Career and Technical Education with Embedded Math

A Special Project

Presented to

Dr. Robert P. Kraig

Heritage University

In Partial Fulfillment

of the Requirements for the Degree

Master of Education

Kevin John Wilson

Summer 2009

FACULTY APPROVAL

Career and Technical Education with Embedded Math

A Master's Special Project

by

Kevin John Wilson

Approved for the Faculty

____, Faculty Advisor

Dr. Robert P. Kraig

ABSTRACT

Title

Researcher: Kevin John Wilson, B.A. in Ed., Industrial Technology, CWU
M.Ed., Heritage University

Chair Advisory Committee: Robert P. Kraig, PhD.

The purpose of the project was to help students master the math skills needed to pass high stakes assessments, to be skilful in the technical fields, and be able to use math as a problem-solving tool as adults. The goal was to help students master the math necessary for them to improve their achievement on math tests and to be successful in their work arena without decrease in their technical skills. Mossyrock students come from many different social-economic backgrounds and rely on many different learning styles. This project was significant because many students had difficulty applying math concepts and skills to real life situations and some students found it easier to learn math concepts that are on high stakes assessments by applying them in hands on activities.

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Introduction

Background for the Project

Math has been a difficult subject for many students and they have typically had difficulty passing the math section of the Washington Assessment of Student Learning (WASL). Teachers have tried many different methods of teaching math but there were few opportunities to use math in a practical manner in real life situations. Students might have been able to understand math concepts and methods better if they could have used it in an application*, e.g. using fractions when measuring and cutting wood.* Adequate Yearly Progress (AYP) was one of the cornerstones of the federal Elementary and Secondary Education Act (ESEA) signed into law January 2002, as the No Child Left Behind (NCLB) Act. In Washington State, it was primarily a measure of year-to-year student achievement on the WASL in reading and mathematics. One of the requirements of NCLB was that states develop a baseline or starting point for students to achieve proficiency as measured by WASL math and reading scores. Each year the state must "raise the bar" in gradual increments so that by 2013-2014, all (100%) students will achieve proficiency in each subject area.

Statement of the Problem

Mossyrock Middle School students did not have the math skills necessary to pass the high stakes assessments and perform common math tasks used in everyday life as an adult. In an attempt to embed math in other classes for improving math skills, they simply emphasized the math already within the curriculum. Career-Technical Education (CTE) teachers could work to make math more explicit with meaningful context. That means that the math usually found in textbooks could be applied in real-life situations in their CTE classes. For example, in a building trades class, they would use the Pythagorean theorem as they construct a building.

Purpose of the Study

The purpose of the project was to help students master the math skills needed to pass high stakes assessments, be skillful in the technical fields, and be able to use math as a problem-solving tool as adults. The goal was to help students master the math necessary for them to improve their achievement on math tests and to be successful in their work arena without decrease in their technical skills.

Delimitations

This project was delimited to Mossyrock Middle School which was comprised of boys and girls in the 7th and 8th grades during the 2008/2009 school year. Mossyrock students come from many different social-economic backgrounds and had many different learning styles. In October 2008 there were 128 students enrolled in grades 7-8 in the middle school that was the focus of this study. The ethnicity of the middle school was broken down into 60% white, 31.1% Hispanic, 3.6% Black, 3.6% Asian and 1.5% American Indian/Alaskan Native. In May2007 32.3% of the student population received free or reduced-price meals and 13% were receiving Special Education services (OSPI, 2007).The participants used in the study were from the Career and Technichal Education Woodshop program.

Assumptions

These are statements of what the author knows of the circumstances which relate to the problem.

1. All students will do their best in the survey.
2. All students will try their best on the pre-test.

3. All students will try their best on the post-test

All students in the study received equal amounts of instructional time with the embedded math. Students received only embedded instruction in the classroom and teachers were not allowed to supplement embedded materials.

Hypothesis

Students who take Middle School Career and Technical Education Woodshop class with embedded math will score higher on a WASL prompt test than Middle School students who do not take a woodshop class with embedded math. Students who are enrolled in an embedded math class will believe they have stronger test strategies when taking a high stakes assessments.

Null Hypothesis

There will be no significant improvement in students' math skills as a result of taking a middle school Career and Technical Education woodshop class with an embedded math, and they will not score higher on assessments when compared to middle school students who took an embedded math component class.

Significance of the Project

This project was significant because many students had difficulty applying math concepts and skills to real life situations. Some students may find it easier to learn math concepts that are on high stakes assessments by applying them in hands on activities. Teaching a CTE course with embedded math would reinforce the math curriculum and provide students another approach to learn math skills for lifelong applications. The math usually found in textbooks would be applied to real-life situations in their CTE classes. For example, in a Building Trades class students would use the common math vocabulary as they constructed a building, such as pitch is equal to slope.

Procedure

For the purpose of this project, the following procedures were implemented.

1. Permission to conduct research at Mossyrock School District was granted by Principal Karl Miller (see Appendix A)
2. A review of literature was conducted to investigate current research results that pertain to learning math and using high-stakes tests.
3. The survey was approved by Principal Karl Miller (see Appendix A)
4. A survey was created to poll students on Math strategies. (see Appendix B)
5. A pre-test was administrated on October 15, 2008 (see Appendix C)
6. A post-test was administrated on January 28, 2009(see Appendix C)

Definition of Terms

For the purpose of this study, the following words are defined:

Pedagogy or pedagogy is the art or science of being a teacher.

The term generally refers to strategies of instruction, or a style of instruction. Pedagogy is also sometimes referred to as the correct use of teaching strategies. In correlation with those teaching strategies the instructor's own philosophical beliefs of teaching are harbored and governed by the pupil's background knowledge and experiences, personal situations, and environment, as well as learning goals set by the student and teacher.

Curriculum (plural curricula) is the set of courses, and their content, offered at a school or university. As an idea, curriculum stems from the Latin word for *race course*, referring to the course of deeds and experiences through which children grow and mature in becoming adults.

No Child Left Behind Act of 2001 (Public Law 107-110), often abbreviated in print as NCLB and sometimes shortened in pronunciation to "nickel bee", is a controversial United States federal law (Act of Congress) (co-Authored by Democratic Rep. George Miller of California and Democratic U.S. Sen. Edward Kennedy of Massachusetts) that reauthorized a number of federal programs aiming to improve the performance of U.S. primary and secondary schools by increasing the standards of accountability for states, school districts, and schools, as well as providing parents more flexibility in choosing which schools their children will attend.

Adequate Yearly Progress, or AYP, is a measurement defined by the United States federal No Child Left Behind Act that allows the U.S. Department of Education to determine how every public school and school district in the country is performing academically. AYP has been identified as one of the sources of controversy surrounding George W. Bush administration's Elementary and Secondary Education Act. Private Schools do not have to make AYP.

Vocational education or *Vocational Education and Training*, also called *Career and Technical Education* (CTE), prepares learners for jobs that are based in manual or practical activities, traditionally non-academic and totally related to a specific trade, occupation or *vocation*, hence the term, in which the learner participates. It is sometimes referred to as *technical education*, as the learner directly develops expertise in a particular group of techniques or technology. (Shapire, L. 2006).

Acronyms

CTE. Career and Technical Education

WASL, Washington Assessment of Student Learning

NCLB, No Child Left Behind

ELL, English Language Learners

WEA, Washington Education Association

OSPI, Office of the Superintendent of Public Instruction

AYP, Adequate yearly process

ESEA, Elementary and Secondary Education Act

CHAPTER 2

Review of Selected Literature

Introduction

This chapter summarizes research results on how (a) effective learning styles, (b) effective teaching strategies, (c) NCLB, and (d) CTE with embedded math could be used to improve math skills, and score higher on high stakes testing (i.e. the WASL). This outcome was not only desirable from a teaching and learning standpoint, but it was also required to meet Adequate Yearly Progress under the federal NCLB law and the graduation requirements in the state of Washington.

Effective learning styles

Teaching and learning practices in education urgently need improvement witnessed by the recommendations of several national commissions on education and the difficulties teachers face with the diverse preparation of today's students. Learning style was a concept that could be important in this movement, not only in informing teaching practices but also in bringing to the surface issues that help teachers and administrators think more deeply about their roles and the organizational culture in which they carry out their responsibilities.

Learning style has been the focus of considerable study, and a number of colleges and universities have made it an important part of their work. The many approaches to learning style can be examined at four levels: (1) personality, (2) information processing, (3) social interaction, and (4) instructional methods. One researcher, however, speculated that several models in fact described correlates of two fundamental orientations in learning: "splitters," who tend to analyze information logically and break it down into smaller parts, and "lumpers," who tend to watch for patterns and relationships between the parts (Kirby 2003).

Information about style can help faculty become more sensitive to the differences students bring to the classroom. It can also serve as a guide in designing learning experiences that match or mismatch students' styles, depending on the teacher's purpose. Matching is particularly appropriate in working with poorly prepared students and with new college students, as the most attrition occurs in those situations. Some studies show that identifying a student's style and then providing instruction consistent with that style contribute to more effective learning. (Kirby 2003)

In other instances, some mismatching may be appropriate so that students' experiences help them to learn in new ways and to bring into play ways of thinking and aspects of the self not previously developed. Any mismatching, however, should be done with sensitivity and consideration for students, because the experience of discontinuity can be very threatening, particularly when students are weak in these areas. Knowledge of learning style can thus help faculty design experiences appropriate for students in terms of matching or mismatching and enable them to do so thoughtfully and systematically. (Shapire, 2006)

Information about learning style was extremely helpful in student affairs. In counseling, for example, style may suggest which approaches to counseling to use for particular students. Further, when students have problems in courses, it can guide counselors' efforts at intervention. In orientation, it can help students understand their own preferences and strengths in learning and be a stimulus for developing new ways of learning.

Learning style is useful in the work setting as well. It enables administrative leaders to be more insightful about using staff members in ways that call on their greatest strengths. At the same time, the use of information about learning styles reminds us that an institution that is seriously interested in the development of students as a purpose needs to embrace such a concept for teachers and administrators as well.

Effective teaching strategies

Researchers at Mid-continent Research for Education and Learning (Roberts 2005) have identified nine instructional strategies that are most likely to improve student achievement across all content areas and across all grade levels. The following is an overview of the research behind these strategies as well as some practical applications for the classroom.

The ability to break a concept into its similar and dissimilar characteristics allows students to understand (and often solve) complex problems by analyzing them in a more simple way. Teachers can either directly present similarities and differences, accompanied by deep discussion and inquiry, or simply ask students to identify similarities and differences on their own. While teacher-directed activities focus on identifying specific items, student-directed activities encourage variation and broaden understanding, research shows. Research also notes that graphic forms are a good way to represent similarities and differences.
Applications use Venn diagrams or charts to compare and classify items and engage students in comparing, classifying, and creating metaphors and analogies. (Roberts 2005)

Summarizing and note taking skills promote greater comprehension by asking students to analyze a subject to expose what's essential and then put it in their own words. According to research, this requires substituting, deleting, and keeping some things and having an awareness of the basic structure of the information presented. Applications provide a set of rules for creating a summary when summarizing, ask students to question what is unclear, clarify those questions, and then predict what will happen next in the text. Research shows that taking more notes is better than fewer notes, though verbatim note taking is ineffective because it does not allow time to process the information. Teachers should encourage and give time for review and revision of notes; notes can be the best study guides for tests. Applications use teacher prepared notes and stick to a consistent format for notes, although students can refine the notes as necessary.

Effort and recognition speak to the attitudes and beliefs of students, and teachers must show the connection between effort and achievement. Research shows that although not all students realize the importance of effort, they can learn to change their beliefs to emphasize effort. Applications share stories about people who succeeded by not giving up and to have students keep a log of their weekly efforts and achievements, reflect on it periodically, and even mathematically analyze the data. According to research, recognition is most effective if it is contingent on the achievement of a certain standard. Also, symbolic recognition works better than tangible rewards. Applications are to find ways to personalize recognition and give awards for individual accomplishments. Plus give “Pause, Prompt, Praise.” If a student is struggling, pause to discuss the problem, and then prompt with specific suggestions to help her improve. (Gay 2003)

Homework provides students with the opportunity to extend their learning outside the classroom. However, research shows that the amount of homework assigned should vary by grade level and that parent involvement should be minimal. Teachers should explain the purpose of homework to both the student and the parent or guardian, and teachers should try to give feedback on all homework assigned. Teachers are to establish a homework policy with advice, such as keeping a consistent schedule, and setting a time limit those parents and students may not have considered. Teachers should also tell students if homework is for practice or preparation for upcoming units and maximize the effectiveness of feedback by varying the way it is delivered. Research shows that students should adapt skills while they're learning them. Speed and accuracy are key indicators of the effectiveness of practice. One method is to assign timed quizzes for homework and have students report on their speed and accuracy focus practice on difficult concepts and set aside time to accommodate practice periods. (Wilson, A. 2005)

According to research, knowledge is stored in two forms: linguistic and visual (Wilson, A. 2005). The more students use both forms in the classroom, the more opportunity they have to achieve. Recently, use of nonlinguistic representation has proven to not only stimulate but also increase brain activity. Lesson should incorporate words and images using symbols to represent relationships and use physical models and physical movement to represent information.

Research shows that organizing students into cooperative groups yields a positive effect on overall learning. When applying cooperative learning strategies, keep groups small and don't overuse this strategy; be systematic and consistent in your approach, and consider a variety of criteria, such as common experiences or interests. Vary group sizes and objectives, design group work around the core components of cooperative learning-positive interdependence, group processing, and appropriate use of social skills, face-to-face interaction, and individual and group accountability. (Marzano 2002)

Setting objectives can provide students with a direction for their learning. Goals should not be too specific; they should be easily adaptable to students' own objectives. Applications set a core goal for a unit, and then encourage students to personalize that goal by identifying areas of interest to them. Questions like "I want to know" and "I want to know more about . . ." get students thinking about their interests and actively involved in the goal-setting process. Use contracts to outline the specific goals that students must attain and the grade they will receive if they meet those goals. (Marzano, 2002).

Feedback generally produces positive results. Teachers can never give too much; however, they should manage the form that feedback takes. Make sure feedback is corrective in nature; tell students how they did in relation to specific levels of knowledge. Rubrics are a great way to do this. Keep feedback timely and specific and encourage students to lead feedback sessions (Marzano, 2002).

Research shows that a deductive approach (using a general rule to make a prediction) to this strategy works best. Whether a hypothesis is induced or deduced, students should clearly explain their hypotheses and conclusions. Teachers should ask students to predict what would happen if an aspect of a familiar system, such as the government or transportation, were changed, and ask students to build something using limited resources. This task generates questions and hypotheses about what may or may not work (Ibid).

Cues, questions, and advance organizers help students use what they already know about a topic to enhance further learning. Research shows that these tools should be highly analytical, should focus on what is important, and are most effective when presented before a learning experience. For example, pause briefly after asking a question. Doing so will increase the depth of your students' answers. Vary the style of advance organizer used: Tell a story, skim a text, or create a graphic image. There are many ways to expose students to information before they "learn" it. (Scott 2006)

<u>No Child Left Behind (NCLB)</u>

The Elementary and Secondary Education Act (ESEA) of 1965 was the first federal aid program for the reform of public schools. Then, President Ronald Regan's *A Nation at Risk* report in 1983 gave the United States of America a grave picture of the nation's schools. American schools were failing miserably, and local, state, and federal reform efforts were needed immediately. There was a call for more and better assessment measures to compare American students with the economic competitors of the United States of America. *A Nation at Risk* called for the use of test scores and a diagnosis for the reform measures needed in our nation's schools. NCLB gave the ESEA a new name. President George W. Bush made strict accountability changes for schools, and NCLB was enacted by Congress in 2001 and signed into law in January 2002.

Major changes to federal education programs were made by NCLB. By the year 2005, all teachers had to be highly qualified, meaning a bachelor's degree and the successful completion of rigorous tests in core subjects. If a student was taught by a teacher who was not highly qualified for more than four weeks, parents were notified. The law required states to set high standards for student achievement and use tests to assess how well students met the standards. States were called to inform parents and the public about school and district performance through annual report cards issued by the state education agency. Schools were required to make Adequate Yearly Progress (AYP) in improving student achievement, and schools were held accountable if AYP was not shown (Henderson, 2002). The goal of NCLB was to boost student achievement and ensure success for all students. The Education Commission of the States called NCLB the progressive reform waves which, "… built the basic structure of public education in the United States, those that guaranteed access for all students, and, now, those focused on ensuring the success for all students" (Henderson, 2002).

CTE with Embedded Math Curriculum

The Math-in-CTE model was a curriculum integration model designed to enhance mathematics that was embedded in CTE content. It's a process that provides the opportunity for math and CTE teacher teams to work together in communities of practice and to identify where math intersects with CTE concepts and applications. This process leads to the creation of math-enhanced CTE lessons that follow a seven-element pedagogic framework. Premised on five core principles, the research-based Math-in-CTE model has been shown to have a significant positive impact on student learning in mathematics with no loss to career and technical area content. (Pearson 2006)

There were five core principles which where needed for the successful implementation of the Math-in-CTE model. These principles are critical in the Math-in-CTE approach to improving the math skills of students.

A. Develop and sustain a community of practice among the teachers.

B. Begin with the CTE curriculum and not the math curriculum.

C. Understand that math is an essential workplace skill.

D. Maximize the math in the CTE curriculum.

E. Recognize that CTE teachers are teachers of math-in-CTE, and not math teachers. (Pearson 2006)

Implementation of the Math-in-CTE model requires a critical mass of CTE teachers from a specific career area. Examples of such areas include: Auto Technology, Health Sciences, and Business and Marketing. Each CTE teacher is partnered with a math teacher for extended professional development throughout the academic year. Math teacher partners are essential to the model because they serve as a resource to help career teachers with any math questions they may have and they provide valuable input for bridging the gap between academic and CTE worlds. The community of practice formed by these partnerships is vital to the success of the model.

Professional Development with the Math-in-CTE model requires that CTE teachers and their math partners participate together in a series of workshops in which they learn the basics of the model and prepare for implementing the math-enhanced lessons into the CTE courses. The professional development consists of 10 total days throughout the year: five days in the summer prior to the start of school, two in the fall, two in the winter/spring and one final day at the end of the school year to reflect, celebrate, and plan for future work.

To map the curriculum in CTE-math, teacher teams work together to interrogate the CTE curriculum and identify areas where the mathematics naturally occurs in the CTE content. In the Math-in-CTE model, math concepts are not forced into or superimposed on the CTE curriculum. Instead, the process always begins with the CTE concepts and applications to ensure the integrity of the curriculum as embedded math within it is enhanced. Creating Math-Enhanced lessons to specific CTE concepts suitable for math enhancement are identified; the teacher teams begin the process of creating their lesson plans using a seven-element pedagogic framework.

Developing a scope and sequence in the Math-in-CTE model is not a replacement curriculum, rather it is a process of integration through which the mathematics in any existing CTE curriculum may be enhanced. Therefore, once the CTE concepts are identified and math-enhanced lessons are developed, each CTE teacher creates a personalized scope and sequence plan for scheduling and teaching the lessons when they should occur in his/her own curriculum.

When teaching the lessons during the professional development sessions, CTE teachers are given opportunities to present and practice teaching the lessons with their peers. Prior to teaching these math-enhanced lesson plans in the classroom, the CTE and math teachers meet to discuss any math questions the CTE teacher may have, and to walk though the specific lesson that the CTE teacher will teach. The math teacher does not participate in teaching the lesson itself, but serves as a "behind the scenes" assistant in preparation. He/she helps the CTE teacher review the math procedures and bridge the vocabulary between the math and CTE contexts.

Revising the Lessons once the CTE teachers have had the opportunity to teach the lessons, they often note ways in which the lessons can be improved. The fall and winter/spring professional development sessions provide time for teachers to critique the lessons and make changes in preparation for teaching the lessons again in the future.

Adequate Yearly Process

AYP is one of the cornerstones of the federal Elementary and Secondary Education Act (ESEA) signed into law January 2002, as the NCLB Act. In Washington, it is primarily a measure of year-to-year student achievement on the WASL in reading and mathematics. One of the requirements of NCLB is that states develop a baseline or starting point for students to achieve proficiency as measured by WASL math and reading scores each year the state must raise the bar in gradual increments so that by 2013-2014, all (100%) students will achieve proficiency in each subject area. Providing skills required to pass the WASL is very important. Teachers must find ways to reach more students and engage them in meaningful learning experiences, like a CTE/math course.

In addition to measuring academic achievement in reading and mathematics, "NCLB requires an additional indicator of student performance be measured" (OSPI 2008). For high school students the on-time graduation rate must be used. The additional indicator for middle and elementary schools in Washington is the unexcused absence rate. Each school and district must meet the yearly AYP goals as a whole and by disaggregated student population groups. In Washington a group must contain at least 30 continuously enrolled students to be considered statistically reliable and at least 10 to protect personally identifiable information. To be considered “continuously enrolled” a student must be enrolled without a break in service from October 1 through the testing period. AYP applies to each school in the state that serves students in grades 4, 7, and 10. School totals for these grades are aggregated up to the district and state totals. From this information, it was obvious how ominous the WASL can be to teachers and students. Students have a good reason to experience test anxiety when taking the WASL. A curriculum that can increase their confidence for taking the test, and be enjoyable enough to keep them in school would be a very valuable tool for schools.

Summary

Creating and using a CTE curriculum with embedded math that also uses the knowledge of different learning styles and effective teaching styles could prove to increase performance on the WASL for middle school students. The research outlined in this chapter supports that hypothesis. It also shows the magnitude and importance of achieving that result. When the students are in middle school, test scores must show improvement to meet AYP for the school. When the students are in high school, they must pass the WASL or show evidence of proficiency, to graduate in addition to the school meeting AYP. Since so much is riding on a student’s WASL score by the time they get to high school, it is important for them to establish good basic math skills in junior high and gain confidence when it comes to doing math and taking a high-stakes test.

CHAPTER 3

Methodology and Treatment of the Data

Introduction

In 2008, twenty-five students were selected from the researcher's school to determine if the embedded math instruction would improve mathematics scores on the WASL. During 2008-2009 school year, students in the middle school received instruction using the embedded mathematics in their CTE class. The students were then given a WASL sample test in the beginning of October 2008 and again in January 2009. The scores were then compared to determine significance.

Methodology

The researcher picked twenty-five students from the CTE woodshop classroom and compared the student's mathematic scores on a sample WASL test. The researcher handed out the math survey to the selected students. The students were given a WASL sample test in the beginning of October 2008 and again in January 2009. To accomplish this task, a quantitative approach was used. Specific testing was necessary to answer the researcher's questions as test data was not available. The students' scores were entered into the STATPAK (2007) computer program using a t-test to determine if students made significant growth on the mathematics portion of the sample WASL test.

Participants

The twenty-five randomly chosen student participants came from a small Washington state school district in Western Washington. Of the students, ten were from middle socio-economic Caucasian families, four were from middle socio-economic Hispanic families, and eleven were from lower socio-economic Caucasian families. Five of the students came from homes with one parent working while the other was a stay home parent, ten of the students came from homes with two working parents, and the rest came from single parent homes where the parent worked one or more jobs to support the family.

Instruments

The sample WASL assessment was given to the twenty-five students in the fall of 2008 and in January of 2009. The WASL sample test was generated from test questions that were on the OSPI website, the sample questions were chosen by the math team and included embedded math that is found in CTE courses. The mathematics WASL scores then were gathered, organized in a table, and analyzed using the STATPAK (2007) computer program. In the results from the math survey students expressed that they have test anxiety and bad study habits.

Design

The selected students' WASL scores from the Fall 2008 sample test and the January 2009 test were used for the study. The Fall 2008 pre-test was used as a baseline for student math scores to compare the January 2009 post-test scores against after implementing the embedded math instruction. Using a pre-test/post-test strategy and the STATPAK (2007) computer program, a t-test was administered to determine if a significance difference occurred.

Procedure

The researcher informed administration and school board members about the study of embedded math in the CTE class. Once the researcher informed and received the approval, the researcher tested twenty-five seventh and eighth grade students from the middle school. Scores were gathered and organized in a table and entered into the t-test portion of the STATPAK computer program to perform necessary calculations. The t-score, degrees of freedom, standard deviation, mean, and probability were then used to determine significance of the embedded math effect on student's mathematics scores. The purpose of the project was to help students master the math skills needed to pass high stakes assessments, to be skillful in the technical fields, and able to use math as a problem-solving tool as adults. The goal was to help students master the math necessary for them to improve their achievement on math tests and to be successful in their work arena without decrease in their technical skills.

Treatment of Data

Each student's WASL sample test score were placed into the t-test portion of the STATPAK (2007) computer program which calculated the sample's t-score. The t-score was then checked against the Distribution Table in the book *Educational Research: Competencies for Analysis and Application* to determine if there was significance in WASL assessment score growth (Gay et al., 2003).

Summary

To answer the question of whether the use of the embedded math in a CTE curriculum improved student mathematics scores as measured by a sample WASL a quantitative study was put into action. The twenty-five chosen students from the researcher's school were given direct instruction in embedded mathematics in the CTE classroom and were given the WASL assessment in the Fall of 2008 and again in January of 2009. The data was then used to answer the study's hypothesis.

CHAPTER 4

Analysis of the Data

Introduction

Quantitative data was collected for the study to show if embedded math in the CTE curriculum would show significant growth as measured by the WASL. After the researcher picked twenty-five students from the chosen middle school, the data was organized and analyzed using the STATPAK (2007) computer program. Last, the researcher used the information from the survey and the test to determine if the hypothesis was accepted or rejected.

Description of the Environment

The author chose a middle school in Western Washington that had over one hundred students. The middle school was located in a small school district that has only one middle school with 150 seventh and eighth grade students. The WASL sample test was given to the twenty-five seventh and eighth grade students in the Fall of 2008 and again in January 2009 in the CTE classroom. The students had limited time to complete the mathematics portion of the sample WASL within the classroom environment. The students who were not finished were moved to a different location and were allowed unlimited time to finish their assessment. The students were not allowed to use tools on the mathematics section of the WASL. Pencil and scratch paper were always allowed. No breaks were given until the test was finished.

Hypothesis

The hypothesis for the study was that students who take Middle School CTE Woodshop class with embedded math will score higher on a WASL prompt test than Middle School students who do not take a woodshop class with embedded math. Students who are enrolled in an embedded math class will believe they have stronger test-taking strategies when taking a high stakes assessments.

Null Hypothesis

The null hypothesis for the study was that there will be no significant improvement in students' math skills as a result of taking a middle school Career and Technical Education woodshop class with an embedded math, and they will not score higher on assessments when compared to middle school students who took an embedded math component class.

Results of the Study

After the data was organized and collected, the researcher was able to determine if the embedded math program that was chosen by the schools math team had any effect on the student's WASL math compensation. Of the twenty-five students in the study, sixteen students showed some growth on the sample math test of the WASL. Seven students score the same in January 2009 as they did in the fall of 2008. The remaining two students scored lower on the sample math test of the WASL when they took it in January 2009 then when they took it in the fall of 2008 as shown in table 1.

Table 1: Student test scores

Students	Oct-08	Jan-09
1	20	20
2	15	18
3	13	16
4	19	20
5	12	15
6	7	10
7	15	17
8	8	14
9	10	10
10	11	10
11	14	14
12	20	20
13	6	8
14	15	15
15	19	19
16	12	12
17	13	15
18	10	10
19	15	16
20	5	10
21	18	20
22	10	12
23	10	12
24	13	15
25	15	17

The students' sample WASL test scores were entered into the STATPAK (2007) computer program to determine the degrees of freedom, standard deviation, mean and the t-score. The STATPAK (2007) calculated the t-score to be a 2.064. The 2.064 level indicates the students made significance growth on the mathematics sample test of the WASL sample test, as shown in Table 2.

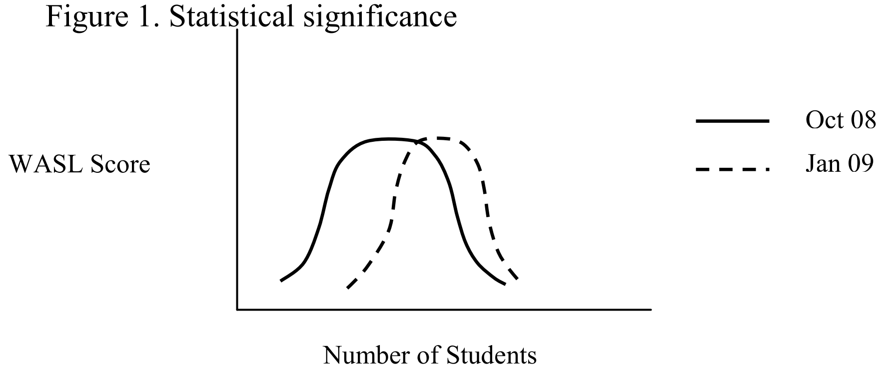
Table 2: T-Test of Pre and Post test

	Oct 08 Test	Jan 09 Test
Mean	13.0	14.6
std deviation	4.2	3.7
upper range (1 SD)	17.2	18.3
lower range (1 SD)	8.8	10.9
T-Test Value	2.064	

Findings

Analysis of the pre-and post-test data revealed that the students made significant growth on the mathematics portion of the WASL. The calculated t-score of 2.064 showed the students' growth was significant. Assuming a normal distribution of the population, there was a positive shift in WASL scores and also a narrowing of the upper and lower range of scores meaning scores were generally higher and more consistent. This is illustrated in Figure 1. These statistics helped determine that embedded mathematics was helpful in raising students' WASL scores in mathematics. Therefore, the hypothesis was accepted and the null hypothesis was rejected.

Figure 1. Statistical significance



Discussion

The researcher strongly believed the embedded math in CTE curriculum was behind the significant increase in mathematics WASL scores at the chosen middle school. The researcher found a relationship between the increase in mathematics WASL scores and with additional help the students will master the math skills needed to pass high stakes assessments and to be skillful in the technical fields, and able to use math as a problem-solving tool in adults. The goal was to help students master the math necessary for them to improve their achievement on math tests and to be successful in their work arena without decrease their technical skills.

Summary

Based on the findings of this study it was determined the project was significant and there was an improvement in students' math test scores after implementing the math embedded CTE courses. Many students have difficulty applying math concepts and skills to real life situations and some students may find it easier to learn math concepts that are on high stakes assessments by applying them in hands on activities. Teaching a CTE course with embedded math will reinforce the math curriculum and provide students another approach to learn math skills. The math usually found in textbooks would be applied to real-life situations in their CTE classes.

CHAPTER 5

Summary, Conclusions and Recommendations

Introduction

Schools all over Washington State have been adopting new mathematics curriculum in an attempt to raise scores on the WASL. The researcher's conclusions and recommendations based on the analyses of the data for the project were made. The findings of the data were discussed. This chapter summarizes the study and offers some recommendations based on the conclusions of the findings.

Summary

The purpose of the study was to determine if the implementation of embedding math in the CTE classroom contributed to an increase in mathematics WASL scores. The WASL was developed as the common assessment used to assess student proficiency in core skills, and both school and district performance (Reaching Higher, 2006). This study was designed to statistically test the hypothesis and analyze the results. The embedded math courses were also designed to increase students' confidence when using math and give them skills they will need in their careers after high school.

Conclusions

The statistical evidence showed a significant improvement in WASL scores after the study was concluded. Different teaching methods such as the one employed in the study are important to the success and satisfaction of students who vary in their learning styles. Embedded math courses where students can physically use or see math concepts give visual and tactile learners a better way to understand math concepts. Of the twenty-five students who were chosen for the study, sixteen students showed some growth on the sample math test of the WASL with seven students scoring the same in January 2009 as they did in the fall of 2008. This is a positive and significant improvement in the educational process.

Recommendations

Based on the conclusions from the study, the researcher recommends educators using embedded math in the classroom to help meet all the math requirements on the state assessment. The researcher does believe embedded CTE math will help in students in passing a high stakes test such as the WASL. Even small improvements in student test scores can increase their confidence in math and decrease their test anxiety.

To replicate the study, there would need to be some similarities including ethnicity, environment, age of students, number of students, ELL students, special education students, and interventions. Persons wanting to replicate the study would need to follow the exact procedure used in the project in order for the project to be duplicated.

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Appendix A

I, Karl Miller as Mossyrock High School Principal, give Kevin Wilson permission to conduct his math survey and permission to conduct research for his project. In Partial Fulfillment of the Requirements for the Degree Master of Education at Heritage University during the 2008-2009 academic school year at Mossyrock Junior High School.

Karl Miller Date

Mossyrock High School Principal

Appendix B

Math Survey

This survey is designed to evaluate the confidence you feel in taking math tests.
Circle your answers

1. Male Female

2. 7th Grade 8th Grade

Circle your answers

Always	Sometimes	Almost Never	Never
4	3	2	1

3. I have a specific time and place to study math.	4	3	2	1
4. I try to start my math homework immediately after school.	4	3	2	1
5. I take notes in class.	4	3	2	1
6. I ask questions when I am confused.	4	3	2	1
7. I review my notes and book before beginning the homework.	4	3	2	1
8. I use flashcards for formulas and vocabulary.	4	3	2	1
9. I preview the test before I begin.	4	3	2	1
10. I begin with the easy questions first.	4	3	2	1
11. I take the full amount of time for the test.	4	3	2	1
12. I have confidence in taking the next high stakes test.	4	3	2	1