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Observed Results and Possible Outcomes of Implementing a Veterinary Technology Program into High School Agriculture Departments in Texas

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ABSTRACT

As our nation strives to remain competitive in the global market, science and math curriculum have come to the forefront. Integrating science and math curriculum into high school agriculture courses allows students the opportunity to improve academically in all content areas. This study examined the current state of the veterinary technology program being taught in Texas high school agriculture departments, as well as determined the needs of those schools currently not teaching the program. The results of the study found that: 1) implementing the veterinary technology program increased enrollment of non-traditional and minority students in agriculture departments; 2) teachers agreed that science and math components of the veterinary technology program are important factors to consider when deciding to implement the program; 3) program faculty were most often the reason the program was implemented; and 4) teachers of the program were the primary curriculum developers. This study recommends agriculture teachers partner with the science and math departments to provide a rich science, technology, engineering, and math (STEM) content in their programs and that a mandatory curriculum training program be implemented for teachers teaching the veterinary technology program.

KEY WORDS: veterinary technology; science, technology, engineer, math (STEM) coalition; agricultural education

INTRODUCTION

As the national public school enrollment numbers increased from 1995 to 2005 by 9.5 percent while Texas' school enrollment numbers over the same ten year period, increased at an even faster rate, increasing by more than 20 percent (TEA, 2009; National Center for Education Statistics, 2007b). Not only did the number of students in Texas public schools increase, so did the diversity of the student population. African Americans, Hispanics, and other minorities have become the majority of the students enrolled in Texas public schools (*Policy Research*, 1998). However, these groups of students are still currently under-represented in high school agriculture programs (Talbert & Larke, 1995). Based on a review of the literature, minority students do not enroll in agriculture programs for a number of reasons. These reasons range from students viewing agriculture negatively due to misconceptions that agriculture deals only with the growing of crops, the lack of support from the guidance counselor, scheduling issues (Nichols &

Nelson, 1993), and changing graduation requirements for the current student (Knight, 1987). Overcoming these perceived barriers held by minority students can prove to be difficult. One way to combat the problem is to possibly spark an interest by offering new, more modern courses in agriculture.

In 2006, 61.6% of all high school graduates in the United States continued on to institutions of higher education (NCHEMS, 2006). By 2008, this number had increased to 68.6% (Bureau of Labor Statistics, 2009). The remaining 31.4 - 38.4% of high school graduates, then, must be trained for some form of employment while enrolled in high school. . From 1997-98 to 2007-08, the enrollment rate of CTE courses rose by 92.1 percent (TEA, 2009). The National Research Council (1988) recommended the continued expansion and improvement of vocational agriculture courses to include more scientific and technical course material in order to provide stable employment opportunities to those students that do not continue on to institutions of higher education.

Much attention has been directed toward increasing students' class time in the areas of math and science (Stephenson, Warnick, & Tarpley, 2007). This increased attention toward math and science is due in part to the United States falling behind other nations academically in these areas (OECD, 2010). In order to rectify the situation, the STEM (science, technology, engineering, and mathematics) Coalition was formed in order to increase awareness of these four areas in Congress (STEM Coalition, 2010).

Many researchers argue the fact that more academics should be integrated into vocational courses and vocational competencies into academic courses. This push toward integrating academic and vocational competencies is not a new one; this integration has been supported and promoted dating as far back as 1918 (Balschweid, 2001; Nolan, 1918; Warnick, Thompson, & Gummer, 2004; National Commission on Excellence in Education, 1983; National Academy of Science, Committee on Agricultural Education in the Secondary Schools, 1988; Secretary's Commission on Achieving Necessary Skills, 1991). The Perkins Act, upon being passed, encouraged collaboration between academic and vocational teachers, increased integration among disciplines, and increased the amount of real-life learning experiences offered to students (Lankard, 1992; Stephenson, Warnick, & Tarpley, 2007). Science has been incorporated into agricultural education curriculum since the Hatch Act of 1887 was passed; however it was not until 1988 that the National Research Council pressed researchers to detail methods to assist educators as they modernized the curriculum to make it more science-based (Budke, 1991; Christian & Key, 1994; Hillison, 1996; Thompson & Balschweid, 2000; True, 1929; Vaughn, 1993).

Integration of science into agriculture curricula has been shown to increase student achievement rates in both the science and agriculture content areas (Chiasson & Burnett, 2001; Enderlin & Osborne, 1992; Enderlin, Petrea & Osborne, 1993; Roegge & Russell, 1990; Warnick, Thompson, & Gummer 2004; Whent & Leising, 1988; Thompson & Balschweid, 2000). Veterinary technology is a high science and modern technology program which can help remove the perceived barrier that agriculture is only studying the production of crops and livestock. This perceived barrier can prevent minority students from enrolling in agriculture courses (Knight, 1987).

The employment field of veterinary technology is considered to be a very stable field during times of economic recession; layoffs are not likely to occur due to the continual need for animal health care (Bureau of Labor Statistics, 2010). In 2008, the field of veterinary technology was projected to increase by 36 percent, a much higher rate than the average of all other occupations according to the Bureau of Labor Statistics

(2010). According to the BLS, in 2008 79,600 people were employed as veterinary technicians. The BLS projects that by 2018, 108,100 people will be employed as veterinary technicians. Across the country, in May 2008, veterinary technologists earned a "median annual wage of $28,900" (BLS, 2010). Some technicians made significantly more, upwards of $41,490, and some made significantly less, around $19,770 (BLS, 2010).

The purpose of this study was two-fold: (1) to determine the current state of the veterinary technology program being taught in high school agriculture departments across Texas and (2) to determine the needs of those agriculture programs not currently teaching the veterinary technology program in the state.

METHODS

The target population of the study was comprised of high school agriculture teachers in the state of Texas. Agriculture teachers who are currently not offering the veterinary technology program was compiled from a list of 1,646 current high school agriculture teachers provided by the Texas Education Agency (TEA). A list of 143 current high school agriculture teachers who teach a veterinary technology program was also obtained from TEA. A random selection of 105 teachers teaching the veterinary technology program and 105 teachers not teaching the veterinary technology program were chosen to participate in the study. Due to firewall restrictions placed on teacher emails across the state, 105 of each group of teachers were reachable via email to participate in the study. The instrumentation for this study consisted of two questionnaires: one for agriculture programs with the veterinary technology program and one for agriculture programs without the veterinary technology program. The instrument included open and closed-ended questions, multiple choice questions, Likert-scale questions, and fill in the blank questions. The researcher developed the questionnaires based on a small pilot-test of agriculture teachers not included in the population for this study.

The data collection procedure used in this study was completed by emailing the randomly selected teachers a cover letter and link to the appropriate online survey hosted by SurveyMonkey.com. One week following the initial email, a reminder email was sent to those teachers that had not responded. The teachers completed the online survey and their answers were compiled into a spreadsheet by SurveyMonkey.com. The data was then downloaded from SurveyMonkey.com and imported into PASW 17.0 for analysis.

RESULTS AND DISCUSSION

The study consisted of three groups: agriculture departments with the veterinary technology program, agriculture departments without the veterinary technology program, and the veterinary technology program as its own entity. Three groups were utilized in the data analysis process to determine what, if any, significant results could be gleaned from comparing the agriculture departments with the veterinary technology program, the agriculture departments without veterinary technology program, and the veterinary technology program as its own entity. Demographic information was obtained for all three groups. As seen in Table 1, agriculture departments with the veterinary technology program were mostly female (M = 50.3%), while agriculture departments without the veterinary technology program were mostly male (*M* = 59.0%). The veterinary technology program consisted mostly of females (*M* = 59.4%).

Table 1. Gender Distribution of High School Students Enrolled.

Gender	Ag. w/ Vet. Tech	Ag. w/o Vet. Tech	Vet. Tech Only
	M	*M*	*M*
Males	49.7	59	40.6
Females	50.3	41	59.4

* All numbers appear in percentages.

Table 2 describes the ethnic break-down of each group; agriculture departments with the veterinary technology program consisted mainly of Caucasian (*M* = 58.5%), Hispanic (*M* = 29.2%), and African American (*M* = 10.0%) students. Agriculture departments without the veterinary technology program consisted mostly of Caucasian (*M* = 66.5%), other minority (*M* = 27.0%), and African American (*M* = 5.32%) students. The veterinary technology program consisted of Caucasian (*M* = 66.6%), Hispanic (*M* = 23.9%), and African American (*M* = 8.07%) students.

Table 2. Ethnicity Distribution of High School Students Enrolled.

Ethnicity	Ag. w/ Vet. Tech	Ag. w/o Vet. Tech	Vet. Tech Only
	M	*M*	*M*
Caucasian	58.5	66.5	66.6
African American	10	5.32	8.07
Hispanic	29.2	0	23.9
Asian	1.4	0.4	1
Native American	0.7	0.33	0.1
Pacific Islander	0.03	0.45	0.03
Other	0.17	27	0.3

* All numbers appear in percentages.

Out of 38 agriculture teachers who are currently teaching the veterinary technology program, 30 of them responded to the survey concerning their perceptions of the importance of the inclusion of science and math competencies (Table 3). The questions were based on a five point Likert scale with 1 being “strongly disagree” and 5 being “strongly agree.” With regard to the science component, the teachers currently teaching veterinary technology mostly agreed (*M* = 3.93) that it was an important factor when deciding to implement the program. When asked about the importance of the math component in the decision to implement the program, teachers currently teaching the program mostly agreed (*M* = 3.60) that this was an important factor to consider when deciding to implement the program.

Table 3. Importance Level of Science and Math in the Decision to Implement the Veterinary Technology Program.

Science and Math Component	*n*	*M*	*SD*
The science component of the veterinary technology program was an important factor in the decision to implement the program.	30	3.93	0.83
The math component of the veterinary technology program was an important factor in the decision to implement the program.	30	3.6	0.81

* Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral/No Opinion, 4 = Agree, 5 = Strongly Agree

Thirty-eight teachers were asked why the program was implemented into their program and 32 responded (Table 4). Teachers currently teaching the program responded that it was mostly due to faculty request (*M* = 50.0%), student request (*M* = 36.8), and career and technology education director request (*M* = 23.7%). According to these teachers, college requirements (*M* = 81.6%), superintendent requested (*M* = 78.9%), and principal requested (*M* = 73.7%) were least related to the implementation of the veterinary technology program.

Table 4. Implementation Reasons of the Veterinary Technology Program.

Reason for Implementation	Yes		No	
	n	%	*n*	%
Student Request	14	36.8	18	47.4
Parental Request	5	13.2	27	71.1
Faculty Request	19	50	13	34.2
Principal Request	4	10.5	28	73.7
Career and Technology Director Request	9	23.7	23	60.5
Superintendent Request	2	5.3	30	78.9
College Requirements	1	2.6	31	81.6
Other (please specify)	5	13	27	71.1

Thirty-eight teachers were asked about enrollment characteristics of the veterinary technology program and 32 responded (Table 5). The teachers currently teaching the program tended to agree (*M* = 4.03) that their program had continued to grow since its implementation. These teachers were mostly in agreement (*M* = 3.63) that the veterinary technology program was implemented to increase enrollment of non-traditional students into the agriculture department. Finally, agriculture teachers currently teaching the program were in agreement (*M* = 3.97) that the veterinary technology program has increased the enrollment numbers for the agriculture department as a whole.

Table 5. Agriculture Teacher Perceptions of Recruitment and Enrollment Trends of the Veterinary Technology Program.

Recruitment Information	*n*	*M*	*SD*
Since its implementation, our veterinary technology program has continued to grow.	30	4.03	0.89
Our school implemented the veterinary technology course to recruit non-traditional students into the agriculture department.	30	3.63	1.06
The veterinary technology program increased enrollment in the agriculture department.	30	3.97	0.85

* Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral/No Opinion, 4 = Agree, 5 = Strongly Agree

Thirty-eight teachers currently teaching veterinary technology were then asked a series of questions regarding how the program was implemented and information concerning the curriculum that is being used and 30 responded (Table 6). These teachers responded that they were neutral/no opinion (*M* = 3.03) when asked about their partnership with the science department at their school. Similar results (*M* = 2.90) were obtained when these teachers were asked about their partnership with the math department at their school. The curriculum information gained in the study showed that teachers currently teaching a veterinary technology program were neutral/no opinion (*M* = 3.27) regarding the availability of curriculum for the course. These teachers also tended to agree (*M* = 3.87) that the curriculum being used in the course was developed by the agriculture teacher in charge of the veterinary technology program. When asked about the facilities and materials used in the veterinary technology program, these teachers were neutral/no opinion for both areas (*M* = 3.17 and *M* = 3.23 respectively).

Table 6. Veterinary Technology Program Implementation and Curriculum Factors.

Implementation and Curriculum Factors	*n*	*M*	*SD*
The agriculture department has a strong partnership with the science department. (team teaching)	30	3.03	1.07
The agriculture department has a strong partnership with the math department. (team teaching)	30	2.9	0.99
The curriculum used in the veterinary technology program was readily available.	30	3.27	1.26
The curriculum used in the veterinary technology program was developed by the agriculture teacher in charge of the program.	30	3.87	1.01
The facilities available are adequate to teach the veterinary technology program.	30	3.17	1.51
The materials available are adequate to teach the veterinary technology program.	30	3.23	1.38

* Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral/No Opinion, 4 = Agree, 5 = Strongly Agree

Table 7 summarizes the training received by the agriculture teacher in charge of the veterinary technology program in preparation to teach the program, as well as, the certification and continued training of the students enrolled in the program. Thirty-eight teachers were surveyed and 30 responded. The teachers were neutral/no opinion (M = 3.17) when asked if their program was certifying students as Certified Veterinary Assistants. On all three questions regarding the continued education of the students in the field of veterinary technology (employment, associates degree, and enrollment in veterinary school) the teachers were neutral/no opinion (M = 3.07; M = 2.93; M = 2.70). With regard to the training received by the teacher in preparation to teach the program (received training; training was helpful; training was easily found), the teachers were neutral/no opinion (M = 3.50; M = 3.43; M = 3.13) on all questions.

Table 7. Veterinary Technology Certification of Students and Training of Agriculture Teachers.

Certification and Training	*n*	*M*	*SD*
The veterinary technology program is certifying students as Certified Veterinary Assistants with the Texas Veterinary Medical Association.	30	3.17	1.26
The majority of students enrolled in the veterinary technology program go on to be employed by a veterinarian.	30	3.07	0.94
The majority of students enrolled in the veterinary technology program go on to enroll in/complete an associate's degree in veterinary technology.	30	2.93	0.94
The majority of students enrolled in the veterinary technology program go on to enroll in/complete veterinary school.	30	2.7	0.84
The agriculture teacher received training specifically for the veterinary technology program.	30	3.5	1.4
The agriculture teacher found the training for veterinary technology helpful.	30	3.43	1.04
Teacher training for the veterinary technology program was easily found and enrollment was simple.	30	3.13	1.33

* Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral/No Opinion, 4 = Agree, 5 = Strongly Agree

Agriculture teachers who are not currently teaching the veterinary technology program were asked a series of questions about their perspective on the potential impact of the program (Table 8). When asked if the teacher thought adding the veterinary technology program would increase enrollment numbers of the agriculture department and non-traditional students, they were neutral/no opinion (M = 3.32; M = 3.35). Teachers agreed (M = 3.82; M = 3.76) that the math and science component of veterinary technology is an important factor in the decision to implement the program.

Teachers not currently teaching a veterinary technology program were also asked a series of questions to establish their school's need for such a program (Table 9). Most teachers not teaching the program agreed (M = 3.79) that their school was aware that the veterinary technology program existed. These teachers were neutral/no opinion regarding if their school has considered implementing this program or would be considered for future implementation (M = 3.03; M = 3.09). Teachers disagreed (M = 2.24) when asked if their school has offered the program previously. Teachers not teaching the program were neutral/no opinion when asked if more student interest or additional faculty would be necessary to implement the veterinary technology program (M = 3.35; M = 3.29). They agreed when asked if more funding or more facilities would be necessary to implement the program (M = 4.00; M = 3.91).

Table 8. Perspectives on the Impact of Implementing the Veterinary Technology Program.

Perspective	*n*	*M*	*SD*
The veterinary technology program would likely increase enrollment numbers of the agriculture department.	34	3.32	1.01
The veterinary technology program would likely increase enrollment numbers of non-traditional students in the agriculture departments.	34	3.35	1.01
The science component of the veterinary technology program would be an important factor to consider when implementing this program.	34	3.82	0.8
The math component of the veterinary technology program would be an important factor to consider when implementing this program.	34	3.76	0.78

* Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral/No Opinion, 4 = Agree, 5 = Strongly Agree

Table 9. Agriculture Departments Without Veterinary Technology Needs Assessment.

Need	*n*	*M*	*SD*
Our school is aware of the veterinary technology program	34	3.79	0.95
Our school has considered implementing the veterinary technology program.	34	3.03	1.11
Our school has offered the veterinary technology program previously.	34	2.24	1.23
The veterinary technology program would be considered for future implementation.	34	3.09	0.99
Additional student interest would be needed to implement this program.	34	3.35	1.04
Additional funding would be needed to implement this program.	34	4	1.13
Additional faculty would be needed to implement this program.	34	3.29	1.29
Additional facilities would be needed to implement this program.	34	3.91	1.14

* Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral/No Opinion, 4 = Agree, 5 = Strongly Agree

CONCLUSIONS & RECOMMENDATIONS

The purpose of this study was two-fold: (1) to determine the current state of the veterinary technology program being taught in high school agriculture departments across Texas and (2) to determine the needs of those agriculture programs not currently teaching the veterinary technology program in the state. The results of this study may be used to assist administrators, career and technology directors, and agriculture teachers in making a decision on whether or not to implement the veterinary technology program into their high school's agriculture department. The veterinary technology program has many positive attributes that should be considered when making such a decision.

This study found that the veterinary technology program is assisting in recruiting females and minorities into the agriculture department. The veterinary technology program is a more science-based program that allows females and minorities the opportunity to experience agriculture without having to study production agriculture, which, as found by Knight (1987), is one barrier to agriculture perceived by minority students. By adding the veterinary technology program to an existing agriculture department, one would be exposing a wider variety of students to the world of agriculture. In doing so, the FFA and agriculture departments alike would experience a growth in enrollment numbers. The agriculture teachers currently teaching the veterinary technology program agreed that implementing this program increased enrollment in the agriculture department (M = 3.97). Since both the FFA and agriculture departments are dependent on enrollment numbers for funding, the veterinary technology program would be a huge asset to these programs.

STEM content will play a role in many future course implementation decisions, regardless of department area, due to the emphasis being placed on such course information in Congress (STEM Coalition, 2010). The agriculture teachers currently teaching the veterinary technology program agreed that the science and math components of the veterinary technology program were important factors to consider when deciding to implement the program (M = 3.93; M = 3.60). Agriculture teachers not currently teaching the veterinary technology program agreed that the science and math components of the veterinary technology program would be important factors to consider when deciding to implement this program (M = 3.82; M = 3.76). Thus, conclusions can be drawn that curriculum which includes STEM content will be a determining factor for many schools in the decision to implement such a program.

Along with the emphasis on improving STEM proficiencies, the TAKS, Texas Assessment of Knowledge and Skills, tests have become the norms in high schools across TX to increase the accountability of individual schools and teachers. Thompson and Balshweid (2000) along with Roegge and Russell (1990) suggest that students will perform better academically when they are taught integrated science and agriculture course material. Increasing the students' performance in science will not only help the student succeed in their courses, but has the possibility to increase the students' performance on TAKS tests or other standardized tests. From the results of this study it is apparent that most agriculture teachers currently teaching the veterinary technology program do not have a strong partnership with either the science or math departments (M = 3.03; M = 2.90). In order for agriculture teachers to provide integrated courses with a rich STEM content, partnering between the agriculture department and the science and math departments is highly recommended by the researcher.

Teacher effects are the main influence on students' academic achievement rates (Wright, Horn, & Sanders, 1997). According to Wright et al,. (1997), the teacher's effect on student achievement rates was higher than any of the other factors studied in twenty out of thirty analyses. As the results of this study show, many of the agriculture teachers currently teaching the veterinary technology program agreed that they are the one responsible for developing the curriculum used in the course (*M* = 3.87). This is cause for concern with regard to the consistency with which the program is being taught. With multiple versions of the course being taught, each developed by the individual teacher in charge of the program, how can the teachers, students, parents, administration, or the state be certain that the students in these programs are learning the required material in a consistent manner across all programs? It is the recommendation of the researcher that a consistent framework for the curriculum be developed and implemented in this program to provide a more consistent delivery to the students enrolled in the program across TX.

One possible solution to the issue of inconsistent curriculum would be to require all agriculture teachers teaching the veterinary technology program to attend mandatory curriculum training for the course. At present, agriculture teachers currently teaching the veterinary technology program agreed (*M* = 3.50) that they received training specifically for the veterinary technology program. By requiring teachers to attend training for the veterinary technology program, a consistent framework for teaching the program could be distributed as well as guidelines for helping students to become certified as veterinary assistants.

A major goal of the veterinary technology program is to train and certify the students as Certified Veterinary Assistants. As evident from the results of this study, when asked if their program was certifying students, agriculture teachers were neutral/no opinion (*M* = 3.17). Agriculture teachers also responded similarly when asked if their veterinary technology students were continuing veterinary studies at institutions of higher education to gain an associates degree in veterinary science or enroll in veterinary school (*M* = 2.93; *M* = 2.70). It is recommended by the researcher that agriculture teachers concentrate on assisting their students in becoming Certified Veterinary Assistants. Increasing the rate of certification of the students enrolled will help to fulfill the goals of the program and provide those students with sufficient training to obtain stable employment regardless of their ambitions towards higher education. Increasing the rate of certification may also increase student matriculation into veterinary studies at institutions of higher education, whether it be an associates degree or veterinary school.

This study shows that the agriculture teachers teaching veterinary technology programs in high school agriculture departments agree that their programs have continued to grow since their implementation (*M* = 4.03). This could be due to demand/interest of the student population. As the economy has continued to make funding decision more difficult for school administrators, economically it makes sense to continue to fund a growing program. For agriculture teachers not currently teaching the veterinary technology program, teachers agreed that increased funding and more facilities were a definite need in order to implement this program (*M* = 4.00; *M* = 3.91). However, as seen through the results of this study, the benefits of implementing this program absolutely outweigh the increased funding and facilities requirements. This study shows that the veterinary technology program can increase the enrollment numbers of nontraditional students in the agriculture department, increase the enrollment number of minorities in the agriculture department, and can be integrated with science and math to meet STEM requirements. This program can also be given as science credit to be used towards student graduation requirements.

This study was directed toward Texas agriculture departments, thus generalizations should not be made beyond this population; however it does raise the question of similar issues existing in other states offering the veterinary technology program. Implementing science-based, technologically current programs into agriculture departments is needed to keep agriculture departments' enrollment numbers at sufficient levels. The study examined only a portion of the possible population; it may be beneficial to expand the survey population to all agriculture departments in Texas currently teaching the veterinary technology program to determine the extent to which the programs vary.

REFERENCES

Balshweid, M. A. (2001). Teaching biology using agriculture as the context: Perceptions of high school students. *28th Annual National Agricultural Education Research Conference*.

Budke, W. E. (1991). Agriculture science-striving for excellence. The Agricultural Education Magazine, 63(7), 4, 11.

Bureau of Labor Statistics, U.S. Department of Labor, *College Enrollment and Work Activity of 2008 High School Graduates*, 2009, Retrieved from http://www.bls.gov/news.release/hsgec.nr0.htm

Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2010-11 Edition*, Veterinary Technologists and Technicians, on the Internet at http://www.bls.gov/oco/ocos183.htm

Chiasson, T. C., & Burnett, M. F. (2001). The influence of enrollment in agriscience courses on the science achievement of high school students. *Journal of Agricultural Education*, 42(1), 61-71.

Christian, T., & Key, J. P. (1994). Agriscience equal to science. (Eric Document Reproduction Service No. ED 334 421)

Enderlin, K. J., & Osborne, E. W. (1992). Student achievement, attitudes, and thinking skill attainment in an integrated science/agriculture courses. *Proceedings of the Nineteenth Annual National Agricultural Education Research Meeting*, St. Louis, MO.

Enderlin, K. J., Petrea, R. E., & Osborne, E. W. (1993) Student and teacher attitude toward and performance in an integrated science/agriculture course. *Proceedings of the 47th Annual Central Region Research Conference in Agriculture Education*. St. Louis, MO.

Hillison, J. (1996). The origins of agriscience: Or where did all that scientific agriculture come from? Agricultural Education Magazine, 37(4), 8-13.

Knight, J. (1987). Recruiting and retaining students: A challenge for vocational agriculture. The Agriculture Education Magazine, 60(1), 9-10.

Lankard, B. A. (1992). Integrating academic and vocational education: Strategies for implementation. *ERIC Digest No. 120.*

National Academy of Sciences, Committee on agricultural education in the secondary schools. (1988). Understanding agriculture: New directions for education. Washington, DC: National Academy Press.

National Center for Education Statistics. (2007b). *Percentage distribution of enrollment in public elementary and secondary schools, by race/ethnicity and state or* *jurisdiction: Fall 1995 and fall 2005*. Retrieved November 4, 2010, from http://nces.ed.gov/programs/digest/d07/table/dt07_040.asp

National Center for Higher Education Management Systems (NCHEMS). *College-going rates of high school graduates - directly from high school*. (2006). Retrieved from http://www.higheredinfo.org/dbrowser/index.php?measure=32

National Commission on Excellence in Education (1983). A nation at risk: The imperative for educational reform. David P. Gardner (Chair). Washington DC: United States Department of Education.

National Research Council. (1988). Understanding agriculture: New directions for education. Washington DC.: National Academy Press.

Nichols, T., & Nelson, C. (1993). Hispanics in agriculture: Barriers to educational recruitment. *Proceedings of the 20th Annual National Agriculture Education Research Meeting, Nashville, TN*, 20, 15-21.

Nolan, A. W. (1918). *The Teaching of Agriculture*. Boston: Houghton Mifflin. OECD. 2010. PISA 2009 Assessment framework – Key competencies in reading, mathematics and science. Retrieved from the World Wide Web: http://www.oecd.org/document/44/0,3343,en_2649_35845621_44455276_1_1_1_1,00.html

Policy Research. Texas education agency policy planning and evaluation division. Report Number 11. July 1998.

Roegge, C. A. & Russell, E. B. (1990). Teaching applied biology in secondary agriculture: effects on student achievement and attitudes. *Journal of Agriculture Education*, 31(1), 27-31.

Secretary's commission on achieving necessary skills, U.S. Department of Labor (1991). What work requires of schools. Washington, DC: Author.

STEM Education Coalition. 2010. Retrieved from the World Wide Web: http://www.stemedcoalition.org/

Stephenson, L. G., Warnick, B. K., & Tarpley, R. S. (2007). Collaboration between science and agriculture teachers. *Proceedings of the 2007 AAAE Research Conference*. (34), 247- 263.

Talbert, B. A. & Larke, A. Jr. (1995). Factors influencing minority and non-minority students to enroll in an Introductory Agricscience Course in Texas. *Journal of Agriculture Education*, 36(1), 38-45.

Texas Education Agency. (2009). *Enrollment in Texas public schools, 2007-08.* (Document No. GE09 601 06). Austin TX: Author.

Thompson, G. W., & Balschweid, M. M. (2000). Integrating science into agriculture programs: Implications for addressing state standards and teacher preparation programs. *Journal of Agriculture Education*, 41(2), 73-80.

True, A. C. (1929). A history of agricultural education in the United States 1785-1925. Washington, DC: The United States Department of Agriculture.

U.S. Department of Education, National Center for Education Statistics (2010). *Digest of Education Statistics, 2009* (NCES 2010-013), Chapter 1.

Vaughn, P. R. (1993). Teaching agriscience: A few cautions. The Agricultural Education Magazine, 66(4), 4.

Warnick, B. K., Thompson, G. W., & Gummer, E. S. (2004). Perceptions of science teachers regarding the integration of science into the agricultural education curriculum. *Journal of Agricultural Education*, 45(1), 62-73.

Whent, L. S. & Leising, J. (1988). A descriptive study of the basic core curriculum for agricultural students in California. *Proceedings of the 66th Annual Western Region Agricultural Education Research Seminar*. Fort Collins, CO.

Wright, S. P., Horn, S. P., & Sanders, W. L. (1997). Teacher and Classroom Context Effects on Student Achievement: Implications for Teacher Evaluation. *Journal of Personnel Evaluation in Education*, 11(1), 57-67.