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The Role of Teachers in Facilitating Mathematics Learning Opportunities in Agriculture, Food, and Natural Resources

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Abstract

Strengthening knowledge and skills in mathematics is critically important to preparing the next generation of innovators, problem solvers, and interdisciplinary thinkers. School-based agricultural education offers a valuable context to co-develop mathematics knowledge and skills alongside knowledge and skills in agriculture, food, and natural resources. The current study explored the role of school-based agricultural education teachers in facilitating interdisciplinary agriculture, food, natural resources, and mathematics learning experiences. Findings suggest teachers possessed positive attitudes, supportive subjective norms, high levels of perceived behavioral control, and moderate to high perceptions of mathematics knowledge. Additionally, teachers intended to teach mathematics content in an average of 24.51% of agriculture, food, and natural resources curriculum. However, in modeling the intentions of school-based agricultural education teachers to teach math, the combination of attitude toward the behavior, subjective norms, perceived behavioral control, and mathematics knowledge explained only 9% of the variance. Within the model, perceived behavioral control was a statistically significant, positive predictor of intentions to teach math. Findings are discussed in terms of statistical and practical significance, with specific recommendations for follow-up research exploring a wider breadth of variables potentially influencing intentions to teach math.

Keywords: mathematics; attitude toward the behavior; subjective norms; perceived behavioral control; mathematics knowledge; interdisciplinary teaching

Introduction

As a society, Americans depend on the education system to ensure continued economic, social, and technological progress. In turn, the education system depends on mathematics education to prepare students with the mathematical knowledge and abilities required to innovate, problem solve, and work across disciplines (Augustine, 2005; Common Core State Standards Initiative, 2010; Kettlewell & Henry, 2009; Kuenzi, 2008). To illuminate the importance of math, one can look to agriculture, food, and natural resources (AFNR), as professionals throughout production, processing, marketing, and conservation regularly utilize mathematical thinking to make decisions, solve problems, and innovate (Kropff et al., 1996; Mitchell, 2011). In the current study, the

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inextricable link between AFNR and mathematics is seen as necessitating interdisciplinary learning environments in which students co-develop knowledge and skills in AFNR and math.

The need for interdisciplinary learning environments in AFNR and mathematics is exacerbated by the need to fill an estimated 15,633 open science, technology, engineering, and mathematics (STEM) positions within AFNR by 2020 (Goecker, Smith, Fernandez, Ali, & Theller, 2016). Furthermore, interdisciplinary learning environments in which mathematics is taught in the applied context of AFNR can be an effective method for engaging students in mathematics education (Nolin & Parr, 2013; Stubbs & Myers, 2015; Young, Edwards, & Leising, 2008), a benefit especially salient given consistent reports of American student underperformance in mathematics (Kuenzi, 2008). Taken in combination, offering interdisciplinary learning experiences in AFNR and mathematics can serve to better prepare students for careers in STEM and AFNR, provide a contextualized method for learning math, and offer a scalable solution to American student underperformance in math.

School-based agricultural education (SBAE) offers a venue for interdisciplinary learning experiences in AFNR and math. However, facilitation of such interdisciplinary learning experiences requires teachers willing and able to incorporate mathematics content and practices within AFNR curriculum (McKim, Lambert, Sorensen, & Velez, 2015; McKim, Sorensen, & Velez, 2016). Currently, a dearth of literature has explored the relationship between SBAE teacher variables and the level at which mathematics is incorporated within AFNR curriculum (McKim et al., 2016; McKim & Velez, 2015). The current study illuminates the role of SBAE teachers in incorporating mathematics while also providing empirical evidence for the variables salient to increasing and enhancing interdisciplinary AFNR and mathematics learning within SBAE.

Theoretical Framework

The purpose of the current study was to model the intentions of SBAE teachers to incorporate mathematics within AFNR curriculum. Therefore, a theoretical framework was sought which provided insight into human behavior. The theory of planned behavior (Ajzen, 1985, 2011) was selected due to the status of the theory as a premier framework for explaining human behavior (Armitage & Conner, 2001; Ajzen & Sheikh, 2013; McEachan, Conner, Taylor, & Lawton, 2011; Montano & Kasprzyk, 2006). Within the theory of planned behavior, three variables are identified as positive predictors of behavioral intentions: (a) attitude toward the behavior – "the individual's positive or negative evaluation of performing the behavior" (Ajzen, 1985, p. 12), (b) subjective norms – an individual's "perception of the social pressure put on [him or her] to perform or not perform the behavior in question" (Ajzen, 1985, p. 12), and (c) perceived behavioral control – the "degree of control a person has over internal and external factors that may interfere with the execution of an intended action" (Ajzen, 1985, p. 35). In addition to the identified predictors, mathematics knowledge was added as a potential predictor of intentions to teach mathematics in AFNR curriculum due to consistent literature identifying the importance of teacher knowledge in incorporating external content (Darling-Hammond & Bransford, 2005; Hamilton & Swortzel, 2007; Scales, Terry, & Torres, 2009; Wilson, Kirby, & Flowers, 2001). Figure 1 provides the conceptual model for the current study, which includes the theory of planned behavior with the addition of mathematics knowledge.

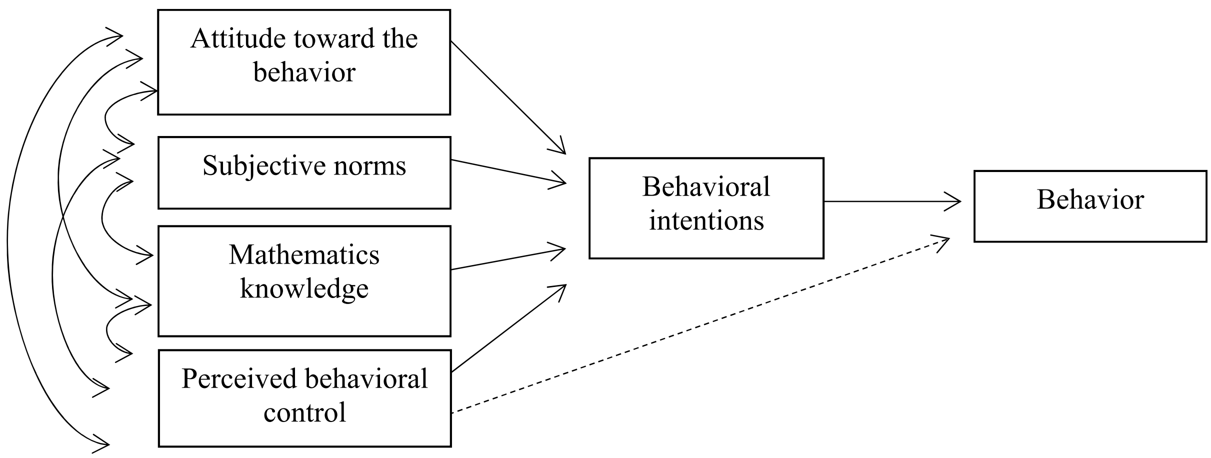

Figure 1. Model of the theory of planned behavior (Ajzen, 1985, 2011) with the addition of mathematics knowledge.

Literature Review

The conceptual framework includes five variables salient in the current analysis: (a) attitude toward the behavior, (b) subjective norms, (c) perceived behavioral control, (d) mathematics knowledge, and (e) behavioral intentions (i.e., intentions to teach mathematics within AFNR curriculum). To provide a comprehensive and focused literature review, research pertaining to each of the identified variables was explored.

Attitude toward the Behavior

Attitude toward the behavior, either positive or negative, plays a critical role in determining behavioral intentions (Ajzen, 2001). Within SBAE, research has identified a majority of teachers hold positive attitudes toward teaching mathematics within AFNR curriculum (Anderson, 2012; McKim et al., 2015; McKim et al., 2016). In addition to positive attitudes, teachers note a need for professional development on specific methods for engaging learners in interdisciplinary AFNR and mathematics experiences, indicating a potential disconnect between attitude toward mathematics incorporation and ability to teach mathematics within AFNR curriculum (Anderson, 2012; McKim et al., 2015). In total, existing research on the attitudes of SBAE teachers toward incorporating mathematics has been limited in two ways: (a) only individual state analyses have been conducted and (b) analyses have not included the relationship between attitude toward the behavior and intentions to teach math.

Subjective Norms

Within the theory of planned behavior, subjective norms serve as the measure of social influence on behavioral intentions (Ajzen, 1985; Montano & Kasprzyk, 2006). Subjective norms are comprised of three normative beliefs: (a) the referent individual from whom the social pressure is perceived, (b) the positive or negative pressure perceived from the referent individual, and (c) the motivation of the actor to comply with the referent individual (Ajzen, 2011). The importance of subjective norms to understanding behavioral intentions (Ajzen, 1985) has not been matched by research efforts in SBAE, in which no known studies have explored the subjective norms of teachers with regard to teaching mathematics in AFNR curriculum.

Perceived Behavioral Control

Perceived behavioral control provides a measure of the volition SBAE teachers perceive toward incorporating mathematics within AFNR curriculum (Ajzen, 1985). Higher perceived behavior control indicates teachers perceived volitional control whereas lower perceived behavioral control indicates external factors (e.g., availability of resources, administrators) have a stronger influence on the incorporation of mathematics in AFNR curriculum. While SBAE research has not evaluated perceived behavior control among teachers, research does exist on mathematics teaching self-efficacy. Self-efficacy, a measure of the confidence an individual perceives in his or her ability to accomplish an identified action (Bandura, 1982), is conceptually similar to perceived behavior control (Ajzen, 1991). Therefore, mathematics teaching self-efficacy research was reviewed to provide insight into perceived behavioral control. Existing research in SBAE has consistently identified teachers possess high mathematics teaching self-efficacy (McKim et al., 2015; McKim & Velez, 2016; Stripling & Roberts, 2012a; Stripling, Roberts, & Stephens, 2014). However, research has not evaluated the relationships between mathematics teaching self-efficacy, perceived behavioral control, and intentions to teach mathematics within AFNR.

Mathematics Knowledge

Mathematics knowledge was added as a potential predictor of intentions to teach mathematics to formulate the conceptual model used in the current research. Existing SBAE research reaffirms the importance of mathematics knowledge in the effective incorporation of mathematics within AFNR curriculum (Hamilton & Swortzel, 2007; Scales et al., 2009; Stripling & Roberts, 2012a, 2012b, Stripling et al., 2014; Wilson et al., 2001). Research exploring SBAE teacher performance on standardized assessments of mathematics illuminates a troubling trend, with the majority of teachers falling below established benchmarks for mathematics proficiency (Miller & Gliem, 1994, 1996; Stripling & Roberts, 2012a, 2012b, Stripling et al., 2014). On average, SBAE teachers score between a 35.6% and 38.5% on mathematics assessments (ibid.). The results of past research present a challenge to improve the mathematics knowledge of SBAE teachers; however, additional research is needed to understand how mathematics knowledge relates to the intentions of teachers to incorporate math. Research exploring the relationship between mathematics knowledge and intentions may clarify how efforts to enhance mathematics knowledge would transfer to the curricular decisions of SBAE teachers.

Intentions to Teach Mathematics in AFNR

At the nexus of teacher characteristics (i.e., attitude toward the behavior, subjective norms, perceive behavioral control, and mathematics knowledge) and interdisciplinary AFNR and mathematics learning opportunities, are the intentions of SBAE teachers to incorporate math. However, only one known study has evaluated the level at which SBAE teachers intend to incorporate math (Wells & Anderson, 2015); finding, overall, 20.74% of SBAE coursework included mathematics content among Kentucky teachers. Broader Career and Technical Education (CTE) research has found including mathematics content in 11% of instructional time yielded statistically significant test scores on two standardized assessments of mathematics without detriment to student learning of CTE content (Stone, Alfeld, & Pearson, 2008). While very little research exists in SBAE evaluating behavioral intentions or level of mathematics incorporation, a broader scope has evaluated the efficacy of mathematics teaching within AFNR curriculum. Studies support AFNR as an effective context to teach math, with research identifying involvement in SBAE relates to increased student learning of mathematics (Nolin & Parr, 2013; Parr, Edwards, & Leising, 2006; Stubbs & Meyers, 2015; Young et al., 2008) without compromising student learning of AFNR content (Parr, Edwards, & Leising, 2008; Young, Edwards, & Leising, 2009).

Review of the literature revealed critical gaps in existing knowledge; specifically, a dearth of research addressing subjective norms, perceived behavioral control, and mathematics teaching intentions of SBAE teachers as well as no empirical models evaluating the intentions of SBAE teachers to incorporate mathematics within AFNR curriculum. The current study sought to address the gaps in the literature by conducting research among a nationally representative sample of SBAE teachers. In total, the knowledge gained includes a comprehensive understanding of mathematics teaching within AFNR as well as identification of variables influential in increasing the interdisciplinary AFNR and mathematics learning opportunities of SBAE students.

Purpose and Research Objectives

The purpose of the current study was to model the intentions of SBAE teachers to incorporate mathematics within AFNR curriculum. The purpose was accomplished by operationalizing the theory of planned behavior, which yielded three research objectives: (a) describe the attitude toward the behavior, subjective norms, perceived behavioral control, and mathematics knowledge of SBAE teachers, (b) describe the mathematics teaching intentions of SBAE teachers, and (c) model the intentions of SBAE teachers to teach mathematics within AFNR curriculum.

Methods

Modeling the intentions to teach mathematics among a nationally representative sample of SBAE teachers required data from a large sample of respondents. Therefore, survey methodology was used as surveys afforded quantitative data collection from a broad scope of respondents in a timely and inexpensive manner (Ary, Jacobs, Razavieh, & Sorensen, 2006).

Instrumentation

Data were collected as part of a larger research project exploring the leadership, mathematics, and science teaching intentions of SBAE teachers. Five constructs from the larger data collection were salient to the current study (i.e., attitude toward the behavior, subjective norms, perceived behavioral control, mathematics knowledge, and intentions to teach mathematics within AFNR curriculum). Items comprising attitude toward the behavior, subjective norms, and perceived behavioral control constructs were measured on six-point scales ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). The attitude toward the behavior construct was comprised of four items (e.g., "As an agriculture teacher, I find it beneficial to integrate mathematics content in the curriculum I teach.") modified from Davis, Ajzen, Saunders, and Williams (2002). The subjective norms construct was measured using three items (e.g., "Stakeholders to my agricultural education program expect me to integrate mathematics content in my agriculture curriculum.") modified from Cheon, Lee, Crooks, and Song (2012). The perceived behavioral control construct was measured using four items (e.g., "I can overcome common obstacles that might prevent the integration of mathematics content in my agriculture curriculum.") also adapted from Davis et al. (2002). Items comprising the researcher-adapted, mathematics knowledge construct were measured on four-point scales ranging from 1 (*no knowledge*) to 4 (*very knowledgeable*). The mathematics knowledge construct included three items (i.e., number and quantity, algebra, and functions) in which respondents self-reported knowledge, a method for measuring content knowledge adapted from Diamond, Maerten-Rivera, Rohrer, and Lee (2013).

Items comprising the intentions to teach mathematics construct were measured in three phases. First, from the list of AFNR career pathways, respondents reported courses previously taught, currently teaching, or courses respondents planned to teach in the future. Courses meeting one of the previous criteria were identified as familiar to the respondent. Second, for familiar courses, respondents indicated the percentage of curriculum in which mathematics content was intended to be taught. Additionally, all SBAE teachers were asked to report the percentage of FFA (i.e., the student leadership organization associated with SBAE) and supervised agricultural experience (SAE) curricula in which mathematics was intended, as all respondents were assumed to be familiar with FFA and SAE. The third step was to average the intended mathematics teaching proportions across familiar curricular areas to get average intentions to teach mathematics in AFNR curriculum. The researcher-developed method for measuring mathematics teaching intentions afforded analysis amongst a variety of curricular experiences as well as average mathematics teaching intentions across SBAE curricula.

Population, Sample, and Data Collection

The population included all SBAE teachers in the United States during the 2015-2016 school year. The National FFA Organization list of SBAE teachers served as the population frame given all SBAE programs must include an FFA Chapter and all FFA programs must be registered with the National FFA Organization. The necessary number of respondents was determined using structural equation modeling research, the statistical method used to address research objective three. Within structural equation modeling, a five to one case to parameter ratio is recommended (Kline, 2005). The model used in the current study included 32 parameters (i.e., 10 factor loadings, four latent variable estimates, four interfactor covariances, and 14 error variances). Therefore, the number of respondents needed to exceed 160 (Kline, 2005; MacCallum, Browne, & Sugawara, 1996). Recent national studies within SBAE suggest a conservative response rate of 20%; therefore, a simple random sample of 950 SBAE teachers was requested and received from the National FFA Organization.

Data were collected in November and December of 2015 using an online questionnaire. Dillman's (2007) tailored design method was used, including a maximum of five points of contact with potential respondents. Due to frame error (i.e., incorrect email addresses, individuals not meeting population parameters), the number of potential respondents was reduced to 828. All 828 potential respondents were invited to take the survey with 212 respondents providing useable questionnaires ($n = 212$; response rate = 25.60%). The intent of the current study is to infer findings to the population of SBAE teachers; therefore, non-response bias was evaluated by comparing on-time ($n = 168$) to late responders ($n = 44$) using an independent samples t-test to evaluate differences in the variables of interest (Lindner, Murphy, & Briers, 2001). Analysis revealed no statistically significant differences between the two groups; therefore, non-response bias was not considered an issue in the current study (Lindner et al., 2001; Miller & Smith, 1983).

Validity and Reliability

Validity and reliability were analyzed in conjunction with a panel of experts which included faculty in SBAE, leadership education, science education, and mathematics education. The complete survey was pilot tested among 31 preservice teachers at Oregon State University and Utah State University. Identifying a threshold for reliability is a highly-negotiated topic (Warmbrod, 2014); however, after review of theory of planned behavior research detailing traditionally lower reliabilities for constructs within the theory (Ajzen, 2011), a conservative estimate (i.e., Cronbach's alpha = .60) was utilized (Creswell, 2008; Robinson, Shaver, & Wrightsman, 1991). Pilot test estimates indicated attitude toward the behavior (Cronbach's alpha = .92), subjective norms (Cronbach's alpha = .89), and mathematics knowledge (Cronbach's alpha = .91) constructs were reliable. However, perceived behavioral control (Cronbach's alpha = .51) was not reliable among the preservice teacher population. After consultation from the panel of experts, variability among the pilot sample (i.e., variability among university expectations, variability among cooperating teacher expectations, variability among timeline for student teaching) was determined to negatively impact the reliability estimates of perceived behavioral control. Therefore, the perceived behavioral control construct was used among the population of interest (i.e., SBAE teachers) with post-hoc reliability estimates (Cronbach's alpha = .69) indicating a reliable construct (Creswell, 2008; Robinson et al., 1991). Furthermore, confirmatory factor analysis, completed during structural equation modeling, provided additional support for using the perceived behavioral control construct.

Data Analysis

Data, collected via the online survey system Qualtrics, were transferred to the Statistical Package for the Social Sciences (SPSS) for analysis. Included in the analysis was an evaluation of the assumptions of structural equation modeling (i.e., multivariate normality, absence of outliers, linearity, absences of multicollinearity, and complete data; Bowen & Guo, 2012). Two assumptions were violated; first, the presence of statistical outliers for intentions to teach math, which was remedied by cutting and replacing outliers with the most extreme response not identified as a statistical outlier (Guttman & Smith, 1969; Moyer & Geissler, 1991); second, the presence of missing data. In total, data were missing from less than 5% of responses; therefore, predictive mean matching imputation was used to address missing data (Blunch, 2013; Byrne, 2010). Importantly, imputed data were only reported in the structural equation modeling; analyses for research objective one and two were completed using only collected data.

Research objectives one and two were analyzed using means and standard deviations for attitude toward the behavior, subjective norms, perceived behavioral control, and mathematics knowledge (i.e., objective one) and intentions to teach mathematics in AFNR (i.e., objective two). Research objective three was analyzed using structural equation modeling, in which the intentions of SBAE teachers to teach mathematics were modeled using attitude toward the behavior, subjective norms, perceived behavioral control, and mathematics knowledge. To complete structural equation modeling, three phases of analysis were conducted.

In phase one (i.e., model identification) of structural equation modeling, the number of distinct elements within the structural model was compared to the number of estimated parameters. In the model, the 160 distinct elements (i.e., $p[p+1]/2$, where p is 15, calculated from the four items measuring attitude toward the behavior plus three items measuring subjective norms plus four items measuring perceived behavioral control plus three items measuring mathematics knowledge plus one item measuring intentions to teach math) exceeded the 32 estimated parameters (i.e., 10 factor loadings, four latent variable estimates, four interfactor covariances, and 14 error variances), a requirement for structural equation modeling. In phase two (i.e., model estimation), the covariance matrixes within the conceptual framework were compared to the covariance matrixes estimated by collected data (Bowen & Guo, 2012). Covariance matrixes comparisons were completed using Generalized Least Squared estimates and chi-squared analysis, with an accepted model producing no evidence of a statistical difference (i.e., p-value > .05) between collected data and the conceptual framework (Bowen & Guo, 2012; Byrne, 2010; Ullman, 2013). In phase three (i.e., model evaluation), the fit between conceptual model and collected data was analyzed using the confirmatory fit indexes (CFI; Bentler & Yuan, 1999) and root mean square error of approximation (RMSEA; Ullman, 2013) with accepted fit indicated by values exceeding .90 for CFI and values below .08 for RMSEA (Blunch, 2013; Hooper, Coughlan, & Mullen, 2008; Hu & Bentler, 1999). Readers are encouraged to review detailed accounts of structural equation modeling (e.g., Bowen & Guo, 2012; Ullman, 2013) for more complete descriptions of the structural equation modeling process.

Findings

In order to provide context, a brief description of responding SBAE teacher demographics is provided. Respondents included slightly more male (*f* = 106; 52.70%) than female (*f* = 95; 47.30%) teachers. On average, respondents had 12.92 years of teaching experience, with teaching experience ranging from first year teachers to a respondent with 42 years of teaching experience. The majority of respondents (*f* = 172; 86.00%) completed traditional SBAE teacher training (i.e., undergraduate or graduate degree in SBAE). Additionally, the majority of respondents taught in rural communities (*f* = 148; 73.60%) with remaining teachers working in suburban (*f* = 38; 18.90%) and urban (*f* = 15; 7.50%) communities.

Research objective one sought to describe the attitude toward the behavior, subjective norms, perceived behavioral control, and mathematics knowledge among responding SBAE teachers (see Table 1). On average, respondents "agreed" with items indicating favorable attitudes (*M* = 5.15; *SD* = 0.75), positive subjective norms (*M* = 5.26; *SD* = 0.72), and perceptions of behavioral control (*M* = 4.75; *SD* = 0.77). On average, respondents reported themselves between "somewhat knowledgeable" and "knowledgeable" on items measuring mathematics knowledge (*M* = 2.89; *SD* = 0.66).

Table 1

Attitude toward the Behavior, Subjective Norms, Perceived Behavioral Control, and Mathematics Knowledge of Respondents

	Minimum	Maximum	*M*	*SD*
Attitude toward the Behavior	1.00	6.00	5.15	0.75
Subjective Norms	1.00	6.00	5.26	0.72
Perceived behavioral control	1.00	6.00	4.75	0.77
Mathematics Knowledge	1.00	4.00	2.89	0.66

Note. Items measuring attitude toward the behavior, subjective norms, and perceived behavioral control were scaled from 1 (*strongly disagree*) to 6 (*strongly agree*). Items measuring mathematics knowledge were scaled from 1 (*not knowledgeable*) to 4 (*very knowledgeable*).

Research objective two sought to describe the mathematics teaching intentions of responding SBAE teachers (see Table 2). In total, respondents indicated intentions to teach mathematics in an average of 24.51% (*SD* = 10.79) of AFNR curriculum. Mathematics teaching intentions were highest in Agribusiness Systems (*M* = 43.96; *SD* = 23.21); Power, Structure, and Technology (*M* = 38.28; *SD* = 18.21); and SAE (*M* = 29.97; *SD* = 19.25) and lowest in FFA (*M* = 14.34; *SD* = 15.77); Natural Resource Systems (*M* = 19.75; *SD* = 12.69); and General Agriculture (*M* = 20.99; *SD* = 14.31).

Table 2

Intentions to Teach Mathematics in AFNR Curriculum

	f	Minimum	Maximum	*M*	*SD*
Agribusiness Systems	139	0.00	100.00	43.96	23.21
Power, Structure, and Technology Systems	144	0.00	100.00	38.28	18.21
SAE: Supervised Agricultural Experience	195	0.00	100.00	29.97	19.25
Biotechnology Systems	84	0.00	100.00	26.01	15.46
Food Products and Processing Systems	97	5.00	50.00	23.85	11.94
Animal Systems	177	5.00	100.00	22.43	12.62
Plant Systems	171	0.00	100.00	22.04	14.20
Environmental Service Systems	97	0.00	100.00	21.01	13.29
General Agriculture	190	0.00	100.00	20.99	14.31
Natural Resource Systems	134	0.00	100.00	19.75	12.69
FFA	168	0.00	100.00	14.34	15.77
Total	212	2.50	57.50	24.51	10.79

Note. Respondents were asked to report the percentage of mathematics content intended for courses previously taught, currently teaching, and/or courses respondents planned to teach.

Research objective three sought to model the intentions of SBAE teachers to teach mathematics within AFNR curriculum (see Table 3). Confirmatory factor analysis, a component of structural equation modeling, yielded statistically significant individual factor loadings, providing evidence of sound construct measurement. Model estimation provided evidence collected data were statistically similar to the conceptual model ($\chi^2 = 91.26$, df = 72, *p*-value = .062), a requirement for structural equation modeling. Furthermore, model evaluation found collected data were a good fit for the conceptual framework (CFI = .94; RMSEA = 0.04; Blunch, 2013, Hooper et al., 2008; Hu & Bentler, 1999).

Table 3

Model of Mathematics Teaching Intentions in AFNR

	Dependent variable: Mathematics Teaching Intentions					
	Zero-order correlation (r)	p-value	B	SEB	γ	p-value
Attitude toward the Behavior	.25	<.001	2.44	1.25	.17	.051
Subjective Norms	.07	.288	0.97	1.67	.05	.562
Perceived Behavioral Control	.20	.004	1.59	0.78	.16	.040
Mathematics Knowledge	.18	.010	0.00	1.61	.00	.998

Note. Based on Generalized Least Squares Estimates; χ^2 = 91.26 (df = 72) *p*-value = .062; R^2 = .09, CFI = .94, RMSEA = .04.

In combination, the four exogenous variables within the structural model accounted for 9% of the variance in the intentions of SBAE teachers to teach mathematics (R^2 = .09). Only one independent variable, perceived behavioral control, was a statistically significant, positive predictor of intentions to teach mathematics (γ = .16, *p*-value = .040). Independently, neither attitude toward the behavior (γ = .17, *p*-value = .051), subjective norms (γ = .05, *p*-value = .562), nor mathematics knowledge (γ = .00, *p*-value = .998) significantly contributed to the explanatory model.

Conclusions, Implications, and Recommendations

Providing interdisciplinary learning opportunities in AFNR and mathematics is critically important to deepening student understanding of AFNR and mathematics; preparing students for careers in AFNR and STEM; and empowering the next generation of innovators, problem solvers, and interdisciplinary thinkers (Goecker et al., 2016; Kropff et al., 1996; Kuenzi, 2008; Mitchell, 2011; Nolin & Parr, 2013; Stubbs & Myers, 2015; Young et al., 2008). In the current study, the intentions of SBAE teachers to incorporate mathematics within AFNR curriculum were explored to illuminate the role SBAE teachers play in offering interdisciplinary AFNR and mathematics learning experiences.

Responding SBAE teachers purported positive attitudes toward teaching mathematics within AFNR, a finding supported by existing literature (Anderson, 2012; McKim et al., 2015; McKim et al., 2016). Additionally, the relatively strong perceived behavioral control of respondents found within the current study supports existing research finding teachers perceive high levels of mathematics teaching self-efficacy (McKim et al., 2016; McKim & Velez, 2015; Stripling & Roberts, 2012a; Stripling et al., 2014). With regard to mathematics knowledge, respondents rated themselves between "somewhat knowledgeable" and "knowledgeable." While the perceptions of mathematics knowledge found within the current study hint at an awareness of reduced mathematics knowledge among SBAE teachers, past research confirms limited mathematics knowledge among SBAE teachers (Miller & Gliem, 1994, 1996; Stripling & Roberts, 2012a, 2012b, Stripling et al., 2014). In addition to attitude toward the behavior, mathematics knowledge, and perceived behavioral control, research identified respondents perceived supportive subjective norms regarding teaching mathematics in AFNR curriculum, a variable previously unexplored in SBAE research. The positive attitudes, supportive subjective norms, and behavioral control perceived among respondents was promising given the positive relationships to behavioral intentions posited within the theory of planned behavior (Ajzen, 1985; Montano & Kasprzyk, 2006).

In addition to the four explanatory variables within the model, findings included an analysis of the outcome variable, intentions to teach mathematics in AFNR curriculum. In total, respondents indicated intentions to teach mathematics in just under one-quarter of AFNR curriculum, slightly more (i.e., 24.51% to 20.74%) than found in previous research among Kentucky teachers (Wells & Anderson, 2015). Deeper analysis of the findings illuminate how teachers are intending mathematics be taught within SBAE. Not surprisingly, the three curricular experiences in which teachers intended the most mathematics content include a stronger emphasis on quantitative market data (i.e., Agribusiness Systems), formulas from geometry and physics (i.e., Power, Structure, and Technology), and record keeping (i.e., SAE). Additional research is needed into *how* mathematics is intentioned across *all* curricular experiences to identify opportunities to strengthen additional mathematical practices in AFNR curriculum; example practices include reasoning abstractly and quantitatively, constructing viable arguments and critiquing the reasoning of others, modeling with mathematics, and looking for and making use of structure (Common Core State Standards Initiative, 2010). Furthermore, research on how mathematics is intentioned within AFNR curriculum would reveal how teachers conceptualize interdisciplinary mathematics and AFNR learning opportunities in SBAE.

In the final research objective, intentions to teach mathematics within AFNR curricula were modeled using attitude toward the behavior, subjective norms, perceived behavioral control, and mathematics knowledge. Findings indicated a statistically significant and good fitting model; however, only 9% of the variance in intentions to teach mathematics were explained using the combination of independent variables. Within theory of planned behavior research, models regularly explain upwards of 34% to 45% of the variance in behavioral intentions (Armitage & Conner, 2001; McEachan et al., 2011). The 91% of unexplained variance within the current model implies additional variables have a significant impact on the intentions of SBAE teachers to teach mathematics within AFNR curriculum. Research on the mathematics teaching intentions of SBAE teachers is recommended, specifically exploring additional variables (e.g., funding, access to curriculum, perceived student preparedness, community type, professional development training, collaborations with mathematics educators) in relation to the mathematics teaching intentions of SBAE teachers.

The need for expanded research on the intentions of SBAE teachers to teach mathematics was clearly illuminated by the findings within the structural equation model. Only one variable (i.e., perceived behavioral control) was a statistically significant predictor, with data indicating a one-unit increase in perceived behavioral control was related to just 1.59% more mathematics content intended for AFNR curriculum. While statistically significant, the relationship between perceived behavioral control and intentions to teach mathematics was not practically significant. Additionally, statistically insignificant predictors (i.e., attitude toward the behavior, subjective norms, mathematics knowledge) failed to illuminate a practically significant variable on which to build recommendations for increasing the intentions of SBAE teachers to incorporate mathematics within AFNR curriculum; thus, strengthening the need for additional research.

Interdisciplinary learning experiences in AFNR and mathematics are essential, and SBAE teachers play a critical role in facilitating such experiences. The current study provided valuable information regarding the attitudes, subjective norms, perceived behavioral control, mathematics knowledge, and intentions to teach mathematics among SBAE teachers. However, an attempt to model the intentions of SBAE teachers using the theory of planned behavior failed to identify practically significant variables related to increased mathematics teaching intentions. Importantly, however, analysis revealed a need for additional scholarship exploring a broader range of potential variables which may influence the role of SBAE teachers in facilitating interdisciplinary AFNR and mathematics learning experiences. The opportunity to enhance student access to interdisciplinary AFNR and mathematics learning opportunities compels additional work to understand the intentions of SBAE teachers to incorporate mathematics within AFNR curriculum.

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