for the current study was to provide a valuable first step in exploring the relationship between CASE certification(s), perceived science knowledge, and science teaching intentions. Building on existing CASE research in AFNR Education (Carraway et al., 2015; Lambert et al., 2014; Ulmer et al., 2013), findings describe the intentions of AFNR educators, both CASE certified and non-CASE certified, to teach science across curricular offerings. Additionally, findings provide a foundation for exploring the effect, if any, of CASE certification(s) on the intentions of AFNR educators to teach science. While more work is needed, the knowledge acquired via the current study provides an opportunity to reflect upon the importance of interdisciplinary learning within AFNR Education and evaluate how approaches, like CASE, can serve to achieve interdisciplinary aims.

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