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Exploring the Role of Agriculture Teachers in Core Academic Integration

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Abstract

Core academic skills are essential for success in our society. However, an abundance of research has identified a large proportion of secondary school students are underperforming in core academic areas such as literacy and math. Researchers have suggested integrating core academic content throughout all secondary coursework as a potential solution to students' underperformance in core academics. This study focused on core academic integration in secondary agricultural education classrooms and explored a conceptual model for teachers' core academic integration competence in the areas of math and literacy. Results indicated pedagogical competence and technical knowledge were significant predictors of teachers' reading integration competence. Pedagogical competence was also a significant predictor of respondents' writing and math integration competences. These findings highlight the importance of agriculture teachers' ability to engage students through effective pedagogical strategies as a potential precursor to competence integrating reading, writing, and math. Implications and strategies for utilizing the proposed model and the findings from this research are discussed.

Keywords: Academic integration; math integration; literacy integration; competence

Introduction

In order to meet the demands of an ever-changing society, students must be empowered with knowledge in a broad range of disciplines including science, engineering, mathematics, and literacy. With numerous studies reporting American students underperforming in these critical disciplines (ACT 2005; OECD, 2012), the search is on for solutions. The contextualized learning potential within agricultural education, in which core academic "principles become more real and understandable for students" (Phipps, Osborne, Dyer, & Ball, 2008, p. 4), provides a possible springboard for student understanding of core academics. This solution requires agriculture teachers competent in the integration of core academics. This study sought to test a model of teachers' perceived competence integrating two core academic subjects, literacy and math. In the following sections, we explore the integration of these core academic topics and their relevance in agricultural education.

Content Area Literacy

An individual's ability to read and write is an essential component to their potential for success in academics and life (Biancarosa & Snow, 2006; Graham & Perin, 2007). One of the roles of education is to develop skills necessary for students to be competitive in a global marketplace;

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an important feature of this skillset is literacy (Biancarosa & Snow, 2006). In fact, research conducted by the National Association of Colleges and Employers indicates literacy skills are one of the most sought after attributes among potential employees (NACE, 2014). Speaking specifically about the literacy skill of writing, Graham and Perin (2007) stated it "is not just an option for young people – it is a necessity" (p. 3).

Research into the development of literacy skills among high school students has been spurred by the overwhelming evidence indicating secondary students are underperforming in literacy. Specifically, studies report 32% of high school graduates are unprepared for college level literacy coursework (ACT, 2005), 40% of high school graduates do not have the literacy skills employers are looking for (Achieve, 2005), and a total of eight million students in grades eight through 12 struggle in reading (Biancarosa & Snow, 2006; Graham & Perin, 2007). The outcomes of this underperformance are numerous, including a higher susceptibility for dropout (Graham & Perin, 2007; Snow & Biancarosa, 2003). In a search for potential solutions to this literacy epidemic, researchers have proposed content area literacy as a method for increasing secondary students' literacy (Biancarosa & Snow, 2006; Graham & Perin, 2007).

Content area literacy refers to "the ability to use reading and writing to learn subject matter in a given discipline" (Vacca & Vacca, 2002, p. 5). The concept of infusing literacy into courses offered outside the English department is widely supported throughout education (Hall, 2005; Shanahan & Shanahan, 2012). Research supports the notion that content area literacy improves students' academic achievements both in literacy and in the subject area in which literacy is being integrated (Bangert-Drowns, Hurley, & Wilkinson, 2004; McConachie & Petrosky, 2010). Specific areas of improvement among students include increased student engagement, increased persistence, and increased achievement on standardized testing (McConachie & Petrosky, 2010). At the crux of content area literacy is a teacher's decision to incorporate reading and writing into their practice (Biancarosa & Snow, 2006). Therefore, it is important to explore the teacher's role as a potential gatekeeper to content area literacy.

Previous research suggests teachers generally have a positive perception toward teaching literacy; however, this positive perception often fails to translate into changes in classroom instruction (Hall, 2005). Research has identified a number of potential reasons behind this disconnect. McConachie and Petrosky (2010) cite content area teachers' obligation to teach their own curricula as a potential barrier between perception and action. Park and Osborne (2005) identified perceived inadequacy to teach literacy, infringement on time spent teaching their content, and a lack of identified importance regarding teaching literacy as potential barriers to literacy integration. Furthermore, content area teachers may have never been trained in the specifics of integrating literacy in their discipline (Hall, 2005). For both preservice and inservice teachers, professional development regarding literacy integration is traditionally presented "as a decontextualized process that contains a set of skills/strategies that can be generically applied across the content areas" (Hall, 2005, p. 404). However, research suggests effective professional development entails empowering content area teachers to integrate literacy strategies tailored to their unique content area (Moje, 2007).

Content area literacy exemplifies the notion that literacy is truly an interdisciplinary subject that should be included in all secondary classrooms (D'Arcangelo, 2002). However, the majority of research in content area literacy has focused on literacy integration within math, history, science, and English language arts classrooms (Moje 2007; Shanahan & Shanahan, 2012). With the onus of literacy development being on all teachers, the breadth of research on literacy integration must grow (Park & Osborne, 2005, 2006a). Agricultural education is one content area with very little research exploring literacy integration.

Within agricultural education, research has identified agriculture teachers often neglect literacy integration in favor of the hands-on learning opportunities prevalent in agricultural education (Park & Osborne, 2006b). However, agriculture teachers still perceive teaching literacy concepts as a positive endeavor with the potential to benefit their students (Park & Osborne, 2006b). The research in agricultural education exemplifies the disconnect identified previously; teachers perceive literacy integration as positive yet fail to continually reinforce literacy skills and concepts within their classrooms. A potential factor between perceived importance and literacy implementation is teachers' competence regarding literacy integration. This exploratory study sought to analyze Oregon agriculture teachers' perceived competence regarding content area literacy integration.

Math Integration

Like literacy, individuals' competence in mathematics is directly related to their potential for academic and professional success (Mullis, Martin, Foy, & Arora, 2012). Unfortunately, as was the case with literacy, secondary students in the Unites States are underperforming in mathematics (OECD, 2012; Stone, 2011). The level of underperformance is alarming, as Schmidt stated, "roughly three quarters of American high school students graduate with a relatively poor grasp of mathematics" (2011, p. 2). Again, content area integration of core academics has been lauded as a method for improving student performance in mathematics (NRC, 2011; Stone 2011).

Career and technical education (CTE) has been distinguished as an applicable context for integrating mathematics (Pearson et al., 2010). The nature of CTE provides a valuable model for math development; as Stone stated, "rigor resides in combining CTE and academic skills as applied to real-world problems" (2011, p. 10). The applied nature of CTE differs from the isolated nature of math education traditionally found in math classrooms. An integrated approach provides students with a relevant context, making math concepts less abstract and more tangible. In 2008, a research team tested the efficacy of math integration through a project called Math-in-CTE (Stone, Alfeld, & Pearson, 2008). Using experimental research methods, researchers tested math-enhanced CTE courses. The results showed students taught in the math integrated courses scored better on two standardized math assessments without any detrimental effect to their knowledge gain of CTE content (Stone et al., 2008).

Unlike content area literacy, a number of research studies in agricultural education have addressed math integration. Some of the earliest work (Loadman, 1986) established the foundational premise of agricultural education as an applicable context for integrating math. More recent research (Parr, Edwards, & Leising, 2006; Young, Edwards, & Leising, 2009) has explored the relationship between math integrated agricultural education classes and student performance in mathematics. These studies found students taught in math integrated agricultural education classrooms performed better in mathematics. Research in agricultural education, in combination with the Math-in-CTE study, illustrates the potential positive effects of a math integrated classroom.

While some research in agricultural education has highlighted the potential benefits of math integration, other studies have called into question agriculture teachers' capacity for such integration. Miller and Gliem (1994, 1996) identified agriculture teachers' knowledge of mathematics, or lack thereof, as a potential limiting factor to math integration in agricultural education. Jansen and Thompson (2008) supported this finding, as they suggested a teacher's content knowledge strongly influenced their self-efficacy toward mathematics integration. More recent research suggests preservice agricultural education teachers lack the level of mathematics ability necessary for integrating mathematics (Stripling & Roberts, 2012a, 2012b; Stripling, Roberts, & Stephens, 2014). In an attempt to improve preservice teachers' capacity for math integration, Stripling and Roberts (2013a, 2013b) tested a math integrated agricultural education teaching methods course and found a significant increase in preservice teachers' personal mathematics ability. However, this research also identified insignificant increases in math teaching self-efficacy (Stripling & Roberts, 2013a) and insignificant decreases in math teaching self-efficacy (Stripling & Roberts, 2013b) after the math integrated preservice experience.

Research in agricultural education has established secondary agriculture classrooms as an applicable context for the integration of math content as well as the positive benefits of integrating math. However, research has also established the teacher as a critical factor in math integration. Based on the imperative role of the teacher in math integration, this study explored practicing agriculture teachers' perceived competence toward math integration. Additionally, we developed and tested a model of unexplored predictive variables for math integration competence. By analyzing this model, our study provides valuable insight into factors potentially influencing agriculture teachers' ability to integrate math.

Theoretical Foundation and Conceptual Framework

It is critical to consider both perceived competence and task value when examining the motivational components of core academic integration. In other words, teachers need to feel *competent* integrating core academics and also *value* integrating core academics in their curricula. Our theoretical foundation, based on the expectancy-value motivational theory (EVT) espoused by Wigfield and Eccles (2002), is grounded in the integral importance of both expectancies for success (i.e. competence) and value. As we consider integration, the EVT is foundational as it, "... suggests that teachers' willingness to change their teaching practices is related to teachers' expectations that they will be able to implement new practices effectively [competence], and that they will be rewarded for making the changes in their classroom practices, and that they will value the rewards they receive" (Tollefson, 2000, p. 74).

The EVT is based on two components, expectancies for success—an individual's beliefs about how well they will do on upcoming tasks, and task value—the value placed in a given task (Wigfield & Eccles, 2000, 2002). Wigfield and Eccles (2002) postulate the presence of both is necessary for an individual to undertake a task and they are key determinants of choice. Wigfield and Eccles (2002) stated, "Expectancies and values are assumed to directly influence performance, persistence, and task choice." (p. 118). As we consider the topic of academic integration, it is vital to consider both expectancies for success and the value teachers place on integration.

The concept of expectancy for success has been operationally defined as both competence and self-efficacy (Pajaras, 1996; Wigfield & Eccles, 2000). In highlighting the similarities, Pajares (1997) stated, "Self-efficacy and other expectancy beliefs are similar in that they are each beliefs about one's perceived capability…" (p. 19). While theoretical purists might argue the unique and subtle differences between expectancy for success, competence, and self-efficacy, we have chosen to focus on the overwhelming similarities as we situate our research. Prior research highlights the importance of competence and self-efficacy as they have been linked with teacher persistence, motivation, and resilience (Labone, 2004; Wheatley, 2005).

Merely feeling competent or efficacious is not enough to spur a teacher to action; rather, they must have a reason or incentive to act, defined as their task value (Wentzel & Wigfield, 1998). From a theory standpoint, task value can be further divided into attainment value—the importance of doing well, intrinsic value—personal enjoyment from doing a task, utility value—how it fits into future plans, and cost value—what one may need to give up to complete the task (Eccles, 2005; Wigfield & Eccles, 2002). For the purpose of this study, we assessed value but did not distinguish the four sub-components. However, it is important to recognize the existence of these components as they may play a role in the value judgments of teachers. For instance, cost value directly relates to academic integration in that teachers may weigh and assess the value of core academic integration in light of the potential loss of instructional time specific to agriculture. Task value has been linked to increased persistence, greater student outcomes, and higher overall satisfaction with teaching (Ashton & Webb, 1986; Wigfield & Eccles, 2002).

Our intent was to extend the expectancy value motivational theory to a conceptual model for core academic integration in agricultural education (see Figure 1). In addition to task value, research highlights a number of potential factors influencing academic integration; in this study we will focus on two of these factors, pedagogical competence and technical knowledge. We operationalized technical knowledge as a teacher's understanding of the content in which core academics will be integrated. Research supports the notion that teachers must first be knowledgeable in their content before being able to integrate core academics (NRC, 2011). In agricultural education, this requires teachers knowledgeable in the variety of course offerings they teach. In addition to technical knowledge, research highlights pedagogical competence as a requirement for core academic integration. Teachers use their "pedagogical knowledge to convey that content to the students in an intelligible fashion and in such a way that it creates meaningful learning experiences for students" (Schmidt, 2011, p. 15). Teachers lacking competence in pedagogy will struggle to integrate core academics due to their inability to engage students.

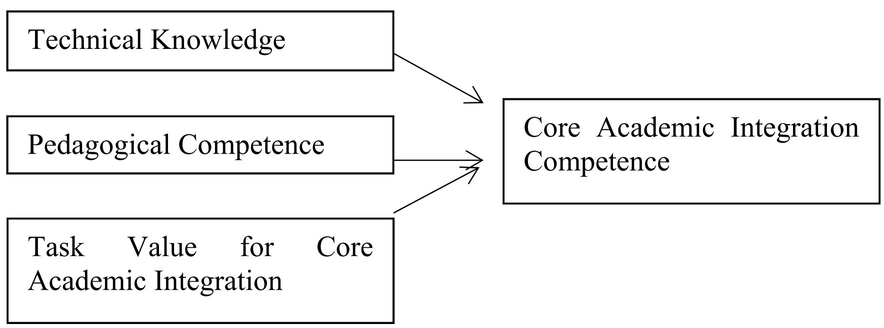

Figure 1. Conceptual model of core academic integration competence.

Purpose and Objectives

The purpose of this research was to gain a deeper understanding of the teacher's role in core academic integration by testing a conceptual model for reading, writing, and math integration in agricultural education. In accomplishing this purpose, our research addressed National Research Agenda priority number five, efficient and effective agricultural education programs (Roberts, Harder, & Brashears, 2016). This priority area identifies effective programs as those meeting the academic needs of learners. Given the overwhelming need for literacy and math skills for success in academics and life, research addressing agriculture teachers' competence in integrating core academic concepts is relevant. The following research objectives were established to guide the development and execution of this study:

1) Describe the sample of agriculture teachers.
2) Describe agriculture teachers' task value and perceived competence in reading, writing, and math integration.
3) Determine the relationship between agriculture teachers' reading integration competence and their task value toward reading integration, pedagogical competence, and technical knowledge.

4) Determine the relationship between agriculture teachers' writing integration competence and their task value toward writing integration, pedagogical competence, and technical knowledge.
5) Determine the relationship between agriculture teachers' math integration competence and their task value toward math integration, pedagogical competence, and technical knowledge.

Methods

The population for this study included all school-based agriculture teachers in Oregon (*N* = 111) during the 2013-2014 school year. Contact information was obtained from the *Oregon Agriculture Teacher Directory* and was vetted for accuracy by experts in the field of agricultural education in Oregon. The data collected through this study were part of a larger research project.

We attempted a census of all secondary school agriculture teachers in the state. Data were collected in December of 2013 using the online survey program Qualtrics. We utilized five points of contact to elicit and gather responses from participants (Dillman, 2007). The first four points of contact were made through e-mail. The final point of contact was a phone-call to individuals who had not yet responded. A total of 80 useable responses were completed, yielding a 72% response rate. We checked for non-response error by comparing participants who responded after the final two points of contact (late respondents; $n = 31$) to those who responded prior to the final two points of contact (on-time respondents; $n = 49$) (Lindner, Murphy, & Briers, 2001; Miller & Smith, 1983). We found late respondents to be statistically similar to on-time respondents for the eight variables of interest: agriculture teachers' task value and perceived competence toward reading integration, writing integration, and math integration as well as pedagogical and technical competence. Therefore, we did not consider non-response error to be significant (Lindner et al., 2001; Miller & Smith, 1983). In this study, we treated non-responders as a sample of the total population of agriculture teachers in Oregon and we generalized our findings to this population.

The survey instrument contained demographic information and eight different constructs measuring agriculture teachers' task value and perceived competence toward the integration of reading, writing, and math as well as pedagogical competence and technical knowledge. The task value and competence constructs of reading, writing, and math integration were developed as part of a larger study. Individual items were developed using the Common Core standards in reading and writing for science and technical subjects (CCSS Initiative, 2010a) as well as the eight Common Core standards for mathematical practice (CCSS Initiative, 2010b). Both the reading and writing components of the Common Core included ten standards grouped into four larger themes. We analyzed these larger themes, and one item was developed based on the combination of standards within the different theme. For example, one theme within the writing Common Core is *Research to Build and Present Knowledge*, and the item we created from this theme stated: "Develop students' ability to present knowledge through research projects in agricultural science and technology (AST)." Similarly, the eight standards for mathematical practice were combined into three themes by the researchers. From these three themes, individual instrument items were developed to measure task value and competence for math integration. We then developed an individual item that reflected the purpose of the standards in each of the three themes. For example, the following item was developed from the problem solving theme: "Develop students' ability to correctly solve AST related math problems." A total of 11 individual items were utilized to measure reading (four items), writing (four items), and math (three items) integration for both task value and competence. Teachers' task value and perceived competence for each of the 11 items were measured using a five-point Likert-type scale ranging from 1 "Very Low" to 5 "Very High," with higher scores indicating higher task value or perceived competence.

Items used to measure agriculture teachers' pedagogical competence and technical knowledge were derived from previous literature (Boone & Boone, 2007; Duncan, Ricketts, Peake, & Uesseler, 2006; Garton & Chung, 1996; Layfield & Dobbins, 2002; Mundt & Connors, 1999; Myers, Dyer, & Washburn, 2005; Sorensen, Tarpley, & Warnick, 2010). Pedagogical competence and technical knowledge were measured on a five-point scale, ranging from 1 "Very Low" to 5 "Very High," with higher scores indicating higher perceived pedagogical competence or technical knowledge. The pedagogical competence construct consisted of eleven items pertaining to classroom teaching methods and pedagogy. Sample items included teachers' ability "teaching with experiments," "evaluating student performance," and "managing student behavior." The technical knowledge construct consisted of twelve items relating to agriculture teachers' ability to teach different technical areas of agriculture. Sample items included agriculture teachers' perceived ability "teaching food science" and "teaching about public issues regarding agriculture."

A panel of experts in the field of agricultural education examined the instrument and established content and face validity for the eight different constructs used in this study. The reliabilities for each construct were analyzed using Cronbach's alpha and are reported in Table 1.

Table 1

Reliability Coefficients of Constructs for the Current Study

Construct	α
Task Value	
Reading Integration	.91
Writing Integration	.95
Math Integration	.94
Competence	
Reading Integration	.85
Writing Integration	.85
Math Integration	.94
Pedagogy	.82
Technical Knowledge	.77

We analyzed the data using the Statistical Package for the Social Sciences (SPSS) version 20. The first objective was demographic in nature; therefore, we reported the results as frequencies and percentages. Research objective two was descriptive in nature; consequently, we reported the results using means and standard deviations. To accomplish the final three research objectives, three different multiple linear regressions were performed in order to determine predictors of reading, writing, and math integration competence, respectively. Reading, writing, and math integration task value, pedagogical competence, and technical knowledge were simultaneously entered into the regression models as independent variables. Standardized betas for each entered variable and an overall R^2 for the model were calculated and reported.

Findings

Demographic information was collected from respondents (n = 80) to accomplish research objective one. The average age of responding teachers was 38 (SD = 11.22) years old, with a range of ages from 23 to 65. Respondents ranged from first year teachers to teachers with 33 years of experience, with an average of 11 years of teaching experience (*SD* = 9.07). The majority of respondents were male (*f* = 44; 55.70%). The most common courses respondents indicated teaching were Introduction to Agriculture, Plant Science, Animal Science, and Agricultural Mechanics.

The second objective of this study was to describe agriculture teachers' task value and perceived competence in reading, writing, and math integration (see Table 2). Overall, respondents' task value toward reading, writing, and math integration exceeded their perceived competence. In comparing the task value ascribed to the three core integration constructs, math integration was valued highest (*M* = 3.87; *SD* = 0.75). In analyzing perceived competence, responding teachers perceived the highest level of competence in their reading integration (*M* = 3.34; *SD* = 0.55). The differences between task value and perceived competence were equal for writing and math integration (Δ = 0.62), and exceeded what was observed within reading integration (Δ = 0.40).

Table 2

Agriculture Teachers' Task Value and Perceived Competence in Content Area Literacy

	Task Value		Perceived Competence	
Variable	*M*	*SD*	*M*	*SD*
Reading Integration	3.74	0.66	3.34	0.55
Writing Integration	3.78	0.55	3.16	0.55
Math Integration	3.87	0.75	3.25	0.79

Note. Task value and perceived competence items scaled from 1 "Very Low" to 5 "Very High."

The third research objective was to determine the relationship between agriculture teachers' reading integration competence and their task value toward reading integration, pedagogical competence, and technical knowledge (see Table 3). Using our conceptual model for core academic integration, we ran a multiple linear regression with reading integration competence as the dependent variable and reading integration value, pedagogical competence, and technical knowledge as independent variables. The three independent variables, in combination, comprised a significant model (*F* = 15.83; p-value < .001) and predicted 39% (R^2 = .39) of the variance in reading integration competence.

Two of the independent variables were significant in their prediction of reading integration competence; pedagogical competence and technical knowledge. Using the standardized coefficients (β) to determine the strength of the relationship between independent and dependent variables, we found pedagogical competence to be the strongest predictor of reading integration competence (β = .37; *p*-value = .004). Additionally, technical knowledge was identified as a significant predictor of reading integration competence (β = .28; *p*-value = .030). The task value teachers attributed to reading integration was the only insignificant predictor in the model (β = .08; *p*-value = .377).

Table 3

Predictive Model of Reading Integration Competence

	Dependent Variable: Reading Integration Competence					
Variable	Zero-order correlation (*r*)	*p*-value	*B*	*SEB*	*β*	*p*-value
Reading Integration Value	.23	.039	.07	.08	.08	.377
Pedagogical Competence	.58	<.001	.46	.15	.37	.004
Technical Knowledge	.56	<.001	.32	.14	.28	.030

Note. $R = .63$, $R^2 = .39$, $F = 15.83$, p-value < .001. Task value and perceived competence items scaled from 1 "Very Low" to 5 "Very High."

The fourth research objective was to determine the relationship between agriculture teachers' writing integration competence and their task value toward writing integration, pedagogical competence, and technical knowledge (see Table 4). Our conceptual model for core academic integration was used to design a multiple linear regression model predicting writing integration competence using writing integration value, pedagogical competence, and technical knowledge as predictor variables. The model was significant in predicting writing integration competence ($F = 12.79$; p-value < .001) and predicted 34% ($R^2 = .34$) of the variance in teachers' perceived competence toward writing. One of the independent variables, pedagogical competence, was significant in predicting writing integration competence ($\beta = .47$; p-value = .001). The two remaining independent variables, writing integration value ($\beta = .07$; p-value = .488) and technical knowledge ($\beta = .12$; p-value = .356), were not statistically significant in the prediction of writing integration competence.

Table 4

Predictive Model of Writing Integration Competence

	Dependent Variable: Writing Integration Competence					
Variable	Zero-order correlation (*r*)	*p*-value	*B*	*SEB*	*β*	*p*-value
Writing Integration Value	.26	.023	.05	.08	.07	.488
Pedagogical Competence	.57	<.001	.57	.16	.47	.001
Technical Knowledge	.46	<.001	.14	.15	.12	.356

Note. $R = .58$, $R^2 = .34$, $F = 12.79$, p-value < .001. Task value and perceived competence items scaled from 1 "Very Low" to 5 "Very High."

The fifth and final research objective was to determine the relationship between agriculture teachers' math integration competence and their task value toward math integration, pedagogical competence, and technical knowledge (see Table 5). The conceptual model for core academic integration was used to design a multiple linear regression model of agriculture teachers' perceived math integration competence. The model was significant ($F = 7.22$; p – value < .001) and the three independent variables, in combination, explained 22% ($R^2 = .22$) of the variance in teachers' perceived math integration competence. One of the independent variables, pedagogical competence

(β = .30; *p*-value = .037), was a significant predicator of math integration competence. The remaining independent variables, math integration value (β = .04; *p*-value = .685) and technical knowledge (β = .20; *p*-value = .170), were not statistically significant in the prediction of math integration competence.

Table 5

Predictive Model of Math Integration Competence

	Dependent Variable: Math Integration Competence					
Variable	Zero-order correlation (*r*)	*p*-value	*B*	*SEB*	β	*p*-value
Math Integration Value	.20	.080	.05	.11	.04	.685
Pedagogical Competence	.48	<.001	.53	.25	.30	.037
Technical Knowledge	.42	<.001	.32	.30	.20	.170

Note. R = .47, R^2 = .22, F = 7.22, *p*-value < .001. Task value and perceived competence items scaled from 1 "Very Low" to 5 "Very High."

Conclusions, Recommendations, and Implications

Integrating reading, writing, and math within all secondary classrooms has been proposed as a solution for student underperformance in these core subject areas. Research suggests career and technical education, including agricultural education, is an applicable context for integrating these core subjects (Park & Osborne, 2005; Parr et al., 2006; Young et al., 2009). However, integrating core academics requires teachers competent in this endeavor. The purpose of our research was to explore a conceptual model for agriculture teachers' competence toward integrating reading, writing, and math. Using expectancy-value motivational theory (Wigfield & Eccles, 2002), our proposed model included three variables influencing agriculture teachers' competence: (a) technical knowledge, (b) pedagogical competence, and (c) task value.

The first objective of this study was to describe the respondents. The population for this analysis was limited to teachers in one state due to the exploratory nature of our research. We encourage readers to use the information reported for the first objective when considering the transferability of our findings to the population(s) of their interest. Additionally, we recommend future research using the proposed model for core academic integration with larger populations.

The second objective of our study was to describe agriculture teachers' task value and perceived competence in reading, writing, and math integration. Across the three academic areas, agriculture teachers' task value exceeded their perceived competence. Expectancy-value motivational theory suggests an individual must have high expectancy for success (competence) as well as high perceived value in order for them to accomplish a given task (Wigfield & Eccles, 2002). While our research did not measure the amount of competence required to successfully integrate core academics, our comparison of competence and task value suggests resources allocated to increasing core academic integration should focus on teachers' academic integration competence rather than their task value.

The third objective of this study was to operationalize the conceptual model for core academic integration into an analysis of teachers' reading integration competence. Using multiple linear regression, we found our conceptual model to be a significant predictor of reading integration competence. Two of the independent variables, pedagogical competence and technical knowledge, were statistically significant in their prediction of reading integration competence. This indicates teachers with higher competence in their pedagogy and increased technical knowledge in agriculture subjects have a higher competence toward reading integration. We suggest these findings imply reading integration is a higher level teaching skill, requiring teachers competent in their ability to engage students (pedagogical competence) and knowledgeable about the subject(s) they are teaching (technical knowledge). It is unreasonable to suggest an agriculture teacher should be integrating reading in their classroom if they do not fully understand agriculture content and are unable to engage their students. In practice, this suggests teacher educators ensure teachers are competent in the areas of pedagogy and technical knowledge before attending to core academic integration. Failure to do so may overload a struggling preservice or practicing teacher and reduce their confidence as an educator.

The fourth objective was to operationalize our conceptual model in an analysis of teachers' writing integration competence. The conceptual model was found to be a significant predictor of writing integration competence. Only one independent variable, pedagogical competence, was found to be a significant predictor of writing integration competence. We suggest these findings indicate pedagogical competence as a foundational skill and writing integration as a higher order skill in agricultural education. In comparing the findings from objective four to the findings from objective three, we note technical knowledge as being an insignificant predictor of writing integration competence yet a significant predictor of reading integration competence. Potentially, this implies a looser connection between writing and technical knowledge than was observed between reading and technical knowledge. We recommend future research exploring the relationship comparing reading and writing integration and their connection to agriculture teachers' technical knowledge.

The final objective of this study was to apply our conceptual model to an analysis of teachers' math integration competence. Our model again proved to be significant, this time for teachers' math integration. Furthermore, pedagogical competence was again identified as the only significant predictor, this time for math integration competence. These findings support the extension of our position that sound pedagogy is a prerequisite to math integration in agricultural education. Furthermore, these findings may explain why interventions during preservice teaching have been inconsistent in increasing math integration self-efficacy (Stripling & Roberts, 2013a, 2013b); preservice teachers are still developing their pedagogical competence and asking them to integrate mathematics may overload their developmental process as a teacher.

While the conceptual model was found to be significant in the prediction of teachers' reading, writing, and math integration competence, we noted task value was an insignificant predictor throughout our findings. This supports previous research in core academic integration which has found a disconnect between the value teachers ascribe to core academic integration and their integration of core academics (Hall, 2005; McConachie & Petrosky, 2010; Park & Osborne, 2005). Our research indicates a necessary change in our initial conceptual model; specifically, pedagogical competence and technical knowledge as mediating variables between perceived value and competence in reading integration and pedagogical competence as a mediating variable between value and competence for writing and math integration. However, we also acknowledge the potential for additional variables influencing the relationship between value and competence. One variable not included in our analysis but recommended for continuing research exploring teachers' competence in core academic integration is teachers' knowledge of the core academics they are integrating.

Agricultural education holds the potential to positively influence students' understanding of reading, writing, and math (Park & Osborne, 2005; Parr et al., 2006; Young et al., 2009). However, this positive influence can only be realized through agriculture teachers competent in core academic integration. A greater understanding of agriculture teachers' competence in core academic integration will empower teacher educators to increase teachers' ability to integrate these core subjects. We believe our study provides a new conceptual model as well as empirical data useful toward understanding core academic integration. However, we also acknowledge the need for continued research exploring influential factors to teachers' core academic integration competence in order to fully understand this phenomenon. Continuing in this effort will enhance teacher development in core academic integration and better position agricultural education as a powerful tool for student learning across academic boundaries.

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