Relationships between Student Achievement and Levels of Technology Integration by Texas AgriScience Teachers

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Abstract

The purpose of this study was to determine if agriscience teacher integration of instructional technology was related to student achievement. A survey instrument was developed to collect information on the level at which teachers integrate technology into their instruction. Teachers' demographics, teachers' technology integration skill levels, teachers' administrative use of technology skill levels, and teachers' technology integration levels were collected from a random sample of 150 agriscience teachers in Texas. Student data were collected on 10th grade students in classes taught by the 150 teachers selected to participate in the study. The Texas Education Agency provided all TAAS data. The primary student variables used in the study to quantify math, reading, and writing achievement were the total number of multiple choice items correct for each of these three subject areas. A low positive correlation was found between student achievement in math and teacher instructional technology integration level (.14). Negligible positive correlations ($r < .10$) were found between teacher instructional technology integration level and student achievement on the writing portions and reading portions of the TAAS.

Introduction

Nationally, in 2001, there were 4.2 students for every instructional school computer, and the number of students per Internet-connected computer in schools dropped from 7.9 in 2000 to 6.8 in 2001 (Skinner, 2002). In 2001, the National Assessment of Educational Progress reported that Texas was above the national average with 3.7 students for every instructional school computer (Zehr, 2003). With this increase in instructional technology has been an increased concern for how this technology is being used and the impact that it has on student learning.

Richard Clark (1994) argued that the literature clearly demonstrates that use of instructional media, technologies used to deliver instruction, does not determine learning. Clark stated his argument most clearly as follows:

> "The best current evidence is that media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in nutrition. . . Only the content of the vehicle can influence achievement" (Clark, 1983, p. 445).

Clark's arguments were not popular among instructional technology researchers, but there is some empirical support for his ideas. In spite of theses findings there has been an increased emphasis on the integration of computers in the curriculum, especially in the ninth through twelfth grades. Educators have placed an emphasis on the need to prepare technologically literate students. Most states have adopted state technology standards and have charged schools with meeting those standards. Texas established the Texas Essential Knowledge and Skills (TEKS). These standards describe what students should know and what skills they should possess when using technology in each grade level.

Theoretical Base

With a focus on measurable outcomes, behaviorist theory helped to drive the integration of technology into the education system. "Because behaviorists seek to produce observable and measurable outcomes in students, they had a tremendous influence on the development of instructional technology" (Thompson et al., 1996, p. 10).

Researchers have debated for years the role that media has on student learning. Early on, as new technologies were developed and introduced to the education system, researchers typically began investigating the new technologies with media comparison studies. Most of these studies found no significant difference in achievement between instructional opportunities delivered through different mediums. Levie and Dickie (1973) stated that people can learn from a variety of media. Much of the research on different instructional technologies produced similar findings; people can learn when instruction is delivered through computers (Salomon & Gardner, 1986; Schlosser & Anderson, 1994).

Researchers in agricultural education have concluded that this holds true for agriscience classes as well. Students can learn through computer-mediated technologies (Murphy, 1999; Zidon & Luft, 1987). Salomon and Gardner (1986) and Schlosser and Anderson (1994) determined that content and instructional variables as well as media play large roles in student learning.

This research prompted many researchers to move from media comparison studies toward studies designed to assess how to most effectively use the technology. As the direction of instructional technology research changed, so did the theories that influenced it.

Clark and Salomon (1986) found that research on learning in education was moving from a behaviorist to a cognitive or constructivist theoretical base. When evaluating student learning from the cognitive learning perspective, learning was viewed as "the degree to which previously learned knowledge and skills can be transferred to new contexts and problems" (Clark & Surgure, 1988, p. 20). Cognitive theory defines learning as a process in which the learner is actively engaged in integrating new knowledge with old knowledge. This view of learning has altered the direction of instructional technology research because student ability, prior knowledge, motivation, and instructional methods are considered to be factors that influence whether or not learning will occur (Clark & Surgrue, 1988). In agricultural education at the collegiate level, Johnson, Ferguson, and Lester (1999, 2000) conclude that students' knowledge of and experience with computing, as well as their self-efficacy in dealing with computing problems, are important in their success in technology-mediated environments.

This study correlated teacher technology integration levels with student achievement. For this reason, this study was grounded in the behaviorist and cognitive learning theories.

Purpose

The purpose of this study was to determine if agriscience teacher use of instructional technology is related to student achievement in math, reading, and writing. To accomplish this purpose, the following objectives were proposed:

1. Determine the technology skill level of Texas agriscience teachers.
2. Determine the current level of instructional technology integration by Texas agriscience teachers.
3. Identify the Texas Assessment of Academic Skills (TAAS) test scores of students who were enrolled in agriscience courses of those teachers surveyed.
4. Determine if relationships exist between instructional technology integration by agriscience teachers and agriscience student achievement.

Methods

Population and Sample

The target population for this study consisted of single teacher agriscience programs, teachers, and their students in public secondary schools in the state of Texas. The accessible population was defined as single teacher agriscience programs in the sate of Texas during the 2002-2003 school year, both the teachers and their tenth grade students. Single teacher programs were selected in order to ensure that student data could be paired to the correct agriscience teacher within a particular school.

The sample frame of teachers was identified using the *Agriscience Teachers Directory System* (AST) housed at Texas A&M University. A sample was drawn by applying random sample techniques as described by Gall, Borg, and Gall (1996). The population was not sorted prior to sampling in order to ensure a truly random sample of all Texas single teacher agriscience programs. Desired sample size was determined to be 85 by using Cohen's table for determining sample size of a nondirectional study with an alpha of .05 (Cohen, 1988). Over sampling was employed to ensure a large enough final sample size could be obtained. The AST mailing list contained 1,876 names and addresses which served as the population. From the population, a sample of 213 names was randomly selected. After the initial random selection was made, names of 63 teachers were removed from the selection for not meeting the criteria of teaching in a single teacher department. The final sample consisted of 150 agriscience teachers.

The student data used in this study came from tenth grade students of the agriscience teachers in the sample. Tenth graders were selected as the participants because they are required by Texas state law to be tested using the TAAS test near the end of their tenth grade year. Student data was collected on tenth grade students from all high schools where there were more than five students in each category of data collection. The requirement of a minimum of five students was instituted by The Texas Department of Education in order to assure student anonymity. The Internal Review Board (IRB) at Texas A& M University approved collection of student data without the use of a student consent form provided the Texas DOE data collection requirements were adhered to.

Instrumentation

Teachers were asked to complete a three-part survey instrument. The first section included demographic information such as gender, teaching experience, age, availability of technology to the teacher, availability of technology to the students at the school, type of Internet connection available at the school, and where the teachers learned their technology skills. The second section included questions that were designed to determine the teachers' competence level concerning specific computers skills such as e-mail, word processing, spreadsheets, presentation software, internet, web pages, file management, presentation equipment, and using computers to complete administrative tasks. The third section included questions designed to determine the level at which teachers were comfortable with integrating technology into their teaching. The third section was modeled after the Intel Teach to the Future Scoring Guide for Integration of Technology by Teachers (Intel Teach to the Future, 2002). This third section used behavioral anchored response scales to assess the teachers' technology integration levels.

Reliability was not calculated on section one of the instrument as responses to demographic data by teachers were expected to be reliable and valid. Section two of the instrument had a reliability measure of .95 for the 42 questions measuring teacher technology skill level. Section three of the instrument had a reliability of .93 for the nine items that were used to measure teacher integration of technology.

The instrument used to measure student achievement was the TAAS test as administered by the Texas Education Agency in Spring of 2003.

Collection of Data

For the purpose of collecting data, Dillman's procedures for collecting survey data were used (Dillman, 2000). The initial contact for the final sample of 150 agriscience teachers was made via a packet that was mailed September 12, 2002. Three more mailings and one round of phone calls brought the total number of responses to 97 of the 150 randomly selected or a response rate of 65%. All data collection from teachers was completed by December 31, 2002.

Student data were collected by contacting the Texas Education Agency (TEA) and requesting a data file containing all TAAS data for students whose agriscience teachers participated in the study. The TEA produced data files containing the TAAS test scores for students who met the qualifications of completing the TAAS test in the Spring of 2003 and also who had been enrolled in agriscience class for either or both 2001-2002 and/or 2002-2003 school years. Of the 97 teachers who participated in the mail survey portion of this study, ten were removed from the study, as corresponding student data could not be collected for their students.

Analysis of Data

The data were analyzed using SPSS 11.5 (SPSS, Inc., 2003). The results generated were descriptive, comparative, and correlational. The first portion of the analysis process was descriptive. The survey described the current demographics of Texas agriscience teachers. SPSS 11.5 (SPSS, Inc., 2003) procedure *Frequencies* and *Descriptives* was used to calculate central tendencies, frequencies, and variability. The descriptive analysis was conducted on the demographic portions of the teacher data using SPSS 11.5. SPSS 11.5 procedure *Reliability Analysis* (SPSS, Inc., 2003) was used to determine the internal consistency of each measurement scale. Correlations were calculated using the procedure *Bivariate Correlation* (SPSS, Inc., 2003) to determine significant correlations between teacher data and student data.

Behavioral anchored response scales that range from "1" to "5" were used to make comparisons between technology competence levels of the teachers and technology integration levels of teachers and all data was recoded to a scale of 0 to 1.

Findings

Demographic Characteristics of Teachers

Only three of the teachers were female; 83 were male, one failed to respond to the gender question. The mean age of the 87 teachers was 41.9 years. The mode age range for the agriscience teachers was 31 - 40 years of age, and the median age was 40.7. The teachers possessed an average of approximately 15.0 years of teaching experience with a standard deviation of 10.2 years. Data in Table 1 provide a profile of the 87 participating agriscience teachers in this study.

Table 1. *Selected Frequencies of Demographic Characteristics for Texas Agriscience Teachers (N=87)*

Demographic Characteristics	f	% “yes”
Gender		
Male	83	95.4
Female	3	3.4
Age		
21-30 years old	16	18.4
31-40 years old	28	32.2
41-50 years old	19	21.8
51-60 years old	24	27.6
Teaching Experience		
1-5 years	21	24.1
6-10 years	14	16.1
11-15 years	13	14.9
16-20 years	11	12.6
21-25 years	13	14.9
26-30 years	3	3.4
31-35 years	9	10.3

Skill Level of Texas Agriscience Teachers

To accomplish the first objective of determining the technology skill level of Texas agriscience teachers, section two of the instrument measured the teachers’ technology skill level.

Teachers were asked questions measuring their competency on nine technology skill sets: 1) e-mail; 2) word processing; 3) spreadsheets; 4) presentation software; 5) Internet use; 6) creating web pages; 7) file management; 8) presentation hardware; 9) administrative use of technology. The questions asked of participants measured specific technology skills. Participants were asked to respond by circling “Y” for yes, they do possess that skill, or “N” for no, they do not possess that skill. Their responses were coded as “N” = 0 and “Y” = 1; so that if subjects responded “Y” to the five questions regarding word processing then they would have scored a 1.0 on their level of word processing proficiency.

A review of the literature and subsequent reliability analysis suggested that the technology skill portion of the teacher data could be condensed from nine "subscales" to only two measurement scales: 1) Teacher administrative use of technology skills; and 2) Teacher use of technology in instruction skills. Table 2 reports the mean and standard deviation of the two technology skill scales.

Table 2. *Descriptive Statistics for Scales Assessing Administrative and Instructional Level of Skills in Technology of Texas Agriscience Teachers (N=87)*

Technology Scale	M	SD
Administrative use of technology skill level	.61	.36
Instructional use of technology skill level	.63	.26

Overall, teachers believed that their skill level in administrative use of technology (mean = .61) to be essentially the same as their skill level in use of technology in instruction (mean = .63).

Current Level of Instructional Technology Integration by Texas Agriscience Teachers

To accomplish the second objective of determining the instructional technology integration level of Texas agriscience teachers, section three of the instrument measured the teachers' level of technology integration. Teachers were asked to rate their own competency on nine technology integration items, with these items being listed in table three.

The questions asked the teachers concerning their level of technology integration used behavioral anchored response scales on a scale of 1 to 5, with 1 being the lowest level of technology integration and 5 being the highest level of technology integration. These responses were then recoded on a scale of 0 to 1 so that comparisons could be made more easily between teacher technology skill levels and teacher technology integration levels. The resulting means listed in table three are on a 0 to 1 scale with 1 being the highest level of technology integration. The N, mean, and standard deviation are reported on each of the nine items and of the scale in Table 3.

Table 3. *N, Mean, and Standard Deviation for Level of Technology Integration by Texas Agriscience Teachers*

Technology Integration Item	N	M	S.D.
1. technology enhances student learning	87	.42	.22
2. technology is important to the lessons	84	.44	.20
3. relationships between technology and learning	86	.42	.22
4. technology is used in the lessons	86	.46	.22
5. lessons require higher order thinking skills	84	.44	.20
6. learning objectives are targeted	84	.40	.20
7. student's work utilizes technology	85	.40	.20
8. objectives align with the TEKS	83	.76	.20
9. obj. align with Tx Standards for Tech. Literacy	85	.36	.24
Technology Integration Scale (alpha = .91)	87	.46	.16

The scale score of .46 for the level of technology integration by teachers is lower than both their skill level of administrative use and of integration. In other words, the level at which they have been able to integrate technology into their instruction is less than their level of skills.

Texas Assessment of Academic Skills Test Scores for Students

The Texas Education Agency was contacted to allow accomplishment of the third objective of determining the academic achievement of the students as measured by their TAAS test scores. The TEA produced data files containing the TAAS test scores for students who met the qualifications of completing the TAAS test in the spring of 2003 and also being enrolled in agriscience classes for fall 2001, spring 2002, fall 2002, or spring 2003. Also, the student test scores collected were test scores of students who were enrolled in agriscience classes of the teachers who participated in the study.

Demographic information regarding the students who participated in this study is illustrated in Table 4.

Table 4. *Selected Frequency Demographic Characteristics of All Students in Sample (N=3009)*

Demographic Characteristics	f	%
Gender		
Male	2040	67.8
Female	969	32.2
Ethnicity		
White, not of Hispanic origin	2128	70.7
Hispanic	653	21.7
African American	200	6.6
American Indian or Alaskan Native	13	0.4
Asian or Pacific Islander	15	0.5
Participated in Free or Reduced Meals		
Not identified as economically disadvantage	2021	67.2
Eligible for Free Meals	798	26.5
Eligible for Reduced-Price Meals	174	5.8
Other Economic Disadvantage	16	0.5
English Proficiency		
Student Identified as LEP	87	2.9
Student Not Identified as LEP	2922	97.1
Special Education		
Student Participating in Special Ed	610	20.3
Student Not Participating in Special Ed	2399	79.7
Gifted and Talented		
Student Participating in Gifted/Talented	228	7.6
Student Not Participating in Gifted/Talented	2780	92.4

Correlations between Instructional Technology Uses by Agriscience Teachers and Agriscience Student Achievement

The individual student names and identification numbers were not provided, but their campus identification numbers were provided. The student and teacher data were paired using the campus identification number. The student variable that was used in statistical analysis for correlations that involved math, reading, and writing was the total number of multiple choice items correct for each of the three subject areas. Table 5 illustrates the teacher technology administrative skills, teacher technology integration skills, and teacher technology integration level correlated with student achievement scores on the TAAS math, writing, and reading scores.

Table 5. *Teacher Technology Administrative Skill Level, Teacher Technology Integration Skill Level, and Teacher Technology Integration Level Correlated with Student Achievement Scores on TAAS Math, Writing and Reading, (N=87)*

TAAS Sections	Admin. Skill	Integration Skill	Integration Level
Math Total Number Correct	.13	.10	.14
Writing Total Number Correct	.17	.12	.04
Reading Total Number correct	-.01	-.07	-.06

Data are presented on the teachers' level of skill in administrative use of technology and on the teachers' level of skill in integrating technology, but the teacher variable that most directly influences student achievement is the teachers' level of technology integration. While no statistically significant correlations were found at the inferential level for these variables, there were some 'descriptively significant" correlations in this sample (Davis, 1971). Low associations existed between the teachers' ability to use technology for administrative purposes and student math and writing scores on the TAAS. More importantly to the purpose of this study, Table 5 also illustrates a low positive association between how much the teacher actually integrated technology and the students' TAAS math scores. Also of note is that correlations were near 0 between teacher levels of integration of technology and students' reading and writing TAAS test scores.

Conclusions

Measuring teacher technology skills revealed that they were most proficient on Internet use with a mean response of .85, a mean of .81 for e-mail, .79 for word processing, .75 for integration of technology, .69 for file management, .56 for presentation hardware, .52 for presentation software, and a mean score of only .19 for creating web pages. The teachers scored a .61 for administrative use of technology skills and a .63 for instructional use of technology skills.

For student data the three key test categories that were analyzed by the researcher were math, writing, and reading achievement. The student variable that was used was the total number of multiple choice questions that the student answered correctly for each portion of the test. Total number of multiple choice items correct was used for this correlation because it generated the most accurate measurement of the students' actual performance on each portion of the test.

The primary purpose of this study was to determine if relationships existed between agriscience teacher integration of instructional technology and student achievement. The findings of this research show that there was, descriptively, a positive low correlation between student achievement on the math portion of the TAAS and teacher instructional technology integration level ($r = .14$). While Davis (1971) identified correlations of .10 to .29 as low associations, the researcher does recognize the "ambivalence" of low r values with regard to descriptive versus inferential conclusions.

Negligible correlations were found between teacher instructional technology integration level and student achievement on the writing portion and the reading portions of the TAAS.

While there are no cause and effect relationships addressed in this study, the findings of this study do offer support that a positive relationship exists between the level of agriscience teacher technology integration and student achievement in basic academic subjects. This information may help teacher educators better prepare in-service trainings for current agriscience teachers and may also help teacher educators have a better idea of what to teach to their current students.

Recommendations

This study found an r value of .14 for the correlation between student achievement on the math portion of the TAAS and teacher instructional technology level. These findings are correlational and do not attempt to show a cause and effect relationship, however these findings do contribute to the growing body of research that supports the role technology plays in improving student achievement in basic academic areas.

More research is needed to further explore this relationship. With this correlation in consideration, the following questions are recommended for further research:

1. Could there be a level of diminishing returns when it comes to the amount of technology that agriscience teachers integrate into their curriculum? With the existing curriculum standards that are in place for agriscience courses, it is evident that agriscience teachers already have obligations to what they are responsible for teaching in their classrooms. To what level should agriscience teachers integrate technology in order to maximize the benefit to their students?

2. Teachers scored .61 on administrative use of technology skills and .63 on technology integration skills level. However, they scored only .46 on actually integrating the technology into their curriculum. Therefore, to increase the level of technology integration, should teacher educators shift their focus (if one exists) from teaching new and current agriscience teachers' specific technology skills to a focus on training that involves actual integration of technology in instruction?

3. What is the disconnect that inhibits teachers from integrating instructional technology into the curriculum? Teachers integrate technology at a level far below their technology skill level. If this disconnect can be identified and addressed, then teachers and teacher educators may be able to eliminate it.

4. What is the cost effectiveness of integrating instructional technology into agriscience courses? Are there other variables positively correlated to student achievement that are less expensive per unit of student achievement? Could it be more beneficial to students if educators reallocate yearly technology budgets to

pay for more agriscience teaching assistants, supervised agricultural experience projects, or increased agriscience teacher salaries?

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