Perceptions of Administrators in STATE Secondary Schools Regarding Agriculture and Mathematics, Teaching Integrated Mathematics, and Meeting State Standards

Dr. Ryan Anderson

Texas State University

r_a461@txstate.edu

Dr. Marshall Swafford

Arkansas Tech University

mswafford@atu.edu

Abstract
This study was conducted to provide an assessment of the attitudes and perceptions of the administrators of Kentucky secondary schools on the use of mathematics integration in agricultural education curricula. The study researched the perceived relationships between agriculture and mathematics, administrator's perceptions on teaching integrated mathematics, and meeting state standards. An accurate assessment of the administrators' perceptions was vital to the research in order to improve their collaboration with educators. The study population included Kentucky secondary school administrators (N=875). The findings indicate a majority of administrators believe agriculture includes applied mathematics yet were neutral regarding whether or not agriculture teachers could teach a mathematics course.

Introduction/Theoretical Framework

The purpose of the study was to gain a greater understanding of the perceptions of secondary school administrators on the integration of core curriculum, specifically mathematics, into the agricultural education curriculum. Kentucky secondary school administrators have played an important role in facilitating change in agricultural education classrooms by mandating curriculum improvement and/or replacement. According to Dietel et al. (1991), Kentucky secondary school administrators use assessments to plan and improve programs, while teachers utilize them to observe student progress. Policy makers use assessment as a way to set standards and monitor education quality. Therefore, it is important to understand the administrators' relationships with these educators and the level of involvement in the classroom they might have experienced.

Administrators' relationships with agricultural educators has often been an overlooked subject. Agricultural education has been the focus of several studies regarding curriculum and the classroom (Doss & Rayfield, 2021). A study conducted by researchers at the National Commission on Excellence in Education (1984) suggested American students are falling behind students in other nations. Subjects including agribusiness, plant science, animal science and agriculture mechanics have provided students with an adequate understanding of basic agricultural principles used to build a foundation for a proper agricultural education. Mandates created in the 1980's threaten administrators by holding them responsible for results based on the

work of others. This caused the administrators to be cautious and display a low-risk attitude toward reform (Klein, 1991). Great care has to be taken to improve curriculum regarding each specific subject matter and increase passing rates among agriculture students without decreasing the amount and quality of the curriculum. A study conducted by Foster et al. (1995) stated the development of curriculum must take a middle ground with teachers, principals, and superintendents working in partnership. Administrators and teachers can adjust curriculum mandates to local conditions, and package them to increase credibility with other teachers and the community.

Data regarding agricultural educators' perceptions and theories concerning curriculum integration of core principles had been discussed for their relationship to this study, and had been deemed relevant to understanding how one group views agricultural education (Stubbs & Myers, 2016). However, administrators represent another vital segment of the educational equation. The author intended to focus on administrator's attitudes and opinions regarding mathematics integration into the agricultural education curriculum in order to fully understand how improvements to curriculum and teacher relations can further benefit agriculture programs and ultimately benefit the students.

A study conducted through the Kentucky Department of Education (2010) examined 11th grade student's scores on the ACT, which is curriculum-based measure of college readiness. This examination tested students' academic achievement in English, mathematics, science, reading and as an option, writing. The ACT was the only college readiness examination that could be directly tied to academic standards. Administrators could use this data to accurately assess secondary schools for effectiveness of curriculum in each subject administered on the ACT. The study averaged the scores from Kentucky 11th grade students during the years 2008 and 2009 to understand the statistics regarding the students meeting state benchmark scores. The benchmark scores for Kentucky were described as "the minimum score needed on an ACT subject-area test to indicate a 50% chance of obtaining a B or higher or about a 75% chance of obtaining a C or higher in the corresponding credit-bearing college courses" (Kentucky Department of Education, 2010). This study indicated that 42,929 students' scores from ACT testing revealed only 20% of Kentucky students met the benchmark score for Mathematics in 2008. In 2009, 43,511 students' scores were reported from the ACT, denoting 21% of 11th grade students met the benchmark scores for Mathematics. These findings indicate a deficiency in Mathematics education in Kentucky secondary schools.

However, simply identifying a deficiency in an academic content area is only one piece of the puzzle. Public schools, and by association agricultural education, have the goal of preparing students for work and college (Rice & Kitchel, 2017). As technology advances, workplace readiness continues to evolve with specific technical skills and job-specific knowledge giving way to creative problem-solving, effective communication, team work, and self-regulation (Robinson et al., 2018). Mathematics education plays a significant role in developing these 21st century skills in students' as employees must be able to employ quantitative reasoning skills (Steen, 2002) to address complex problems that involve complex calculations and require problem-solving skills (Robinson et al., 2018).

The development of 21st century skills including quantitative skills, which falls under the umbrella of mathematics, requires an effective context that provides the foundation for critical thinking and problem-solving (Agustin et al., 2012). According to contextual learning theory, learners process new information in such a way that it makes sense to them in their own frames of reference (Center for Occupational Research and Development, 2010). Furthermore, students gain deeper understandings of the curriculum when they are provided opportunities to construct their own knowledge in contexts they find meaningful (Brown et al., 1989). Agricultural education has been found to provide an effective context to integrate mathematics education (Swafford, 2018). Through the use of projects, students in the agricultural education classroom have the opportunity to practice and sharpen their mathematics skills thus, improving necessary 21st century skills required by contemporary employers (Robinson et al., 2018).

Studies have been conducted regarding the primary educators' perceptions and attitudes concerning the integration of core curriculum in Agricultural Education courses (Anderson et al., 2008; Brister & Swortzel, 2009). A principle concern for educators is that in order for students to successfully complete high school, they must have a positive educational experience. One theory is to achieve success through an integrated curriculum. Integrative instruction aims to teach concepts from two or more subject areas during the same instructional unit (Wells, 2015). A key aspect of integrative instruction is the intention of demonstrating connections between the subjects (Wells, 2015). This is particularly important as students often miss the connections on their own, thus the need for integration (Agustin et al., 2012). Agricultural educators have an increasingly daunting task, which includes balancing lecture and contextual learning, Career Development Events, Supervised Agricultural Experiences, and FFA activities. Young et al. (2007) concluded a math-enhanced Agricultural power and technology curriculum showed a positive effect on math achievement. Attitudes concerning the application of content, allows for students to create an understanding of how concepts are beneficial and meaningful (Moore & Carlson, 2012). Mathematics teachers have articulated a need to greatly reform Mathematics education, listing contextual learning as a possible solution (Briner, 1999).

Agricultural Educators have become aware that they will be called upon to convey a broader knowledge of Educational tools to increase student understanding of basic agricultural concepts. One study shows "Fitting new practices and techniques to unique, on-the-job conditions is an uneven process that requires time and extra effort, especially when beginning" (Berman, & McLaughlin, 1978, p.60). Secondary Career and Technical Education (CTE) students might only have a cursory understanding of core principles in regards to general secondary education. In order for these students to properly grasp the concepts of agricultural education, some remedial teaching has to be completed to bring these students up to speed. A study by Buriak (1992) defined agricultural science as, "instruction in agriculture emphasizing the principles, concepts, and laws of Science and their mathematical relationships supporting, describing, and explaining agriculture with a foundation in biological and physical science" (p.4). Career and technical educators and critics of both viewed integration of academics as a curricular reform that has improved the academic content of CTE and has helped prepare students for employment in our current workforce (Thompson, 2000). Agricultural educators must be willing and able to adopt these principles to allow their students the opportunity to gain these fundamental concepts in an applied method. The Carl D. Perkins Vocational and Applied Technology Act Amendments of 1990 include mandates that require states to develop systems of performance measures and

standards. These systems are designed to aid the states in program evaluation and improvement. "The Center for Law and Education (1990) indicated that a measure is a description of an outcome and a standard is the level or rate of that outcome" (Belcher et al., 1996, p.1). Furthermore, "once a state decided the types of academic and other performance to measure (measures), it was necessary to select the level of acceptable performance (standards)" (p.1).

Graduation rates have become a gauge for curriculum effectiveness due to the No Child Left Behind Act of 2001 (NCLB) and public concerns. NCLB requires states to develop and implement a statewide yearly assessment measuring students' progress and understanding of the state curriculum (United States Department of Education, 2009). Schools have shifted the main focus from improving overall academic achievement to increasing testing scores. NCLB legislation has placed a greater importance on preventing students from failing than on challenging students to become higher order thinkers. Kentucky secondary school funding has been directly related to the scores from these tests as compared to other schools in Kentucky, as well as throughout the Nation.

Secondary school systems have recently been focusing on integrating core curriculum into agriculture and other career clusters in an attempt to increase testing scores on standardized tests, such as Kentucky's Accountability Testing System (CATS). In the past decade, federal legislation authorizing funding for Career and Technical Education began to mandate improved academic achievement. The 1998 Carl D. Perkins Vocational Education and Applied Technology Act continued to commit federal funding to integrating academics into CTE (Myers & Thompson, 2009).

Kentucky's Accountability Testing System (CATS) has been used to not only compare general education students, but also CTE students across the state. Standardized testing can be used to compare scores from Agricultural Education students to general education students at both the school and state levels. These figures are also useful in assessing the effectiveness of programs, viability of the curriculum, and the need for reform. Woglom et al. (2005) describe this CATS testing system as a "very useful form of assessment, in that it is designed for both state and national comparison" (p.36). The researchers discussed the creation of the CATS standardized test through a broad collaborative process that included teachers, administrators and members of the community. This test is given over a multi-day period, and includes single answer questions used to test students' specific knowledge in certain core subjects. These subjects include mathematics, science, reading and writing, social studies, arts, and humanities. "In addition to a conglomeration of student academic scores, schools also receive scores regarding non-academic issues including student retention rate, dropout rate, and the percentage of graduates that continue their education in college" (Woglom et al., 2005, p. 36). One of the criticisms of administering standardized testing is that lengthy tests discourage students prior to taking the test. It is also the belief that these standardized tests encourage memorization due to the fact that standardized tests narrow curriculum by focusing on recall (Sloan & Kelly, 2003). Another criticism is that teachers will teach for the test, missing out on important curricula normally taught in non-testing semesters.

Research has indicated that math and science concepts integrated in agricultural education curriculum has a positive impact on student achievement (Stubbs & Myers, 2016). Young et al.

(2007) concluded that a positive effect on Mathematics achievement could be realized through a Mathematics-enhanced Agricultural Power and Technology curriculum. Agricultural Education programs have begun aligning curriculum to state standards to improve both Science and Mathematics scores. Region 8 of the Texas Education Agency has implemented a new course called Agricultural Algebraic Extensive Exploration (A^2E^2). The A^2E^2 course was designed for ninth grade students who were unsuccessful in mastering the eighth grade Texas Assessment of Knowledge and Skill (TAKS) test and are enrolled in Algebra I (Burris et al., 2008). This course was designed to assist students who were struggling in understanding Mathematics concepts by applying to the context of real world settings. The research concluded that the A^2E^2 course provided the students with similar improvement in testing scores when compared to current forms of remediation.

Theoretical Framework

"A description of attitude is explained as a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object" (Fishbein & Ajzen, 1975). Fishbein and Ajzen describe four classifications which categorize predispositions:

- Affect (feelings, evaluations): A favorable or unfavorable evaluation of an object. (attitude)
- Cognition (opinions, beliefs): Information a subject has of an object, thus linking a belief of the object to an attribute.
- Conation (behavioral intentions): A subjects intention to perform various behaviors, based on strength of intention.
- Behavior (observed overt acts): Observable act, reaction, or response.

Any response to a questionnaire or verbal survey is considered a behavioral instance. The responses can be used to aid in creating inferences regarding beliefs, intentions or attitudes. The fourth category, however, is used to measure a particular overt behavior in order to understand the details relating to it (Fishbein & Ajzen, 1975). This theory suggests prior exposure to a subject would have an effect on the perceptions of respondents. Positive experiences would tend to lead researchers to infer positive attitudes, and negative experiences would lead to negative attitudes. Knowledge of a subject, the respondent's own belief system, and personal opinions all serve to guide the respondent behaviors in regards to completing the survey instrument.

Greenwald (1989) supported this theory by concluding that individuals, who showed a positive favor towards a situation or an issue, also tend to evaluate the situation in a positive manner. This concept suggested that if an administrator had a positive attitude in relation to the integration of mathematics in the agricultural education curriculum, administrators would tend to be more supportive of agricultural educators efforts to integrate mathematics into the curriculum. In theory, changing a person's attitude regarding a subject could change the level of support that would be offered for that subject.

The Purpose of the Study

The purpose of this study was to provide an assessment of the attitudes and perceptions of administrators of Kentucky secondary schools regarding mathematics integration in the agricultural education curriculum. The research objectives of the study were:

1. Determine the demographics of schools offering agricultural education in Kentucky.

2. Determine and compare the perceived level of mathematics integration in the Kentucky secondary school agricultural education curriculum by administrators (superintendent, assistant superintendent, principal, guidance counselor, and professional development personnel).
3. Determine and compare attitudes of administrators regarding the agricultural education curriculum as a viable source of mathematics in Kentucky secondary schools.
4. Determine and compare the perceived level of mathematics integration in the Kentucky secondary school agricultural education curriculum by administrators for any correlations to specific demographic data.

Methods/Procedures

Kentucky secondary administrators were surveyed for their perceptions regarding mathematics integration in the agricultural education curriculum. An email list of administrators was compiled from the Kentucky Department of Education employee listing from the Kentucky Department of Education website. A total of 130 superintendents, 78 assistant superintendents, 170 principals, 369 guidance counselors and 128 professional development coordinators were emailed a copy of the instrument. Superintendents, assistant superintendents, principals, and professional coordinators comprised between 24% and 27% of email addresses being returned or seemingly invalid, while guidance counselors displayed nearly 38% of email addresses listed through the KDE database to be invalid, unwilling, or missing from the email list. Response rates for individual administrative positions included 31.5% for superintendents, assistant superintendents with 28.2%, principals with 28.8%, professional development coordinators with 28.1%, and guidance counselors indicating a 9.2% response rate yielding an overall response rate of 20.8%.

The instrument consisting of 71 statements and 17 demographic questions was created using a compilation of five of Thompson's (2000) surveys regarding science and mathematics integration, and modified to fit the spirit of this study. The respondents were asked to respond to 71 statements regarding different aspects of mathematics integration and agricultural education curriculum. The instrument was divided into 10 categories. These categories included *Agriculture and Mathematics*, *Teaching Integrated Mathematics, Barriers to Integrating Mathematics, Teacher Preparation Programs, Student Enrollment, Meeting State Standards, Collaboration, Administrator and Agriculture, Agriculture Program Support, and Relationships.* Their responses were measured using a five point Likert-type scale where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The participants were also asked a series of 17 demographic questions designed for a greater understanding of background information and school population characteristics.

The reliability and face validity were examined through the field study. The reliability of the instrument was found to be "very good" according to DeVellis (1991) with the Cronbach's alpha coefficient score falling between .80 and .90 from the results of the study yielding an (α=.895). Murray State University pre-service teacher candidates and selected faculty members served as the panel for review of the instrument due to the background in agricultural education. The student and faculty panel was asked to review the instrument for face and content validity.

Data was collected following the guidance of Dillman's (2000) *Tailored Design Method* and included five-points of contact. Non-response error was assessed using Dillman's

recommendations with no significant differences identified between those participants considered respondents and non-respondents. Data was analyzed using SPSS with means and standard deviations calculated.

Results and Findings

As indicated in Table 1, the administrators were the most unified in their response to the statement regarding the applied nature of mathematics in agriculture (*M*=4.68; *SD*=0.50). Administrators also rated three statements regarding the need for understanding mathematical concepts highly among the statements in this section of the survey (4.48, 4.44, and 4.44). Administrators agreed with the statements regarding student learning and motivation with an agricultural education curriculum integrated with mathematical concepts. However, the administrators were less positive on the statement, *Students are better prepared in mathematics after they have completed a course in agricultural education that integrates mathematics* (*M*=3.99; *SD*=0.73).

Table 1
Agriculture and Mathematics (n=182)

Statement	M	SD
Agriculture uses applied mathematics.	4.68	0.50
People pursuing a career in agriculture must have a greater understanding of mathematical concepts than they did ten years ago.	4.48	0.66
Agricultural education curriculum requires a greater understanding of mathematical concepts than it did ten years ago.	4.44	0.67
Students are more aware of the connection between mathematical principles and agriculture when mathematical concepts are an integral part of their agricultural education instruction.	4.44	0.54
Mathematical concepts are easier for agriculture students to understand when mathematics has been integrated into the agricultural education curriculum.	4.31	0.62
Students learn more about agriculture when mathematical concepts are an integral part of their instruction.	4.26	0.66
Students are more motivated to learn mathematical concepts when the concepts are integrated into the agricultural education curriculum.	4.24	0.74
Students are better prepared in mathematics after they have completed a course in agricultural education that integrates mathematics.	3.99	0.73

Note. Scale 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree.

Table 2 contained statements on the topic of teaching integrated mathematics. Respondents agreed that integrating mathematics into agricultural education curriculum would take more preparation time than currently required of non-integrated curriculum (3.78). Administrators agreed integrating mathematics into the agricultural education curriculum had increased the schools ability to solve problems (3.53). Statements regarding agricultural education teachers teaching integrated concepts (3.51), and agricultural education teachers being prepared to teach

integrated concepts (3.36) were also placed high among the statements ranked in this section. The two statements ranking lowest in this section were regarding their agriculture teacher integrating more mathematics into advanced agricultural education courses versus introductory courses (3.32), and their agricultural education teacher's ability to teach a general mathematics course (3.21).

Table 2
Teaching Integrated Mathematics (n=182)

Statement	M	SD
Integrating mathematical concepts into the agricultural education curriculum requires more preparation time for my agriculture teacher than before integrated concepts were emphasized.	3.78	0.76
Integrating mathematics into agricultural education courses has increased our schools ability to teach students to solve problems.	3.53	0.73
My agriculture teacher teaches integrated mathematical concepts in agricultural education.	3.51	0.83
My agriculture teacher is adequately prepared to teach integrated mathematical concepts.	3.36	0.91
My agriculture teacher has integrated more mathematics into advanced agricultural education courses than he/she has into introductory agricultural education courses.	3.32	0.75
My agriculture teacher is prepared to teach a general mathematics course.	3.21	1.03

Note. Scale 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree.

Table 3 consisted of statements about meeting state standards for Kentucky secondary school administrators through an integrated curriculum. Administrators agreed strongly that integrated mathematics would align agricultural education programs with Kentucky Department of Education standards (4.06). Respondents agreed an integrated program would help students meet Commonwealth Accountability Testing System (CATS) standards (4.03). Respondents indicated, almost identically, that students would be better prepared for standardized testing through contextualized agriculture courses (3.99), and mathematics teachers with an agricultural background should examine agricultural education curriculum for integration opportunities (3.99).

The first section of the instrument delved into the administrators' perceptions on the subject of agricultural education and mathematics. Administrators indicated this section contained the most agreeable statements of the study. The statement, *Agriculture uses applied mathematics* was the highest rated statement of the entire study with a mean score of 4.67 (SD 0.50). Administrators strongly agreed with this statement. The lowest ranked statement in this section was the statement, *Students are better prepared in mathematics after they have completed a course in agricultural education that integrates mathematics*, with a mean score of 3.98 (SD 0.72). This score indicated that even though this was the lowest score, administrators still agreed with the

statement. This was the only statement in this section that administrators did not indicate a strong agreement. The author concluded this section was highly rated due to the value placed upon the integration of core curriculum into career and technical education by administrators.

Section two focused on the administrators' perceptions regarding teaching integrated mathematics. The statement regarding integrating mathematical concepts into the agricultural education curriculum would require more preparation time for administrators' agriculture teacher than before integrated concepts were emphasized ranked the highest with a mean score of 3.77 (SD 0.76). Administrators agreed with this statement, but did not feel as strongly about statements from the previous section. Administrators indicated, with a mean score of 3.21 (SD 1.03), the statement, *My agriculture teacher is prepared to teach a general mathematics course* was the lowest rated in this section. The rating of statements in this section suggests administrators have more faith in their agricultural education teacher's ability to teach an integrated course than in the ability to teach a general mathematics course.

Table 3
Meeting State Standards (n=182)

Statement	M	SD
Integrating mathematics will help align agricultural education programs with emerging KDE educational standards.	4.06	0.60
Integrating mathematics will support agricultural education programs by helping our students meet C.A.T.S. standard requirements.	4.03	0.68
Students will be better prepared for standardized testing if they learn the application of mathematical concepts in agriculture.	3.99	0.65
Mathematics teachers with knowledge of agriculture should examine curricula and instructional materials to identify opportunities to incorporate agricultural education subject matter into mathematics instruction.	3.99	0.63
State standards (C.A.T.S.) are seen as an asset to what we are trying to achieve in our agricultural education program.	3.53	0.79
Agricultural education courses that integrate mathematics should be credited toward satisfying college admission mathematics requirements.	3.22	0.92

Note. Scale 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree.

The sixth section of the instrument included statements on the subject of meeting state standards. Administrators' perception of the statement regarding integration would help align agricultural programs with Kentucky Department of Education standards showed a strong agreement with the statement, with a mean score of 4.06 (SD 0.60). The statement, *Agricultural education courses that integrate mathematics should be credited toward satisfying college admission mathematics requirements* rated lowest among secondary administrators, indicating a mean score of 3.22 (SD 0.92). Examination of this section of research revealed secondary administrators advocate the use of Mathematics integration to improve the current curriculum in order to meet Kentucky Department of Education testing standards but did not believe integrated agricultural education courses should replace general mathematics for college admission credit.

Conclusions and Recommendations/Implications

Support for the integration of mathematics into the agricultural education is vital if this integrative instructional practice is to be successful. This study provided baseline data to ascertain the perceptions of secondary school administrators toward integrating mathematics. Data from this study can be used to assist agricultural education teachers, state departments of education, and teacher preparation programs. As administrator support is a key aspect of agricultural education program development and growth. Due to the positive perceptions of the administrators toward agriculture and mathematics there exists data that can be useful in making curriculum enhancements in agricultural education curriculum.

While the perceptions of the administrators were generally positive, areas of concern in this study exist. The administrators' perceptions of teaching integrated mathematics were mostly neutral, warranting further examination. Of primary concern relates to the administrators' concerns with their agriculture teacher's preparation to teach integrated mathematics. Using this as a call, this study can assist teacher preparation in planning curricular changes. Furthermore, the findings can be used as a foundation to develop and delivery professional development opportunities for in-service teachers.

While not concerning, the administrators' perceptions toward the requirement that mathematics teachers incorporate agriculture topics into mathematics instruction were interesting. Could these perceptions be the result of the administrator taking for granted that agriculture teachers must able to teach math to teach agriculture but mathematics teachers do not need to teach agriculture to teach mathematics? This provides an opportunity to provide professional development to secondary school administrators regarding the symbiotic relationship which exists between agriculture and mathematics. Additionally, this supports integrative instructional design. If integrating mathematics in agriculture education is viewed as positive and providing an effective context to facilitate mathematics instruction could not integrating agriculture in mathematics still provide that context? This question should be further investigated and expand to include mathematics instructors' perceptions of integrating agriculture and mathematics. Developing rapport between the agriculture and mathematics teachers will create a positive professional relationship which will support collaboration between the disciplines, resulting in enhanced agriculture and mathematics curricula.

References

Agustin, M., Agustin, M, Brunkow, P., & Thomas, S. (2012). Developing quantitative reasoning: Will taking traditional math courses suffice? An empirical study. *Journal of General Education, 61*(4), 305-313.

Anderson, R., Williams, R., & Hillson, J. (2008). Self-reported level of Mathematics integration of outstanding Virginia Agricultural educators. *Journal of Southern Agricultural Education Research, 58*(1), 81-93.

Belcher, G., McCaslin, N., & Headley, W. (1996). Implications of Performance Measures and Standards for Evaluation and Assessment in Agricultural Education. *Journal of Agricultural Education*, *37*(4), 1-7. https://doi.10.5032/jae.1996.04001

Berman, P., & McLaughlin, M. (1978). *Federal programs supporting educational change, Vol. 8. Implementing and sustaining innovations.* The Rand Corporation.

Brister, M., & Swortzel, K. (2009*). A comparison of attitudes of Agriscience teachers, counselors, administrators toward science integration with students' attitudes toward Agriscience programs* [Paper Presentation]. American Association for Agricultural Education Research Conference Proceedings, Louisville, KY.

Brown, J., Collins, A., & Dauguid, P., (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Buriak, P. (1992). *Filling the gap in Agriculture*. *The Agricultural Education Magazine, 64*(9), 4, 23.

Burris, S., Bednarz, A., & Fraze, S. (2008). *Investigating student achievement in mathematics: The effect of an integrated agriculture and mathematics curriculum* [Paper Presentation]. 2008 Western Region AAAE Research Conference

Center for Law and Education (1990). *Guide to designing systems of standards and measures for evaluating the performance of vocational education programs*.

Center for Occupational Research and Development (2010). *What is contextual learning?* Waco, TX. http://www.cord.org/contextual-learning-definition/

DeVallis, R. (1991). *Scale development*. Sage.

Dietel, R.J., Herman, J.L., & Knuth, R.A., (1991). *What does research say about assessment?* North Central Regional Educational Laboratory. Oak Brook.

Dillman, D. (2000). *Mail and Internet Surveys: The tailored design method.* Wiley and Sons.

Doss, W., & Rayfield, J. (2021). Comparing Texas principal and agricultural education teacher perceptions of the importance of teaching activities in agricultural education classrooms. *Journal of Agricultural Education, 62*(1), 1-16. https://doi.org/10.5032/jae.2021.01001

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, Intention, and Behavior: An Introduction to Theory and Research.* Addison-Wesley.

Foster, R., Bell, L., and Erskine, N., (1995). The importance of selected instructional areas in the present and future secondary agricultural education curriculum as perceived by teachers, principals, and superintendents in Nebraska. *Journal of Agricultural Education*, *36*(3), 1-7. https://doi.10.5032/jae.1995.03001

Greenwald, A. (1989). *Attitude, structure, and function.* Erlbaum Associates.

Kentucky Department of Education (2010). ACT Profile Report-State. *Kentucky State Testing 2009, Grade 11 Tested Students*. Commonwealth of Kentucky. Retrieved from http://www.education.ky.gov/NR/rdonlyres/61549509-C22B-4D50-AB8D-AED059EC934B/0/ACT_Kentucky_11_2009.pdf?

Klein, M. (1991). *The politics of curriculum decision-making. Issues in centralizing the curriculum.* State University of New York Press.

Moore, K., & Carlson, M. (2012). Students' images of problem contexts when solving applied problems. *The Journal of Mathematical Behavior, 31*(1), 48-59.

Myers, B., & Thompson, G. (2009). Integrating academics into Agriculture programs: A Delphi study to determine perceptions of the national Agriscience teacher ambassador academy participants. *Journal of Agricultural Education, 50*(2), 75-86. https://doi.10.5032/jae.2009.02075

National Commission on Excellence in Education (1984). *A Nation at Risk*. USA Research.

Rice, A., & Kitchel, T. (2017). Teachers' beliefs about the purpose of agricultural education and its influence on their pedagogical content knowledge. *Journal of Agricultural Education*, *58*(2), 198-213. https://doi.10.5032/jae.2017.02198

Robinson, K., Westfall-Rudd, D., Drape, T., & Scherer, H. (2018). Conceptualizing integrative agricultural education: Introductory framework for integrating mathematics in agricultural curriculum. *Journal of Agricultural Education*, *59*(4), 253-269. https://doi.10.5032/jae.2018.04253

Sloan, F., & Kelly, A., (2003). Issues in High-stakes Testing Programs. *Theory into practice*, *42*(1), 12-18.

Steen, L. (2002). Quantitative literacy: Why numeracy matters for schools and colleges. *FOCUS, 22*(2), 8-9.

Stubbs, E., & Myers, B. (2016). Part of what we do: Teacher perceptions of STEM integration. *Journal of Agricultural Education*, *57*(3), 87-100. https://doi.10.5032/jae.2016.03087

Swafford, M. (2018). The state of the profession: STEM in agricultural education. *Journal of Agricultural Education*, *59*(4), 87-100. https://doi.10.5032/jae.2018.04315

Thompson, G. (2000). *Principals' perceptions of integrating science into agricultural programs* [Paper Presentation]. 27th National Agricultural Education Research Conference, San Diego, CA

United States Department of Education, (2009). *The no child left behind act of 2001*. http://www.ed.gov/nclb/overview/intro/execsumm.html

Wells, J. (2015). *A technology perspective on the potential of STEM education*. Virginia Polytechnic Institute and State University.

Woglom, C., Parr, B., & Morgan, J., (2005) A comparison of commonwealth accountability atandardized testing scores between high school agricultural education/career and technical education students and Kentucky state standards. *Journal of Southern Agricultural Education Research*, 55(1).

Young, R., Edwards, M., and Leising, J. (2007). *Effects of a math-enhanced curriculum and instructional approach on student's need for post-secondary remediation in mathematics: A yearlong experimental study in agriculture power and technology* [Paper Presentation]. 2007 AAAE Research Conference, Minneapolis, MN.