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EFFECTS OF INTEGRATING MATHEMATICAL CONCEPTS
INTO AN ANIMAL SCIENCE CURRICULUM

by

Andrea R. Clark

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Agricultural Systems Technology
(Secondary/Postsecondary Agricultural Education)

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2013

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ABSTRACT

Effects of Integrating Mathematical Concepts into an Animal Science Curriculum

by

Andrea R. Clark, Master of Science

Utah State University, 2013

Major Professor: Brian K. Warnick, Ph. D.

Department: Agricultural Systems Technology and Education

Nationwide, mathematical scores have been a topic of concern among elementary and secondary educators for many years. Decreasing math skills are also trickling into post-secondary education, requiring universities to provide additional remedial math instruction in colleges and universities. Studies have been conducted to discover the most effective pedagogical methods of teaching math. Teaching contextualized math has been found to be effective and includes providing a direct application to real-life scenarios rather than teaching linear equations and algebraic principles outside of their application.

A study was conducted measuring the effects of integrating mathematical skills in an animal science curriculum. Eight Utah schools participated in the research study. Students received a pretest measuring their existing mathematical skills and self-efficacy in math. All students were taught a unit of instruction about animal nutrition and feeding. The control group received a typical nutrition unit and the treatment group received the

same unit of instruction with the addition of mathematical skill integration. Students were taught to use the Pearson Square to calculate feed rations as well as solve basic equations to balance rations. Following the unit of instruction, students completed a posttest survey, which included a math attitudinal scale, posttreatment self-efficacy scale, and posttreatment math skills quiz.

There was no statistically significant difference in math self-efficacy or math skills between the control group receiving a typical nutrition unit and the treatment group which received the math-enhanced unit of instruction. Correlational statistics were gathered and showed a strong positive relationship between students' self-efficacy and math skills. Gender, grade level, highest completed math class, and grade received in highest-level math class were not found to be statistically significant predictions of math skills. Highest level of math completed and overall grade point average were statistically significant factors in predicting math self-efficacy.

PUBLIC ABSTRACT

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Andrea R. Clark
Utah State University

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CHAPTER 1
INTRODUCTION

Background

Nationwide, math test scores have dropped and are a subject of concern among teachers, administrators, and even college professors whose students do not have adequate entry-level math scores to be successful in college level math classes after high school (Howard & Whitaker, 2008). Colleges have responded by increasing their remedial math course offerings to help freshmen prepare for college level math courses. In order to fix this growing concern, educators must determine what motivates students to master and retain mathematical skills and determine what type of pedagogy is most effective.

The New York Times reported that changes are needed due to students' lagging performance on international tests (Lewin, 2006). Educational standards and objectives are under constant change and improvement. Lewin reported that a tighter focus on basic math skills was in play and that the "mile wide, inch deep" state standards were forcing elementary and secondary math teachers to teach dozens of math topics too quickly without taking the time for students to truly grasp and master the principles.

Colleges and universities are facing growing needs for remedial math courses in order for their students to be successful in college courses. It is also believed that math requirements actually hinder some students from pursuing a major they would otherwise choose if its math requirements were not so high (Howard & Whitaker, 2008).

Prior research has indicated that teaching math in its natural context is the most effective method for students to acquire and master true mathematical skills (Stone & Hansen, 2007). A traditional math classroom focuses on context-based problems to integrate into math curriculum. Stone, Alfred, and Pearson (2008), citing The National Council of Teachers of Mathematics (2000), reported, “Research has shown that disengagement or lack of interest is a factor in low student achievement” (p. 769). They also indicated that students typically disengage in the learning process due to difficulty with the subject, lack of support, boredom, or because the topic does not seem relevant to life after high school.

Most high school Career and Technical Education (CTE) classes have a natural bridge between math and its practical application. When math is applied within CTE curricula, students find it more relevant and are more motivated to master the concepts (Stone et al., 2008). An agricultural classroom setting has natural mathematical applications, allowing math principles to be mastered and retained. For example, animal feed and medication quantities must be calculated according to the weight of an animal before they are administered, ratios and proportions are calculated in the processing of agricultural products such as hamburger, and genetic inheritance probabilities are determined using mathematical equations. If properly applied to the agricultural curriculum, mathematical principles can be taught and applied to real-life scenarios that students can visualize and see the direct application of the concept.

Statement of the Problem

While more and more students struggle to learn and master mathematical skills in elementary and secondary classes, the effects and frustrations are merely a beginning to this problem. These frustrations may lead to remedial college math courses, fewer career options due to math requirements, and continued frustration (Howard & Whitaker, 2008). In 2011, the National Center for Education Statistics reported that only 35% of eighth graders in the state of Utah scored at or above proficient level. As students continue to struggle with mastering mathematical concepts, methods of teaching and reinforcing math skills need to be discovered and implemented. Agricultural education courses, specifically animal science, provide an opportunity for students to apply mathematical concepts using relevant contexts. The perceptions of and performance in math used by animal science students in Utah has never been assessed.

Purpose and Research Questions

This study investigates how the effect of integrating basic algebra concepts into an animal science course reflects on math achievement scores. A secondary purpose of this study is to explore the students' attitude toward and perceived ability to perform math skills when mathematical concepts are integrated into the animal science curriculum.

The following research questions guided the study:

1. Does the integration of algebra concepts into an animal science instructional unit improve students' ability to complete math problems?

Ho₁: There will be no significant difference in student math test scores when taught using applications in animal science.

2. Does the integration of algebra concepts into an animal science instructional unit improve students' self efficacy in math?

Ho₂: There will be no significant difference in students' perceived ability to master mathematic skills.

3. Is there a relationship between student math scores and their math self-efficacy?
4. What student characteristics are predictive of math self-efficacy and math performance?

Significance of the Study

This study was intended to provide valuable insight for integrating academic concepts, specifically math concepts, into agricultural education curricula. This study contributed to and built upon prior research in related studies as well as taking another step forward by focusing primarily on integrating math into animal science courses.

While other studies have focused on various theories and phenomenon in math pedagogy and achievement, no study has measured the confidence or self-efficacy of students in this type of math-enhanced animal science curriculum.

The overall goal of this study was to help determine a more effective teaching pedagogy for mathematical skills within the agriculture curriculum, which could result in long-term benefits for students. These potential benefits included improved student

grades in high school, improved motivation to master math skills, improved college entrance exam scores, and a more successful transition from high school to post-secondary math class placement.

CHAPTER II

REVIEW OF LITERATURE

The purpose of this chapter is to provide an overview of the available literature dealing with the effects of integrating mathematical concepts into the animal science curriculum. Based on the review of literature, Chapter II has been divided into the following sections: (a) theoretical framework; (b) math pedagogy; (c) math achievement; (d) math and gender; (e) attitudes about math; (f) self-efficacy in math; (g) math in career and technical education; and (h) math and agriculture. Information was obtained from the USU Library online databases using Google Scholar, Eric, and EBSCO host's Education collection. Searches were conducted using the following words or combination of words: math, achievement, gender, pedagogy, agriculture, career and technical education, self-efficacy, and attitude.

Theoretical Framework

In studying the known effects of integrating mathematic principles in the agricultural education curriculum as well as the development of self-efficacy in education, two theories were utilized to design this study.

To identify and measure self-efficacy, the theory of Bandura's Social Learning Theory (1977) was utilized as the theoretical framework. Bandura described self-efficacy as the strength of people's convictions in themselves and their own ability to cope with stress or challenging situations. Efficacy expectations determine how long someone will persist when faced with an obstacle or stressful situation. If their sense of perceived self-

efficacy is strong, they will not give up. Self-efficacy expectations lead to specific behavior. Behavior leads to an expected outcome, which leads to an actual outcome (Bandura, 1977).

In the design of this experiment, math was integrated into the CTE curriculum following the model of Parr, Edwards, and Leising (2006). Following this model requires that the majority of the lesson be CTE curriculum based materials with only a small portion of math enhancement. A conceptual model for this study, based on the Parr (et al.) model, is provided in Figure 1.

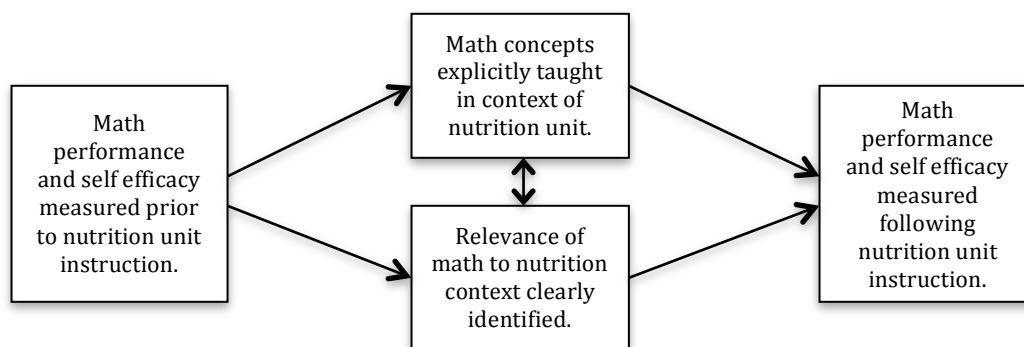


Figure 1. Conceptual model for math performance and self-efficacy related to contextual instruction within an animal science course.

Math Pedagogy

“Traditional” math instruction takes place in a specific math classroom and often consists of a daily routine where the teacher provides a demonstration of a math skill followed by an assignment to practice and memorize the steps of the skill. It also consists of a list of numerical problems to be solved, generally without a context or a

direct need to solve them. Dr. Virginia Warfield (cited in Lewin, 2006), of the University of Washington's Math Education Department said, "Traditional math instruction did not work for most students. It produces people who hate math, who can't connect the math they are doing with anything in their lives" (p. 2). Warfield further suggested that the struggle of knowing the best math teaching pedagogy lies between "mathematicians who say too many American students never master basic math skills, and math educators who say children who construct their own problem-solving strategies retain their math skills better than those who just memorize the algorithm that produces the correct answer" (Lewin, 2006, p. 1).

The contrasting math pedagogy is contextually based teaching and learning. Students learn mathematics best when they can see the concepts' applications in real-life (Shinn et al., 2003). This type of teaching and learning is typically taught with a direct application to authentic principles rather than to simple facts or memorization. Contextually based teaching and learning is more visual to the learner and can be seen in more than just numbers on a paper. "Research has shown that disengagement or lack of interest is a factor in low student achievement. Students may disengage from math because of difficulty with the subject, lack of support, or simply boredom. Many of these students believe that the math that they learn in school is not relevant to life after high school" (National Council of Teachers of Mathematics, 2000, p.769, cited by Stone et al., 2008). Recognizing these stumbling blocks allows educators to change their course of instruction and turn to a contextually based curriculum. Students must learn how to transfer the knowledge and skills they learn in a classroom to a "real world" application.

Another way to describe this method of teaching and learning is “curriculum integration.” Curricular integration models are methods of pedagogy that do not isolate each subject, but instead integrates them across the curriculum (Stone et al., 2008).

For example, a traditional agriculture class and a traditional math class each teach only agriculture and math principles without crossing over to another subject. In contrast, an integrated agriculture curriculum will teach principles of animal science including genetics, nutrition, and more while at the same time teaching students to apply related math skills such as calculating percentages, ratios, and other related calculations in order to master the skill in animal science. “A contextual mathematics approach requires that educators change the way in which they deliver content in order to produce enhanced thinking about and use of mathematics concepts among students” (Stone et al., 2008, pp. 771-772).

Though it seems very positive to rely on contextually based math instruction, it does have a drawback. In some cases, students are not able to transfer the knowledge learned in one context to another context (Stone et al., 2008).

Math Achievement

A study was conducted at Utah State University concerning students’ perceptions of successful and unsuccessful learning of math. The study interviewed numerous students who struggled in mathematics. All students who participated in the study identified an exact point in their education when they began to have problems understanding mathematical concepts. Howard and Whitaker (2008) refer to this as a

“turning point.” Students identified the exact grade they were in when the math struggles began. Directly following this “turning point” when their understanding of math decreased, their motivation to learn math also decreased. Students participating in the study who experienced success were consistently highly motivated students. In addition, students who struggled in learning mathematical concepts consistently disliked the subject (Howard & Whitaker, 2008).

While some factors influencing patterns of low math achievement are internal, external factors have also been identified such as class size, socio economic status, and teacher effectiveness. On an elementary and secondary education level, some students who lack basic math skills are still passed to the next grade without demonstrating proficiency in the prior math level (Howard & Whitaker, 2008).

An external factor in student achievement is the issue of class size. Class sizes in the public education system have increased over the years. This external factor has been identified across the education spectrum as being a cause for decreased performance in education (Akerhielm, 1995). The effects of class sizes have been studied and linked specifically to variables such as socio economic status, low achieving students, and elementary students in general. These sub groups are particularly sensitive to the ill effects of large class sizes (Akerhielm, 1995). A qualitative study observing elementary and secondary schools identified the following characteristics as being effected by class size: classroom behavior, student engagement, and teacher’s individual attention to students (Blatchford, Basset, & Brown, 2011).

Teachers also have a role and make a difference to students' motivation to learn mathematical principles. Howard and Whitaker identified the following teacher characteristics as most effective in motivating students to learn mathematical concepts: personal interest in each student, a willingness to help them learn outside of class, a comfortable classroom atmosphere, and clear, organized teaching presentations (Howard & Whitaker, 2008). Howard also identified highly effective teachers as those who are open to sharing their own experiences along their learning journey.

Math and Gender

Learning strengths and weaknesses have unique trends specific to gender. Some learning differences between boys and girls can be societal, but they can also stem from physiological differences in the brain (King, Gurian, & Stevens, 2010). More than 100 structural differences have been identified between a girl and boy's brain. These physiological and anatomical differences lead to learning differences in the classroom setting. For example, boys rely more on pictures and moving objects to learn, while girls excel simply with words and colors. Girls are more capable of sitting still and reading and boys require higher levels of learning engagement to prevent them from entering a state known as "neurological rest," or boredom. Boys are task oriented and more aggressive by nature, while girls are more likely to comply with rules and instructions from the teacher (King & Gurian, 2006).

Single gender classes have been studied and discovered that math scores for both boys and girls are higher than math scores in traditional classes with boys and girls

(McFarland, Benson, & McFarland, 2011). King et al. (2010) report that teacher education and certification programs lack the training teachers need to effectively teach boys and girls according to their strengths.

Historically, boys have outperformed girls in math (McFarland et al., 2011). However, some gender differences associated with performance have narrowed in recent years. In 1992, boys earned average test scores 0.25 standard deviations higher than girls (Pope & Sydnor, 2010). A 2010 study found that, although boys scored higher in math and science and girls scored higher in reading, an average score across the three subjects was basically equal (Pope & Sydnor). To add to these findings, there is also a trend showing that women that who experienced early success in math performance took more classes in math and science, which led to the likelihood of choosing science and math majors in postsecondary education (Trusty, 2002).

Attitudes Toward Math

Levels of motivation to learn math skills are correlated positively with academic success (Howard & Whitaker, 2008). In the study conducted at Utah State University, Howard and Whitaker discovered that, “Motivation was the most common reason given as the difference between unsuccessful and successful math skill development” (Howard & Whitaker, 2008, p. iv). In addition, Howard and Whitaker found that “when successful, students actually enjoyed learning mathematics and expressed confidence that they would be successful [in future math courses]” (p. iv).

Struggling math students report being more motivated to learn when math is applied to their situation and to their prospective vocation. Another method of improving student motivation to learn math principles is to make it directly applicable to the student. One task that must be accomplished to successfully teach math skills is to make math valuable and applicable in the student's life. Howard and Whitaker's (2008) study indicates that the struggling math student "does not see the value of their education for their future or how learning mathematics would apply to their situation, which consequently reinforced the negative attitudes towards having to learn mathematics" (p. 49).

Even having a positive attitude towards the subject of math is identified as a factor in successfully learning and mastering mathematical skills. To reinforce and increase efforts in math, students must begin by developing positive self-concepts (Fiore, 1999).

Self-Efficacy in Math

Akinsola and Awofala (2009) researched the effects of personalizing the context through which mathematical principles were taught. Research participants filled out an interest inventory prior to receiving math instruction. Following the interest inventory, a computer based program created practice worksheets that were individually tailored to each student's interests, but required the same problem solving techniques. At the conclusion of the study the control group, which did not receive personalized math instruction had an average test score of 10.81, while the test group had a mean test score

of 18.21. This study supports the theory that teaching math through a context increases confidence, enjoyment, and learning and that it can be considered a method of increasing self-efficacy in math.

Stevens, Olivarez, Lan, and Tallent-Runnels (2004) identified the primary factor in the development of self-efficacy in math to be a student's prior performance (grades) in math classes. If the student experienced success in prior math classes, they exhibited a higher level of intrinsic motivation to learn further math skills, which are directly correlated with both math performance and self-efficacy in math.

In a study conducted by Pajares and Miller (1997), the method of competency testing was reviewed to determine if there was a correlation between test format and self-efficacy. There was no significant difference between using a multiple choice formatted test and an open-ended question test format. Additionally, Pajares and Miller found that overall, boys reported a higher level of self-efficacy in math. Boys were also more accurate in predicting their performance than girls.

Math and Career and Technical Education

To some, the obvious solution to lagging math performance would be to require more mathematics courses in high school. However, increasing math requirements alone may not be the answer to the problem. Career and Technical Education (CTE) courses focus on students learning specific skills in their area of trade. Core academics and soft skills are naturally and easily embedded within CTE (Tews, 2011). What is learned in a CTE classroom is often specific and directly applicable to the student's life and potential

vocation. CTE classrooms provide a good opportunity to integrate math skills and curriculum with real life problems in areas of business, family and consumer sciences, agriculture, and other technical skills areas. Stone and associates (2008) stated, “CTE courses have the best potential for demonstrating to students that rigorous math is in fact highly relevant” (p. 791). CTE curriculum which has mathematical concepts integrated within the curriculum provides teaching and learning opportunities which incorporate real-world math skills which will prepare students for college and careers (Tews, 2011).

One obstacle to encouraging a math-enhanced curriculum in CTE courses is the lack of training of high school teachers. In a 2005 study of the relationship between teachers and their students’ math achievement, a direct relationship was identified between teacher training and student test scores. In order to improve student achievement in math, teacher achievement and skill must also be improved (Hill, Rowan, & Ball).

Stone and others (2008) investigated the effects of math and CTE integration. Over the course of one year, CTE teachers were paired with math teachers. Together they created a curriculum map identifying ways to integrate math skills into the CTE curriculum. The results of the study were positive showing that math and CTE integration could improve traditional math scores and that they could improve CTE students’ scores on a college placement math test. However, the study also concluded that CTE students’ scores on applied math tests did not improve (Stone et al., 2008). Incorporating math skills within a student’s area of interest will dramatically increase the retention and understanding of math skills (Tews, 2011).

In a study conducted at Michigan State University, preservice math teachers were interviewed about their pedagogical approach to teaching mathematical principles. The results of the study indicate that teaching math is more than simply adding up sums and equations within the math curriculum. Instead, it is a reflection of the teacher's ability to understand how knowledge and beliefs in multiple domains or subject areas interact one with another (Ball, 1998). As indicated in this study, it is important for teachers to have the ability to understand their curriculum in contexts such as those found in Career and Technical Education classes.

Math and Agriculture

A study of math-enhanced curriculum in agriculture classes was conducted by Parr and associates (2006) focusing on the effects of integrating math in the agricultural power and technology course. This study found that students who experienced the experimental treatment performed better on postsecondary math placement tests. This study supported other theories that, "providing a context in which learning may take place does hold value for improving student comprehension and retention of subject matter" (Parr, 2006, p. 89).

A study by Young, Edwards, and Leising (2009) focused on discovering if students taught using a math-enhanced agricultural mechanics curriculum gained equivalent technical competence when compared with students in a curriculum without math enhancement. The treatment group received math-enhanced lessons, which were designed specifically to increase the contextually based mathematics, found in the

agricultural power and technology curriculum. The result of the study indicated no significant difference in the acquisition of technical skills between students who experienced a math-enhanced curriculum and students who did not receive a math-enhanced curriculum (Young et al., 2009).

Summary

A study specifically measuring the effects of integrating math skills into the Animal Science curriculum could not be found. Limited studies have been conducted measuring math achievement in agricultural mechanics courses and other similar CTE courses. However, no previous study has measured self-efficacy and motivation in relationship to animal science curriculum and math integration.

In reviewing the literature, studies have indicated that effective math pedagogy includes applying the math principles to real life situations and making the math technique more visual. Additionally, studies have been conducted about increasing self-efficacy in students and improving student attitudes about math. However, few studies have been conducted measuring the effects of applying math in the agriculture curriculum and no known studies have been conducted researching the motivational and self-efficacy effects of applying mathematical principals in the Animal Science curriculum.

Further assessment of the effects of integrating math in the animal science curriculum is vital and will benefit students and school districts by supporting and teaching the value of cross-curricular education.

CHAPTER III

METHODS AND PROCEDURES

The purpose of this study was to assess the effects of integrating mathematic principles in the animal science curriculum to determine changes in math self-efficacy, math performance, and student preference. The results of this study will help agriculture teachers, Career and Technical Education directors, and state boards of education support and promote the value of Career and Technical Education to core curriculum. In addition, agricultural educators, state leaders, and school administrators will be able to see the need and benefit of providing professional development and the use of effective Professional Learning Communities to increase the quality of mathematical education and learning.

Research Design

This research study utilized a quasi-experimental approach using a Solomon Four-group design (Campbell & Stanley, 1963). The experiment consisted of four randomly assigned groups which included two control groups and two experimental groups of high school agriculture students enrolled in animal science courses. This design was selected to minimize threats to internal validity while enhancing external validity. The Solomon four-group design is particularly effective in determining whether the effects of testing influenced the results of the study.

The independent variable in this experiment was the explicit teaching of math concepts within an animal nutrition unit in an animal science course. The dependent variables were the test scores, student attitudes, and perceived ability to master

mathematical principles (math self-efficacy). Other extraneous variables included the time of day instruction was given and direct applicability to each participating student.

The study evaluated two factors: student motivation and self-efficacy in learning mathematical principles and mathematical test performance.

Participants

Eight schools were purposely selected throughout the State of Utah. Each participating school offered at least two sections of the Utah State Office of Education approved *Animal Science I* course taught by the same teacher during the last half of the 2012-2013 academic year. One section in each school was randomly assigned as a treatment group and one as a control group. The total number of study participants was 416 (224 treatment; 192 control).

Instrumentation

The math performance portion of the pre and posttests was developed with a math teacher to ensure the concepts and questions match competencies found on Utah Math Core Competency tests. The instrument used for measuring math performance was reviewed by a panel of experts including secondary mathematics teachers and university teacher educators. The instrument was pilot tested by an animal science class not included in the experiment and by a high school algebra class.

The attitudinal and self-efficacy instrument was developed by the researcher, using the expertise of high school math teachers and the math skills outlined in the state

standards and objectives. Questions were modified to specifically address the application of math concepts to the animal science context. This self-efficacy instrument was also reviewed by a panel of experts including university teacher educators and was pilot tested with a secondary math class and an animal science class not included in the research study. A copy of the pretest instrument is included in Appendix A and a copy of the posttest instrument is included in Appendix B.

Data Collection

The principal at each participating school was contacted prior to the research study to obtain permission (see Appendix C). Institutional Review Board approval was obtained and Letters of Information were developed and distributed to students and parents in English (see Appendix D) and Spanish (see Appendix E).

Training was provided by the researcher to the participating teachers to minimize the extraneous variable of the teacher. All curriculum including instructional PowerPoint presentations, notes, practice worksheets, and review activities were prepared beforehand and given to each participating teacher. The total instruction time for the entire unit was 5-7 days depending on whether the school had a traditional 5-6 period schedule or an A/B block schedule.

The experiment was conducted during the months of February and March, 2013. The pretest was administered randomly to half of the students in each group at least one week prior to the beginning of the unit of instruction. It was not given immediately prior to the unit of instruction in order to avoid biased or conditioned responses. This created a

baseline of mathematical knowledge and controlled for outside variables that could impact the final results.

Following the administration of the pretest, all experimental groups received instruction within the designed animal nutrition unit. Providing the manipulation to an experimental group that did not receive the pretest ensured the researcher was measuring a change caused by the manipulation and not by other outside factors. The manipulation included a unit of instruction that focused primarily on an animal science concept that required accurate algebra computing skills to reach mastery levels on the posttest.

Following delivery of the instructional unit, the math performance posttest and the math attitude and self-efficacy instrument was given to all of the subjects. The posttest measured students' math ability, perceived math ability, and motivation to learn math principles. Demographic information on all research subjects including grade level, gender, highest completed math class, and grade earned in highest completed math class was collected at the time of the pretest. This data allowed the researcher greater control in the research design and accounted for outliers in the final results. Gathering demographic information allowed the evaluation of correlational patterns associated with the test scores and the students' perceived ability and attitudes towards math.

Data Analysis

Research question one was analyzed by summing the correct answers for each student on the math performance posttest. These summated scores were analyzed by using a two-by-two analysis of variance (ANOVA). This allowed for comparisons to be made between and within the four groups and allow the research to accept or reject the null hypothesis. The significance level was set a priori at .05.

The data related to research question two was analyzed by summing the scores on the math attitude and math self-efficacy instrument. These summated scores were then treated as interval data and were analyzed using a two-by-two ANOVA with the significance level set a priori at .05.

A Pearson product-moment correlation was used to analyze the data related to research question three. Using the Pearson correlation allowed the research to explore the relationships between the math performance variables and the math self-efficacy variables. Question four was analyzed using multiple regression analysis.

CHAPTER IV

RESULTS AND FINDINGS

The purpose of this study was to measure the effects of integrating mathematical concepts into the animal science curriculum. Specifically, this study measured the change in students' math skills and self-efficacy in math when basic algebraic principles were integrated into the curriculum. Additionally, the research was used to determine if there was a relationship between math scores and self-efficacy. The results of this study will help guide teachers, teacher educators, and administrators in the process of developing effective professional development training for secondary CTE and math teachers.

Four objectives were established to achieve the purpose of the study. The objectives were to:

1. Measure the change in pre and posttest math scores of students receiving math enriched animal science instruction.
2. Measure the change in self-efficacy before and after receiving math enriched animal science curriculum.
3. Identify correlations between self-efficacy and math performance.
4. Determine which personal characteristics are predictive of math self-efficacy and of math performance

Descriptive Characteristics of Study Participants

The total number of animal science student participants in Utah was 416. A post hoc reliability analysis of the survey instrument was performed to determine if the instrument had an acceptable reliability value. Internal consistency was estimated at 0.773 using Cronbach's alpha.

There were four respondent groups in this study. A summary of the groups can be found in Table 1.

Table 1

<i>Description of Research Groups</i>			
Group	Participation in study		<i>N</i>
1	Control Group	Pretest, posttest, Animal Nutrition Unit without math integration	71
2	Experiment Group	Pretest, posttest, Animal Nutrition Unit with math integration.	85
3	Control Group	Posttest only following Animal Nutrition Unit without math integration	121
4	Experiment Group	Posttest only following Animal Nutrition Unit with math integration.	139

The entire research group consisted of 220 males (52.9%) and 196 females (47.1%). There were 13 (3.1%) 9th graders, 124 (29.8%) 10th graders, 205 (49.3%) 11th graders, and 74 (17.8%) 12th graders. Respondents reported their highest level math class completed. Results can be found in Table 2.

Table 2

Highest Completed Math Class of Research Participants (N = 414)

Class	N	%
General Math	35	8.4%
Algebra 1	87	20.9%
Geometry	119	28.6%
Algebra 2	144	34.6%
Trigonometry	11	2.6%
Calculus	10	2.4%
Math 1050 Concurrent Enrollment	8	1.9%

Students reported the grade they received in the highest completed math class.

Results can be found in Table 3.

Table 3

Grade Reported By Participants in Their Highest Level Math Class Completed (N = 410)

Grade	N	%
A	101	24.3%
A-	45	10.8%
B+	47	11.3%
B	57	13.7%
B-	20	4.8%
C+	38	9.1%
C	40	9.6%
C-	22	5.3%
D+	8	1.9%
D	15	3.6%
D-	9	2.2%
F	8	1.9%

Objective One: Measure the change in pre and posttest math scores of students receiving math enriched animal science instruction.

Math Performance Pretest

There was no statistically significant difference between the control group ($M = 5.070$, $SD = 1.760$) as compared to the mean of the experimental group ($M = 5.040$, $SD = 1.770$), $t(154) = 0.082$, $p = .606$ (two-tailed). Therefore, the researcher failed to reject the null hypothesis.

Math Performance Posttest

There was no statistically significant difference between the control group ($M = 4.960$, $SD = 2.100$) as compared to the mean of the experimental group ($M = 4.850$, $SD = 2.250$), $t(414) = 0.516$, $p = .935$ (two-tailed). Therefore, the researcher failed to reject the null hypothesis.

Two-way analysis of variance (ANOVA) was used to determine if differences existed on the posttest math performance score between the group that took both the pretest and the posttest measures and the group that took only the posttest measure. No statistically significant difference was found between the posttest scores of these groups, $F(3, 412) = 1.593$, $p = .190$.

Math Performance Gain

There was no statistically significant difference between the control group ($M = 0.140$, $SD = 1.510$) as compared to the mean of the experimental group ($M = 0.820$, $SD =$

1.760), $t(154) = 0.220$, $p = .827$ (two-tailed). Therefore, the researcher failed to reject the null hypothesis. A summary of math performance gain is provided in Table 4.

Table 4

Summary of Math Performance Gain

	Control Group	Experiment Group	<i>t</i>	<i>p</i>	<i>df</i>
Pretest Raw Score			.082	.935	154
Mean	5.07	5.04			
Standard Deviation	1.76	1.77			
Posttest Raw Score			.516	.606	414
Mean	4.96	4.85			
Standard Deviation	2.10	2.25			
Gain Raw Score			.220	.827	154
Mean	0.14	0.82			
Standard Deviation	1.51	1.76			

Objective 2: Measure the change in self-efficacy before and after receiving math enriched animal science curriculum.

Math Self Efficacy Pretest

There was no statistically significant difference between the control group ($M = 27.662$, $SD = 5.338$) as compared to the mean of the experimental group ($M = 28.859$, $SD = 4.577$), $t(151) = -1.493$, $p = .138$ (two-tailed). Therefore, the researcher failed to reject the null hypothesis.

Math Self Efficacy Posttest

There was no statistically significant difference between the control group ($M = 27.323$, $SD = 5.618$) as compared to the mean of the experimental group ($M = 28.022$, $SD = 6.326$), $t(414) = -1.183$, $p = 0.237$ (two-tailed). Therefore, the researcher failed to reject the null hypothesis.

Two-way analysis of variance (ANOVA) was used to determine if differences existed on the posttest self-efficacy score between the group that took both the pretest and posttest measures and the group that took only the posttest measure. No statistically significant difference was found between the posttest scores of these groups, $F(2, 412) = 1.656$, $p = .176$.

Math Self-Efficacy Gain

There was no statistically significant difference between the control group ($M = 0.019$, $SD = 0.223$) as compared to the mean of the experimental group ($M = .000$, $SD = 0.245$), $t(154) = 0.506$, $p = 0.614$ (two-tailed). Therefore, the researcher failed to reject the null hypothesis. A summary of math self-efficacy gain can be found in Table 5.

Objective 3: Identify correlations between self-efficacy and math performance

A Pearson Correlation was used to explore the relationship between self-efficacy measures and math performance. A large positive relationship (Davis, 1971) was found between math self-efficacy and math performance ($r = .425$).

Table 5

Summary of Math Self-Efficacy Gain

	Control Group	Experiment Group	<i>t</i>	<i>p</i>	<i>df</i>
Pretest Self Efficacy Raw Score			-1.493	.138	151
Mean	27.662	28.859			
Standard Deviation	5.338	4.577			
Posttest Self Efficacy Raw Score			-1.183	.237	414
Mean	27.323	28.022			
Standard Deviation	5.618	6.326			
Self-Efficacy Gain Raw Score			.506	.614	154
Mean	0.019	.000			
Standard Deviation	.223	.245			

Objective 4: Determine which personal characteristics are predictive of math self-efficacy and of math performance

Multiple regression analysis was used to determine which personal characteristics predicted math self-efficacy. Characteristics included self-reported grade point average in their most recent math class, highest level of math completed, grade level, and gender. These factors explained 13.7% of the variance ($r = .371$; r squared = .137). Highest level of math coursework completed ($t = 5.224$; $p < .001$) and overall grade point average ($t = 4.639$; $p < .001$) were statistically significant factors.

Multiple regression analysis was also used to determine which personal characteristics predicted math performance. Math self-efficacy, gender, grade level, grade point average in most recent math class, and highest level of math coursework completed were entered into the regression model. Just over 17% of the variance was

explained by the model ($r = .414$; r squared = .171). Math self-efficacy was the only statistically significant factor ($t = 7.665$; $p < .001$).

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Purpose and Objectives of the Study

The purpose of this study was to measure the effects of integrating mathematical concepts into the animal science curriculum. Specifically, this study measured the change in students' math skills and self-efficacy in math when basic algebraic principles were integrated into the curriculum. Additionally, the research was used to determine if there was a relationship between math scores and self-efficacy. The results of this study will help guide teachers, teacher educators, and administrators in the process of developing effective professional development training for secondary CTE and math teachers.

Four objectives were established to achieve the purpose of the study. The objectives were to:

1. Measure the change in pre and posttest math scores of students receiving math enriched animal science instruction.
2. Measure the change in self-efficacy before and after receiving math enriched animal science curriculum.
3. Identify correlations between self-efficacy and math performance.
4. Determine which personal characteristics are predictive of math self-efficacy and of math performance.

Conclusions and Discussion

There was no statistically significant difference in pretest and posttest math scores when comparing the control group and the treatment group. Therefore the researcher failed to reject the null hypothesis. Stone and associates (2008) identified one drawback to contextually based math instruction. They reported that in some cases students are unable to transfer math skills from one specific context to another. In this study, students were taught to mathematically balance a feed ration using the Pearson square. The Pearson square requires skills in solving basic algebraic equations, but the appearance of the math problem is very different than a typical, linear algebraic equation found in a traditional math class as well as on the pre and posttest. It is possible that the lack of statistically significant change in pre and posttest math performance in this study is due to this limitation.

There was no statistically significant difference in pretest and posttest self-efficacy scores when comparing the control group and the treatment group. Therefore the researcher failed to reject the null hypothesis. Possible limitations in measuring change in self-efficacy include survey fatigue and student's inability to recognize vocabulary and terminology used in the survey.

The study found a strong positive correlation between student's self-efficacy scores and their math performance. These study results match those found in Howard and Whitaker's (2008) study, which reported that students with decreased motivation had decreased math skills and highly motivated students experienced success.

There were two personal characteristics among research participants that predicted math self-efficacy or math performance. Highest completed math class and GPA in highest level math class showed a large, positive correlation. Gender and grade level were also observed and no statistically significant correlation was found. Numerous studies have historically labeled boys to be higher achievers in math (McFarland et al., 2011; Pope & Sydnor, 2010; Trusty, 2002). However, gender was not a statistically significant characteristic among the research participants. Both boys and girls performed with similar results.

The study was carried out following the conceptual model for math performance and self-efficacy (Figure 1). Math performance and self-efficacy were measured prior to the unit of instruction, math was taught relevant to the subject of animal science and in context to the subject of nutrition. Finally math performance and self-efficacy were measured through the use of a posttest. Additionally, following the model of Parr and associates (2006) the majority of the research unit was based in CTE curriculum and only a small portion of the unit required the use of math skills.

Some limitations of the study include the inability to identify and monitor various external factors related to math performance and math self-efficacy. Significant external factors as identified by Akerhielm (1995) include class size, socio economic status, and individual teacher differences. Ball (1998) discovered that teaching math is more than simply adding and subtracting. Though every effort was made to create an identical learning environment in each of the eight participating schools, teacher differences still exist. Another limitation in this study is the short amount of time between the pretest,

treatment, and posttest. This study measured the effects of only a single math-enhanced unit of instruction. Howard and Whitaker (2008) reported that students who struggle with math could remember an exact “turning point” when the struggles began. For many students, they have struggled for years and to expect a change in attitude and performance in such little time is too optimistic. Another limitation, which could not be controlled, is the level of interest of research participants in animal science. Howard and Whitaker (2008) reported that a math student who struggles needs to see the value and understand the direct application in his/her life in order to maintain a positive attitude and therefore higher math self-efficacy. Interest in the subject of animal science was not measured.

Recommendations and Implications

Although there were no statistically significant differences between those who received the math-enhanced animal science curriculum and those who didn't, teaching contextualized math did not decrease their ability to perform math or their motivation and self-efficacy in math.

By incorporating math throughout an entire class year, students may become more confident over a longer period of time. This change could take place due to a positive correlation between self-efficacy and math performance following increased exposure to contextualized math. Teacher educators can be encouraged to train pre-service teachers to design and teach integrated curriculum across multiple subjects. Classroom teachers can learn methods of improving student motivation to learn as they present more

advanced cross-curricular lessons. Administrators can also better implement the use of Professional Learning Communities, giving secondary teachers opportunities to collaborate with teachers of other subjects. For example, agriculture and other CTE instructors can improve their math skills by developing contextualized math and agricultural curriculum.

Recommendations for Further Study

In future studies it is recommended that the math taught in the integrated math lesson is directly transferrable to the math skills required on the pre and posttests. This additional measure will help students overcome the barrier and inability to transfer math skills from one context to another and potentially provide a more accurate measurement of change before and after the treatment.

Further studies should be conducted with similar lesson formats and math integration, but should cover a longer length of time. Changing student perceptions and self-efficacy in math, especially for students who often struggle with math will take longer than a single unit of instruction.

Additional insight could be found from a future study, which includes and compares math performance and math self-efficacy across the CTE department. Math performance and self-efficacy could be compared across CTE departments comparing students' ability to apply contextualized math in all CTE subjects including Family and Consumer Science, Business, Health Sciences, and so forth.

Another research focus could be to study the best pedagogical practices of teaching contextualized math by team teaching math-enhanced agricultural curriculum with a math instructor.

Final Statement

Although no statistically significant difference was found between the treatment group and the control group, the correlational findings can prove valuable in focusing efforts to improve math skills and self-efficacy in math on the factors that directly apply to the desired result.

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APPENDICES

APPENDIX A

Pretest Instrument

Part II. Math Self-Efficacy

Directions: Circle the number below that best describes your confidence in performing the math skills listed below.

Item	Not at all confident	Somewhat Confident	Mostly Confident	Totally Confident
I can solve an equation that requires simple addition and subtraction.	1	2	3	4
I can solve an equation that requires multiplication and division.	1	2	3	4
I can solve an equation with absolute values.	1	2	3	4
I can solve an equation in a story problem.	1	2	3	4
I can add and subtract any number between 0-100 without using a calculator.	1	2	3	4
I can solve difficult math equations if I work hard enough.	1	2	3	4
I could easily multiply 2 digit numbers in my head	1	2	3	4
I can solve math equations when they have a direct application or need in my life.	1	2	3	4
I can solve math equations if they are about a specific subject that I'm interested in.	1	2	3	4

Please turn the page and continue

Part III. Math Performance

Directions: Using your prior knowledge in math, solve the following equations.

1. $27 + y = -49$	2. $52 = 18 + j$
3. $9p = 63$	4. $b/3 = -5$
5. $1 = / 2 + p /$	6. $/ s / + 12 = 6$

7. After grain is harvested from the farm, it is loaded on to a truck and weighed before it is dumped into a silo. Shannon's ticket says her truck including the grain weighed 31,911 pounds. After it was emptied, the truck weighed 10,629 pounds. Wheat is sold by the bushel. A bushel is sixty pounds. How many bushels of wheat were on the truck?
8. You are mixing a feed ration for a horse. It includes alfalfa hay and a grain mixture. The total ration weighs 22 pounds. The hay should account for 83% of the total weight of the ration. How many pounds of hay would you feed?

Thank you for completing this assessment.

APPENDIX B

Posttest Instrument

School ID _____

Post Test Survey

Student ID Code: Please answer the following questions to create your own personalized code that only you will know. This will allow the researchers to match your pre-test answers with your post-test answers without knowing your identity.

What are the last two letters of your mother's first name? _____

What is the two-digit DAY of the month were you born?
(e.g., if I were born on February 4, I would answer "04") _____

*What are the first two numbers in your street address or
post office box number?* _____

Part I. Questions about You

Directions: Answer the following questions by choosing the best answer that represents yourself.

- _____ Gender
 - Male
 - Female
- _____ Current Grade in School
 - 9
 - 10
 - 11
 - 12
- _____ What is the highest level math course you have completed?
 - General Math
 - Algebra I
 - Geometry
 - Algebra 2
 - Trigonometry
 - Calculus
 - Math 1050 (Concurrent Enrollment)
- What grade did you earn in the class indicated in question #3?

a. A	e. B-	i. D+
b. A-	f. C+	j. D
c. B+	g. C	k. D-
d. B	h. C-	l. F

Please turn the page and continue

Part II. Math Attitudinal Scale

Directions: Circle the number on the scale that best represents your prior experiences and attitudes in math up to this point in your education.

5. Rate your motivation or interest in learning math principles.

1 2 3 4 5 6 7 8 9 10
 Little or no motivation Extreme Motivation

6. Rate the difficulty you experience in learning new mathematical skills.

1 2 3 4 5 6 7 8 9 10
 Extremely Difficult Easy to master new math skills

7. Rate how much you enjoy the subject of math.

1 2 3 4 5 6 7 8 9 10
 I hate it I love it

Directions: Now that you have completed the unit of instruction on Animal Nutrition and Feeding, answer the following questions by choosing the answer that best represents your attitude.

8. _____ Which of the following best represents your attitude toward math following this unit?

- a. I hate it even more
- b. No change
- c. It seems a little easier
- d. I like it much more, it's easier when it has real life application

9. _____ Compared to other units of instruction in Animal Science, how difficult did you feel this unit was?

- a. More difficult than other units
- b. Similar difficulty
- c. Less difficult than other units

Please turn the page and continue

Part III. Math Self-Efficacy

Directions: Circle the number below that best describes your confidence in performing the math skills listed below.

Item	Not at all confident	Somewhat Confident	Mostly Confident	Totally Confident
I can solve an equation that requires simple addition and subtraction.	1	2	3	4
I can solve an equation that requires multiplication and division.	1	2	3	4
I can solve an equation with absolute values.	1	2	3	4
I can solve an equation in a story problem.	1	2	3	4
I can add and subtract any number between 0-100 without using a calculator.	1	2	3	4
I can solve difficult math equations if I work hard enough.	1	2	3	4
I could easily multiply 2 digit numbers in my head	1	2	3	4
I can solve math equations when they have a direct application or need in my life.	1	2	3	4
I can solve math equations if they are about a specific subject that I'm interested in.	1	2	3	4

Please turn the page and continue

Part IV. Math Performance

Directions: Using your prior knowledge in math, solve the following equations.

1. $27 + y = -49$	2. $52 = 18 + j$
3. $9p = 63$	4. $b/3 = -5$
5. $1 = / 2 + p /$	6. $/ s / + 12 = 6$

7. After grain is harvested from the farm, it is loaded on to a truck and weighed before it is dumped into a silo. Shannon's ticket says her truck including the grain weighed 31,911 pounds. After it was emptied, the truck weighed 10,629 pounds. Wheat is sold by the bushel. A bushel is sixty pounds. How many bushels of wheat were on the truck?
8. You are mixing a feed ration for a horse. It includes alfalfa hay and a grain mixture. The total ration weighs 22 pounds. The hay should account for 83% of the total weight of the ration. How many pounds of hay would you feed?

Thank you for completing this assessment.

APPENDIX C

Principal Consent Request



December 6, 2012

Dear Principal _____,

Andrea Clark is leading a research study investigating the effects of integrating mathematical principles into an animal science curriculum. The purpose of the study is to investigate the effectiveness of integrating mathematical principles into an animal science curriculum. With increasing concern over math scores across the state and nation, I would like to investigate other methods of teaching and reinforcing mathematical skills outside of a traditional math classroom. As an agriculture teacher, I have noticed that students resist the integration of math skills in agriculture classes. However, I have also noticed that once they attempt to learn the skill, they experience success and often have an improved attitude towards the subject by the time they complete the unit of instruction. My goal is to do a formal study on this topic. The research questions for the proposed study include:

1. Will math skill competency improve after a math enhanced animal science lesson is taught?
2. Will students be more motivated to learn mathematical skills when applied to an animal science context?
3. Will students report an increased level of math self-efficacy when mathematical skills are taught in context of an animal science class?

All participating agriculture teachers will receive a complete lesson plan including all instructional materials for the Animal Feeding & Nutrition unit in the animal science class to be taught in February and March 2013. This unit of instruction does not deviate from the Utah Standards and Objectives of the approved animal science course. Other pertinent facts about the study include the following:

- Each student will take a pre-test and post test;
- Results of the study will be used to write a thesis and possible publication in a research journal;
- No individual identifiable student or school information will be published;
- Participation by students in the study will be voluntary and parent consent will be sought.

Before carrying out this study, approval must be received from the Institutional Review Board (IRB) at Utah State University. Part of the approval process requires that the principals of the participating schools give permission for the study to take place at their school. After reviewing this letter with details of the study, we ask that you draft a letter giving your consent. I have attached a Microsoft Word document with the letter I will use from my school. Please feel free to use this document as a template. Please print the letter on your school letterhead and send the signed copy via email if possible to andclarkrea@gmail.com. The letter could also be faxed to 435-797-4002 (attention Brian Warnick). We ask that this letter be received by December 19, 2012. Thank you for considering this.

Sincerely,

Andrea Clark
Agriculture Teacher and Graduate Student Researcher

Brian Warnick
Associate Professor

cc: Andrea Clark

Letter of Information- English Version



Page 1 of 2

LETTER OF INFORMATION

Integration of Mathematics into the Animal Science Curriculum

Introduction/ Purpose Andrea Clark, an agricultural science teacher and graduate student researcher at Utah State University, along with Dr. Brian Warnick, a faculty member in the Department of Agricultural Systems, Technology, and Education at Utah State University, are conducting a research study to find out more about the effects of integrating math in the animal science curriculum. Your child has been asked to take part because she or he is enrolled in an animal science class at a participating school. All animal science students at this high school are invited to take part in this research study. This school is one of eight high schools in Utah participating in this research.

Procedures If you agree to allow your child to participate in this research study, he or she may be asked to complete a pretest and survey. Your student will then be taught a unit of instruction in animal science, and will then be asked to complete a follow up test and survey. This unit of instruction is directly from the curriculum of the animal science class and does not deviate in any way from what students would normally be taught.

Alternative Procedures Instead of participating in this research, if you choose not to participate, your child may take part in the instruction without her or his pre and post test being included in the study.

New Findings During the course of this research study, you will be informed of any significant new findings (either good or bad), changes in the procedures, risks or benefits resulting from participation in the research, or new alternatives to participation that might cause you to change your mind about continuing in the study.

Risks Participation in this research study may involve some added risks or discomforts. Although procedures will be used to protect participant confidentiality, participation in this study includes the minimal risk of loss of confidentiality.

Benefits There may or may not be any direct benefit to you or your student from these procedures. The investigator, however, may learn more about ways to teach math to students so that their ability and attitudes toward math improve.

Explanation & offer to answer questions If you have other questions or research-related problems beyond what is explained to you in this letter, you may reach (PI) Brian Warnick at (435) 797-0378 or at brian.warnick@usu.edu.

Voluntary nature of participation and right to withdraw without consequence Participation in research is entirely voluntary. You or your student may refuse to participate or withdraw at any time without consequence or loss of benefits. Please let the student's animal science instructor know immediately if you or your student would not like his or her test or survey results to be included in this research study.



Page 2 of 2

LETTER OF INFORMATION

Integration of Mathematics into the Animal Science Curriculum

Confidentiality Research records will be kept confidential, consistent with federal and state regulations. Only the investigator and Andrea Clark will have access to the data which will be kept in a locked file cabinet or on a password protected computer in a locked room. To protect your student's privacy, personal, identifiable information will not be collected on study documents. A study identifier, created by each individual participant, will be used to match pre-test data with post-test data. Identifying information will not be collected in the course of this research study.

IRB Approval Statement The Institutional Review Board for the protection of human participants at Utah State University has approved this research study. If you have any questions or concerns about your rights or a research-related injury and would like to contact someone other than the research team, you may contact the IRB Administrator at (435) 797-0567 or email irb@usu.edu to obtain information or to offer input.

Investigator Statement "I certify that the research study has been explained to the individual, by me or my research staff, and that the individual understands the nature and purpose, the possible risks and benefits associated with taking part in this research study. Any questions that have been raised have been answered."

Brian Warnick
 Principal Investigator
 435-797-0378
Brian.warnick@usu.edu

Andrea Clark
 Student Researcher
 801-941-2891
andclarkrea@gmail.com

If you do NOT want your student to take part in the survey, check the box and return the form to the school no later than February 15, 2013. Please see the attached form for more facts about the surveys. If the student's teacher or principal cannot answer your questions about either survey, please call the Brian Warnick at 435-797-0378 or email brian.warnick@usu.edu. Copies of the survey questionnaires are available at school if you wish to review them. Thank you.

Student's name: _____ Grade: _____
 I have read this form and know what the survey is about.
 The student may NOT participate in this survey.
 Parent's signature: _____ Date: _____
 Phone number: _____

APPENDIX E

Letter of Information- Spanish Version



Department of Agricultural Systems Tech & Ed
2300 Old Main Hill
Logan UT 84322-2300
Telephone: (435) 797-0378



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Protocol 4918
IRB Password Protected per IRB Administrator

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Introducción/ Propósito Andrea Clark, una maestra de ciencias agrícolas e una investigadora estudiante graduada de Utah State University, junto con Dr. Brian Warnick, un miembro de la facultad en el Departamento de Sistemas Agrícolas, Tecnología y Educación de Utah State University, están conduciendo un estudio de investigación para saber más acerca de los efectos de la integración de las matemáticas en el currículo de la ciencia animal. A su hijo le ha pedido a participar porque se está matriculado en una clase de ciencia animal en una escuela participante. Todos los estudiantes de la ciencia animal en esta escuela secundaria son invitados a participar en este estudio en algún momento entre Febrero y Abril de 2013. Esta escuela es una de las ocho escuelas secundarias en Utah que están participando en esta investigación con una esperada participación total de aproximadamente 450 estudiantes.

Procedimientos Si usted permite que su hijo participe en este estudio, se le puede pedir a cumplir una prueba y investigación por encuestas. Su estudiante entonces será enseñado una unidad de instrucción en la ciencia animal, y después sería pedido a cumplir una prueba y encuesta posterior. Esta unidad de instrucción es directamente desde el plan de estudios de la clase de ciencia animal y no se desvía de alguna manera de lo que los estudiantes normalmente se enseña. El tiempo total por el estudio no será más de dos períodos de clase (uno por la primera prueba y otro por la prueba posterior) más de la unidad de instrucción que normalmente sería enseñada en la clase de ciencia animal.

Procedimientos Alternativos En lugar de participar en este estudio, si decide no participar, su hijo puede participar de la instrucción sin cumplir las pruebas que son incluidos en este estudio.

Nuevos Hallazgos Durante el curso de este estudio, será informado de cualquier nuevo hallazgo significativo (bueno o malo), cambios de procedimientos, riesgos o beneficios resultando de participación en el estudio, o Nuevo alternativas a participación que puede cambiar su opinión en cuanto a continuar con el estudio.

Riesgos Participación en este estudio puede implicar algunos riesgos o incomodidades adicionales. Aunque procedimientos estarían empleados para proteger la confidencialidad del participante, participación en este estudio incluye un mínimo riesgo de perder la confidencialidad.

Beneficios Puede o no puede haber ningún beneficio directo para usted o su estudiante de estos procedimientos. El investigador, sin embargo, puede aprender más acerca de las maneras a enseñar matemáticas a los estudiantes para que su capacidad y actitudes hacia las matemáticas mejorar.

Explicación y oferta de responder a las preguntas Si usted tiene otras preguntas o problemas con el estudio más allá de lo explicado en esta carta, puede comunicarse con Andrea Clark en 801-941-2891 o en andclarkrea@gmail.com. También puede comunicarse con Brian Warnick en (435) 797-0378 o en brian.warnick@usu.edu.

Libertad de participación y derecho a retirarse si consecuencia Participación en el estudio es totalmente voluntaria. Usted o su estudiante puede negar a participar o retirarse en cualquier momento sin consecuencia o pérdida de beneficios. Por favor informe al instructor de ciencia animal



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inmediatamente si usted o su estudiante no quieren que sus resultados de la prueba o encuesta ser incluido en este estudio.

Confidencialidad Registros de la investigación se mantendrán confidenciales, de acuerdo con las regulaciones federales y estatales. Solo el investigador y Andrea Clark tendrán acceso a los datos que guardan en un archivador bajo llave o en un computador protegido por contraseña en una habitación cerrada con llave. A proteger la privacidad de su estudiante, la información personal identificable no será recogida en los documentos del estudio. Un identificador de estudio, creado por cada participante, será utilizado para coincidir datos de la primera prueba con los de la posterior. Información de identificación no serán recogidos en el curso de este estudio de investigación.

Declaración de aprobación de IRB The Institutional Review Board por la protección de participantes de Utah State University ha aprobado este estudio de investigación. Si tenga alguna pregunta o preocupación acerca de sus derechos o una lesión relacionada con la investigación y quería comunicarse con alguien que no sea del equipo de investigación, puede comunicarse con el Administrador de IRB en (435) 797-0567 o email irb@usu.edu para obtener más información o ofrecer su opinión.

Declaración Investigador “Certifico que el estudio de investigación se ha explicado a la persona, por mí o por alguien del equipo de investigación, y que el participante comprenda la naturaleza y propósito, los posible riesgos y beneficios asociados con la participación en este estudio. Las preguntas que tenían ha sido resultados.

Brian Warnick
Principal Investigator
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Si no desea que su estudiante participar en la encuesta, firmar con iniciales abajo y volver la forma a la escuela antes de 15 de Febrero de 2013. Por favor vea la forma adjunto por mas datos sobre la encuesta. Si el maestro del estudiante o el principal no puede contestar su preguntas acerca de la encuesta, por favor llame a Brian Warnick en 435-797-0378 o email brian.warnick@usu.edu .

Copias de la encuesta están disponibles en la escuela si quiere revisarla. Gracias.

Nombre de Estudiante: _____ **Grado:** _____

He leído esta forma y entiendo el propósito de la encuesta.

_____ **El estudiante NO puede participar en la encuesta.**

Firma de Padre: _____ **Fecha:** _____

Numero de teléfono (con código de región): _____