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Kentucky Agricultural Education Teachers' Self-reported Percentages of Mathematics Content within Secondary Agricultural Education Curricula

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Abstract

The mathematics achievement of secondary students in American schools is, to say the least, shocking. In addition, as the need for a more competent workforce in the agricultural industry has emerged, the agricultural education profession has taken up the charge of preparing individuals who are capable of solving tomorrow's complex agricultural issues. A portion of this response has been contextually teaching mathematics through agricultural education coursework. However, a question has emerged: Are agricultural education teachers in Kentucky adequately utilizing mathematics content within their curricula? The researchers utilized a modified version of Anderson's (2006) instrument to address the research objectives. Eighty-nine Kentucky agricultural education teachers participated in this study. The researchers found that mathematics content utilization within Kentucky agricultural education coursework is, at the moment, somewhat limited. The Advanced Agricultural Economics & Agribusiness Management course indicated the highest percentage of mathematics content while the Agricultural Power, Structures, & Technical Systems career pathway reported the highest percentage of mathematics. Perhaps agricultural education teachers vary in their working definitions of mathematics content integration. Additional research should further examine mathematics content integration as applied to the context of agricultural education.

***Keywords*:** mathematics integration; agricultural education; career pathway

Introduction & Theoretical Framework

The mathematics achievement of secondary students in American schools is, to say the least, shocking. Recent data (National Center for Education Statistics, 2010) indicated that students in various grade levels lack competence in even basic mathematics skills. Further, the shift toward a global economy has resulted in the need for graduates with increased competence in a range of technical and academic abilities (Doerfert, 2011). As a result, students must be capable of solving a multitude of problems that require knowledge in both academic content, such as mathematics, and technical content (Parr, Edwards, & Leising, 2006; Stone, Alfeld, Pearson, Lewis, & Jensen, 2006; Young, Edwards, & Leising, 2009). As Career and Technical Education (CTE) remains a robust method of providing students with the necessary skills for obtaining gainful employment, careful attention must be paid to ensure that students are provided opportunities to develop and demonstrate the various skills necessary for advancement in their chosen professions (Stone, Alfeld, & Pearson, 2008).

In 2011, the National Center for Education Statistics reported that only 72% of the eighth-grade students in Kentucky achieved at least a “basic” level of mathematics content comprehension. Further, only 31% of eighth-graders in the state fell within the “proficient” achievement benchmark. These data indicate that students in Kentucky are not adequately prepared to move into advanced mathematics coursework. The inescapable conclusion is this: current mathematics education teaching methods seem to be failing Kentucky students. What is more, these findings support calls for diversification in methods of teaching mathematics content (Edwards, 2004; Stone et al., 2006). Perhaps agricultural education could play a role in this process through a contextualized approach to the teaching of mathematics content.

Secondary agricultural education, as a traditional component of CTE, has been identified as a leading area through which academic content, such as mathematics, can be taught through a contextualized teaching approach (Conroy, Trumbull, & Johnson, 1999; National Research Council, 1988; Parr, Edwards, & Leising, 2009; Stone et al., 2006; Stone et al., 2008; Young et al., 2009). Mathematics content integration has been shown to result in no negative effects on students’ retentions of technical agriculture knowledge (Parr, Edwards, & Leising, 2008; Young et al., 2009) while concomitantly increasing students’ understandings of mathematics concepts (Parr et al., 2006). As a result, agricultural education curricula can serve as an appropriate context for enhancing students’ understanding of mathematics concept application without harming technical content knowledge (Parr et al., 2006; Young et al., 2009).

Mathematics teachers associations, such as the National Council of Teachers of Mathematics (NCTM), have exhibited much support for uniting mathematics content to practical, real-world contexts (NCTM, 2013). Researchers (Layfield, Minor, & Waldvogel, 2001; Roberson, Flowers, & Moore, 2001; Warnick & Thompson, 2007) have reported that academic teachers have expressed support for contextualized teaching of academic content in practical, hands-on applications, such as those offered through agricultural education. Agricultural education teachers have responded positively toward integrating mathematics into their curricula (Anderson, 2012). Conroy and Walker (2000) discovered that secondary students believe positive benefits exist as a result of providing academic instruction within an agricultural education context. Thus, the potential exists for powerful and meaningful collaboration between mathematics and agricultural education teachers that can enhance student interest and achievement in both agricultural education and mathematics content (Edwards, 2004; Stone et al., 2008; Wells & Parr, 2011).

With the recent implementation of the Common Core State Standards (CCSS), mathematics education is changing in new and interesting ways. Developed to be flexible in their use within differing states' curriculums, the CCSS will play a role in American mathematics education for years to come, ultimately helping to define applied mathematics instruction as well (Common Core State Standards Initiative, 2015). In addressing the definite need to more fully develop mathematics education in new and meaningful ways, this pursuit works in conjunction with the mission to further the role of secondary agricultural education (National Council for Agricultural Education, 2012). Providing an appropriate context for academic education should be a primary role of agricultural education curricula (Parr et al., 2008), and it appears that the chance to progress the profession is at the forefront. Other recent legislation designates that all CTE areas should make a more concerted effort to incorporate the mathematics content naturally found with the respective curriculum areas.

The Carl D. Perkins Act of 2006 called for "an increased focus on the academic achievement of career and technical education students" (United States Department of Education, 2007, Introduction section, ¶ 1). As a result, CTE teachers, including agricultural education teachers, are now required to devote more time to integrated mathematics instruction within their courses. Hunnicutt (1994) reported that agricultural education teachers in Alabama integrated mathematics content into only 26% to 50% of their agricultural education curricula. Anderson (2006) found that agricultural education teachers in Virginia reported integrating mathematics content in selected courses with a range of 0% to 75%. These results are indicative of a wide variance in teachers' use of agricultural education coursework as a tool for teaching mathematics. Little literature currently exists regarding mathematics content usage within Kentucky agricultural education coursework. Could findings from Alabama and Virginia be true in Kentucky as well?

As the need for improved math performance in secondary students is apparent, agricultural education teachers remain in a prime position to help address that need through a contextualized teaching approach (Parr et al., 2009). Further, agricultural education teachers support teaching mathematics within an agricultural context (Anderson, 2012; Anderson & Anderson, 2012). The need for more academically-rigorous agricultural education curricula is apparent, as illustrated by the American Association for Agricultural Education's (AAAE) National Research Agenda (Doerfert, 2011). Research priority three of the National Research Agenda addressed the need for "a highly educated, skilled workforce capable of providing solutions to 21st century challenges and issues" (Doerfert, 2011, p. 19). Additionally, priority four of the Agenda stated that "[d]esigning, developing, and assessing meaningful learning environments that produce positive learner outcomes is essential to properly educating the citizens of the 21st century" (Doerfert, 2011, p. 22). As a result, agricultural education teachers must be prepared to implement practices that foster the intellectual and technical development of students through engaging and relevant curricula that prepare them for advanced agricultural careers (Doerfert, 2011). Are agricultural education teachers up for the challenge?

Regarding pre-service agricultural education teachers at the University of Florida, Stripling and Roberts (2012) found that "preservice teachers were not proficient in solving agricultural mathematics problems" (p. 109). Further, these pre-service agricultural education teachers considered themselves "efficacious in personal teaching efficacy and personal mathematics efficacy, and moderately efficacious in their mathematics teaching efficacy" (Stripling & Roberts, 2012, p. 109). Wells and Parr's (2012) research concerning the mathematics ability of pre-service agricultural education teachers at Auburn University echoed the findings of Stripling and Roberts (2012). What perhaps may be more troubling is the historical trend of pre-service teachers' deficiencies in mathematics competency. Miller and Gliem (1996) found that pre-service agricultural education teachers at Ohio State University "were not capable of applying basic mathematics skills to agricultural problems" (p. 19). As a result, it becomes clear that perhaps pre-service teachers at other institutions may be unprepared to teach mathematics content within an agricultural context. From the perspective of instilling in pre-service agricultural education teachers the virtues of mathematically-enhancing agricultural content, the question remains: Could this spell trouble for the call for more rigorous, academically-enhanced agricultural education coursework?

Researchers (Miller & Gliem, 1994) have indicated that in-service agricultural education teachers have fared no better in their abilities to solve “agricultural related mathematics problems” (p. 28). Further, Hunnicutt (1994) found that in-service agricultural education teachers in Alabama lacked proficiency in solving agriculturally-based mathematics problems. While it is evident that agricultural education teachers support utilizing agricultural content as the context for mathematics education (Anderson, 2012), their abilities in the subject reflect limited mathematical competency. Thus, results are indicative of a broader problem concerning agricultural education teachers’ applied mathematics problem-solving. Does such deficiency affect the attitudes and subsequent behavior of agricultural education teachers’ utilization of mathematics content within their coursework?

Despite their apparent lack of competency in solving agriculturally-related mathematics problems, both pre-service and in-service agricultural education teachers (Miller & Gliem, 1994; Miller & Gliem, 1996; Stripling & Roberts, 2012; Wells & Parr, 2012) have reported favorable attitudes regarding infusing their agricultural content with mathematics concepts (Anderson, 2006; Anderson, 2012). These positive attitudes are encouraging for advancing secondary agricultural education toward the rigorous paradigm necessary for preparing the next generation of high-quality agricultural industry members (Doerfert, 2011). What may perhaps be more encouraging, however, is that agricultural education teachers in Virginia and Alabama have reported the incorporation of mathematics into their agricultural content (Anderson, 2006; Anderson & Driskill, 2012; Hunnicutt, 1994). Thus, positive attitudes toward mathematics integration may have influenced many agricultural education teachers to proactively begin implementing this behavior. Is the same true for agricultural education teachers in Kentucky?

Based on the literature review and the accompanying findings, the theoretical framework that was utilized for this study was a modified version of Swanson’s (1972) model of the assumption of the existence of relationships amongst education, knowledge, attitude, and behavior (as cited in Faulkner, Baggett, Bowen, & Bowen, 2009) (see Figure 1). This model reflects the concept that agricultural education teachers begin the process of infusing mathematics content into their agricultural curricula in the pre-service teacher education stage. This notion is guided by research (Stripling & Roberts, 2012; Wells & Parr, 2012) that indicated pre-service agricultural education teachers have responded positively toward the contextualized teaching of mathematics within their teacher preparation coursework. This was regarded as the *Education* stage. Moving to the *Knowledge* stage, the researchers postulated that experience gained during the course of their teaching careers carried influence over attitudes and decisions to integrate mathematics content into their agricultural courses. Anderson and Driskill (2012) discovered that “younger teachers were more receptive to integrating mathematics into the agricultural education curriculum” (p. 64). Thus, it could be speculated that perhaps younger teachers have been exposed to coursework that has addressed calls for academic integration.

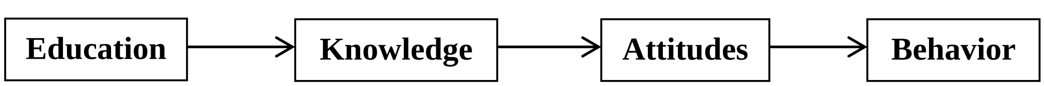

Figure 1. Adapted version of Swanson’s (1972) model of the assumption of the existence of relationships amongst education, knowledge, attitude, and behavior (as cited in Faulker et al., 2009).

Researchers (Anderson, 2006; Anderson, 2012; Anderson & Driskill, 2012) have indicated that in-service agricultural education teachers have regarded mathematics integration into their agricultural coursework favorably. Furthermore, Anderson and Driskill (2012) investigated outstanding teachers in Virginia and found that "the typical agricultural education teacher… integrated mathematics into 23% of their… lessons" (p. 64). The researchers posited that based on their positive perceptions and *Attitudes*, as described in Figure 1, these agricultural education teachers have and are adopting and incorporating explicit mathematics content into their curricula, which the researchers classified as a *Behavior*. Can the same be said for agricultural education teachers in Kentucky?

Research Question & Objectives of the Study

The need for a more integrated approach to teaching mathematics content is apparent. Perhaps a change in context is warranted (Parnell, 1996; Parr et al., 2008; Young et al., 2009). As agricultural education teachers are able to consistently incorporate hands-on and minds-on learning activities into their coursework (Phipps, Osborne, Dyer, & Ball, 2008), their courses remain a rich context through which to offer academic instruction alongside practical application (Parr et al., 2009). Results from Alabama (Hunnicutt, 1994) and Virginia (Anderson, 2006) indicated that agricultural education teachers' mathematics content integration varies widely. However, little is known regarding Kentucky agricultural education teachers' efforts at integrating mathematics content into their coursework. Thus, a question remains: To what extent are agricultural education teachers in Kentucky currently utilizing mathematics content into their coursework? In order to address this research question, the following objectives were developed to guide this study:

1. Determine the self-reported percentage of agricultural education course content that utilized mathematics within the curriculum taught in Kentucky.
2. Determine which agricultural education career pathway reported the highest percentage of mathematics content.

Methods & Procedures

A researcher-modified version of Anderson's (2006) electronic Survey of Mathematics Integration questionnaire was used to address the objectives of the study. These modifications included the changing of the state name and the agricultural education course titles. It should be noted that per the instrument, participants were asked to report the percentage of course content that utilized mathematics within the curriculum of each course. The instrument contained five sections. Section one included 10 demographic questions related to the agricultural education teacher. Section two consisted of 5 demographic questions about program and school characteristics. Section two also included an area for participants to include each course they taught, the number of students in those classes, and the percentage of mathematics integrated into those classes. Section three utilized 19 statements to collect participants' opinions regarding the integration of mathematics. Section four had 5 statements related to the participants' effort to collaborate with others in an effort to integrate mathematics. The fifth section included 10 statements that focused on the participants' needs. Sections 3-5 utilized a five-point Likert-type scale to indicate the level of accuracy of each statement. As part of a larger study, the researchers wish to point out that the data reported in this manuscript emerged from sections one and two only.

Content validity was reviewed by a team of five university faculty members with expertise in the fields of agricultural mechanics and agricultural education. Following suggestions of Dillman, Smyth, and Christian (2009), the electronic instrument was pretested through a pilot study with a group of ten agricultural education student teachers in a nearby state. Post-hoc reliability analysis was used to determine a Cronbach's alpha coefficient. The last three sections of the instrument that addressed participants' opinions, collaboration, and needs regarding mathematics integration indicated a reliability consistency at the .868 level (α = .868). This was congruent with the reliability yielded from the instrument used in Anderson's (2006) study, as he reported a reliability consistency at the .868 level (α = .868) as well. DeVellis (1993) indicated that reliability coefficients that fell between .8 and .9 level were "very good" (p. 85).

Data were collected through an electronic instrument following Dillman, Smyth, and Christian's (2009) methods for electronic data collection. This census study included all Kentucky agricultural education teachers listed in the state electronic database. Eighty-nine (n = 89) out of 247 agricultural education teachers in Kentucky completed the questionnaire, resulting in an initial response rate of 36%. However, 36 e-mail addresses were returned as invalid or blocked, reducing the total potential population to 201, thus resulting in an adjusted response rate of 44%. No further effort was made to obtain data from non-respondents due to restrictions placed by the university IRB office, which insisted that the identifier on the instrument used to track non-respondents be removed to ensure complete anonymity of the participants. The researchers choose not to compare respondents to Kentucky Department of Education data due to the high level of inaccuracies in the database. As a result, non-response error was addressed through following the suggestions of Lindner, Murphy, and Briers (2001) by comparing early to late respondents to find potential differences. No significant differences were found. Data were coded and analyzed using PASW 18.0 (SPSS, n.d.).

Results

As detailed in Table 1, most respondents (40%) reported that they held a master's degree, while 39% had attained Rank 1 status of 30 credit hours beyond a Master's degree. Only 21% reported that their highest degree to be at the bachelor's level. Because Kentucky requires all teachers to possess, at the minimum, a master's degree by the end of their first five years of teaching, it is expected that current bachelor's-only teachers will either obtain further education or resign from teaching agricultural education in Kentucky (Kentucky Legislature, n. d.). Most respondents were male (73%), reported their race as Caucasian (99%), and taught high school agricultural education courses (95%). Only 1% reported their race as African American. Only 5% currently taught courses at the middle school level. Further, 92% of the respondents indicated that they were currently members in the Kentucky Association of Agricultural Educators (KAAE).

Table 2 data reported the previous mathematics coursework completed by agricultural education teachers in Kentucky. A majority of respondents (42.2%) reported completion of at least four mathematics courses during their enrollment in high school while 35.6% completed three courses. 11.1% completed five or more math courses while 8.9% completed two or fewer in high school. Moving to community college mathematics courses, 56.7% of respondents completed none or only one mathematics course while 7.8% completed two or more courses. A majority of respondents (56.6%) completed two or more mathematics courses at a university while only 36.7% completed one or less mathematics courses at the university level.

Table 1. Summary of Selected Teacher Characteristics (n = 89)

Teacher Demographics		*f*	%
Level of Education	Bachelor's Degree	18	21
	Master's Degree	36	40
	Rank 1	35	39
Gender	Male	65	73
	Female	24	27
Ethnicity	African American	1	1
	Caucasian	88	99
Grade Level Taught	Middle School	4	5
	High School	85	95
Member of KAAE	Yes	82	92
	No	7	8

Table 2. Mathematics Courses Completed by Respondents

Mathematics Courses and Levels		*f*	%
Mathematics Courses Completed in High School	2	8	8.9
	3	32	35.6
	4	38	42.2
	5	9	10.0
	6	1	1.1
Mathematics Courses Completed in Community College	0	42	46.7
	1	9	10.0
	2	6	6.7
	3	1	1.1
Mathematics Courses Completed at a University	0	7	7.8
	1	26	28.9
	2	28	31.1
	3	13	14.4
	4	6	6.7
	5	1	1.1
	6	2	2.2
	8	1	1.1

Table 3 reported that most agricultural education teachers taught within a rural school (58%), while 27% taught in small towns and a further 15% taught in urban settings. Most programs utilized two teachers in the department (55%), while 22% of programs had one teacher and the remaining programs (23%) were conducted by three or more teachers. Most schools (43%) taught under the 4x4 Block schedule system. While 21% of schools used the seven-period schedule, 6% used the A/B Block schedule, 1% used an eight-period schedule, and 21% reported the use of another scheduling system.

Table 3. Summary of Selected Program Characteristics (n = 25)

Program Trait		*f*	%
Location of School	Urban	13	15
	Small town	24	27
	Rural	52	58
Agricultural Education Teachers on Campus	1	20	22
	2	47	55
	3	20	22
	4	1	1
Type of School Schedule	7 Period	19	21
	8 Period	1	1
	A/B Block	6	6
	4x4 Block	38	43
	Other	25	28

Research objective one, determine the self-reported percentage of agricultural education course content that utilized mathematics within the curriculum taught in Kentucky, data are reported in Table 4 below. The respondents indicated a range from 0% to 100% of agricultural education coursework that utilized mathematics content. A mean of 20.74% of the agricultural education coursework in Kentucky reported mathematics content, with a standard deviation of 14.92. The course with the highest reported mathematics content was *Advanced Agricultural Economics & Agribusiness Management*, which reported that 100% of the agricultural content contained elements of mathematics concept education. On the converse, agricultural education teachers who taught the *Agricultural Sales & Marketing* course reported a mean of 3% of the agricultural content contained mathematics. A breakdown of each agricultural education course's percentage of mathematics is detailed in Table 4 below.

Research objective two sought to determine which agricultural education career pathway reported the highest percentage of mathematics content. Data in Table 5 below indicated that the *Agricultural Power, Structural, & Technical Systems* pathway utilized the highest percentage of mathematics content with a mean of 33.12%. The *Horticulture & Plant Science Systems* pathway reported a mean mathematics content percentage of 27.30% while the *Agricultural Education, Communications, & Leadership* pathway reported a mean mathematics content percentage of 27.11%. Further, the *Animal Science Systems* pathway described that a mean of 25.43% of agricultural education coursework utilized mathematics while means of 23% and 22.16% of agricultural content in the *Agribusiness* and *Food Science & Processing Systems* pathways contextually utilized mathematics content, respectfully. The lowest amounts of agricultural coursework that utilized mathematics were found in the *Agribiotechnology* (mean of 21.40%) and *Environmental Science & Natural Resources* pathways (mean of 20.02%).

Table 4. Percentage of Mathematics Utilized Per Agricultural Education Course in Kentucky (n = 92)

Course Title	*N*	Min.	Max.	Mean	SD
Adv. Agri. Econ & Agribusiness Management	1	100	100	100.00	0.00
Nursery & Orchard Tech.	5	50	90	69.00	18.16
Small Power & Equipment	30	0	100	41.46	22.90
Small Animal Science & Technology	2	30	45	37.50	10.60
Agricultural Biotechnology	4	5	100	36.25	43.27
Agricultural Construction Skills	7	15	50	30.00	13.54
Aquaculture	2	15	45	30.00	21.12
Agricultural Business/Farm Management	5	20	50	29.00	11.93
Agricultural Math	20	5	100	25.25	23.19
Principles of Agricultural Sci. & Technology	20	5	100	25.25	23.19
Agriscience Interdisciplinary	1	25	25	25.00	0.00
Principles of Teaching Agricultural Education	1	25	25	25.00	0.00
Greenhouse Technology	13	5	50	23.26	14.11
Agricultural Power & Machinery Operation	18	2	100	23.05	21.99
Advanced Plant Science	12	3	50	22.33	12.42
Animal Technology	11	10	40	21.95	12.74
Equine Science	4	15	50	21.25	12.50
Environmental Science & Technology	3	5	38	21.00	16.52
Wildlife Resources	5	5	30	21.00	12.44
Landscape & Turf Management	1	20	20	20.00	0.00
Agricultural Structures & Design	7	3	30	19.35	9.50
Agriscience	25	0	50	18.10	11.21
Animal Science	19	1	40	18.10	11.35
Agriscience Exploration	25	3	50	16.92	11.70
Food Processing, Distribution, & Marketing	25	3	50	16.92	11.70
Agricultural Employability Skills	8	10	30	15.00	9.25
Agri-Biology	9	2	30	13.88	9.53
Veterinary Science	9	2	30	13.88	9.53
Crop Technology	2	1	25	13.00	16.97
Advanced Animal Science	10	10	40	12.50	10.28
Food Science & Technology	16	0	25	12.50	7.30
Floriculture & Floral Design	32	5	100	12.01	18.11
Plant & Land Science	1	10	10	10.00	0.00
Forestry	9	0	20	8.55	6.32
Agricultural Communication	3	0	10	6.66	5.77
Agricultural Sales & Marketing	1	3	3	3.00	0.00

Table 5. Percentage of Mathematics Utilized Per Agricultural Career Cluster (n = 92)

Agricultural Career Cluster	*N*	Min	Max	Mean	*SD*
Ag. Power, Structural, & Technical Systems	104	3	100	33.12	22.38
Horticulture & Plant Science Systems	176	0	100	27.30	21.15
Ag. Education, Communication, & Leadership	44	3	90	27.11	21.79
Animal Science Systems	172	0	100	25.43	20.56
Agribusiness	91	3	100	23.00	19.33
Food Science & Processing Systems	80	0	100	22.16	18.16
Agribiotechnology	62	0	100	21.40	17.41
Environmental Science & Natural Resources	101	0	100	20.02	16.98

Conclusions, Discussion, Limitations, Implications & Recommendations

This study was designed to gather data regarding the utilization of mathematics content within secondary agricultural education courses in Kentucky. The agricultural education teachers in this study reported that a mean of 20.74% of agricultural education coursework utilized mathematics content. These findings are consistent with data reported from agricultural education teachers in Alabama (Hunnicutt, 1994) and Virginia (Anderson, 2006). It was noted that there were vast differences in mathematics content percentages within multiple samples of the same course. This indicated that there was significant variance of mathematics content utilization between teachers. For example, between thirty teachers, some reported that none of their *Small Power & Equipment* course content utilized mathematics while some agricultural education teachers specified that 100% of their course content utilized contextual mathematics. These results indicate that many agricultural education teachers in Kentucky have may not have yet begun to contextually teach mathematics within their coursework.

Based on the variance of mathematics content percentages between multiple offerings of the same courses, it is plausible that the agricultural education teachers may have varied in their working definitions of mathematics content integration. Did some teachers believe that if basic arithmetic is utilized within portions of the curriculum then that class has effectively utilized mathematics content? On the converse, did some agricultural education teachers perceive that a lesson has only achieved substantial mathematics content percentages if all portions of the lesson contain, at the minimum, algebraic or trigonometric formulas? In addition, many of the agricultural education courses in Kentucky had reported very low percentages of mathematics content within the curricula. Once again, did these percentages indicate limited understanding of mathematics content utilization, or was there truly no mathematics content? In order to shed further light on these interesting findings and challenging questions, perhaps a content analysis of teachers' lesson plans should take place in order to gain a better understanding of teachers' actual mathematics content percentage utilization. Further, such investigation should address potential misconceptions regarding the teaching and learning of mathematics content within an agricultural context.

In regard to the mathematics content percentages of the individual agricultural education courses offered in Kentucky, it is interesting to note that the *Agricultural Math* class reported minimum and maximum mathematics content percentages of 5% and 100%, respectively. The mean percentage for this class, however, was only 25.25%. This raised significant concerns in the researchers' minds, and thus leads to some interesting limitations of the present study. Was the title of this course misleading? Were agriculturally-related mathematics problems being covered in this course as the title suggests, or was different content altogether being taught? Did agricultural education teachers differ in their working definitions of mathematics content integration? These questions represent significant challenges that must be addressed regarding agricultural education curricula as a whole. Further inquiry should work to answer these perplexing issues.

The researchers discovered that while each of the career pathways reported some percentage of mathematics content, the career pathway that highlighted the highest level was the *Agricultural Power, Structural, & Technical Systems* pathway with a mean of 33.12%. Researchers (Anderson & Driskill, 2012; Parr et al., 2006, 2008, 2009; Wells & Parr, 2011; Young et al., 2009) have noted agricultural mechanics content as an area that contains extensive amounts of mathematics content. The results of this study substantiated these findings. As agricultural mechanics coursework allows for students to connect academic coursework to practical, hands-on applications (Parr et al., 2006, 2008, 2009; Young, 2009), this career pathway remains an ideal vehicle with which to contextually teach mathematics content. As such, it is conceivable that the *Agricultural Power, Structural, & Technical Systems* pathway is the most appropriate context for the advancement of the teaching and learning of science, technology, engineering, and mathematics (STEM) concepts within secondary agricultural education. However, as all of agricultural education is fundamentally rooted in applied sciences and academics (Phipps et al, 2008), the remaining career pathways remain viable for mathematics content teaching as well. Anderson and Anderson (2012) reported that agricultural education teachers in Virginia identified other areas of agriculture, such as plant science and natural resources, as serving as pertinent and applicable areas for mathematics content utilization. These additional career pathways can also highlight mathematics concepts that may not have been addressed in the *Agricultural Power, Structures, & Technical Systems* pathway. Further research should be conducted regarding mathematics content integration in the agricultural education career pathways of other states.

Many agricultural education teachers in Kentucky seemed to have embraced some of the constructs of contextually teaching mathematics within their content. Could this be related to pre-service teacher education? Stripling and Roberts (2013) found that the use of a "math-enhanced agricultural education teaching methods (MEAETM) course" (p. 125) led to positive results for the pre-service teachers in the population. Perhaps these positive experiences and increased education in the content (such as "increased mathematics ability" and "[increased] mathematics teaching efficacy and personal teaching efficacy" (Stripling & Roberts, 2013, p. 124) could lead to more positive attitudes concerning mathematics content utilization. Further, such positive attitudes could evoke increased behavior in teaching mathematics content into secondary agricultural education content. This process was described by Swanson's (1972) model (see Figure 1), as *Knowledge* derived from *Education* (i.e., pre-service teacher preparation) about a particular topic (mathematics content integration) can lead to *Attitudes* (positive or negative) that ultimately affect *Behavior* (decisions to ignore or heed calls for mathematics integration in agricultural education coursework).

Researchers (Anderson & Driskill, 2012; Conroy et al., 1999; Parr et al., 2006, 2008, 2009; Wells & Parr, 2011; Young et al., 2009) have identified agricultural education as a practical, hands-on context through which mathematics content education can occur. Anderson (2012) described that agricultural education teachers "concur that agricultural education provides an excellent avenue to teach mathematics and that mathematics is an integral component of agricultural education (p. 79). In addition, the NCTM (2013) has specified that secondary students should be frequently exposed to practical applications of mathematics. Perhaps secondary agricultural education could be part of the solution. With support from mathematics teachers (NCTM, 2013) and agricultural education teachers (Anderson, 2012; Anderson & Driskill, 2012), further contextualized mathematics teaching efforts should be of profound importance and priority to each profession.

The need for increased rigor in secondary agricultural education has been reiterated recently, as Doerfert (2011) stated that "[n]ew trends in today's global economy require greater capacity of the agricultural workforce… a sufficient supply of well-prepared agricultural scientists and professionals is needed to drive sustainable growth, scientific discovery, and innovation" (p. 9). This call should not go unheeded. Because it is the responsibility of agricultural education teachers to prepare students for the agricultural challenges of tomorrow (Doerfert, 2011; Phipps et al., 2008), teachers must be prepared to implement curricula that emphasize critical thinking and relevant, real-world learning experiences that emphasize cognitive abilities and practical learning (Edwards, 2004; Parr et al., 2009; Young et al., 2009). Rigorous agricultural education content delivery strategies, such as mathematics content utilization within agricultural education coursework, can help to address these challenges and needs (Doerfert, 2011; Parr et al., 2006, 2008, 2009; Young, 2009). The advent of the CCSS as well as goals for the advancement of secondary agricultural education should work hand-in-hand to address the educational needs of students, particularly as STEM-based education initiatives continue.

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