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# The Relationship of High School Mathematics Standard Test Scores and Illustration and Design Technology Courses

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**THE RELATIONSHIP OF  
HIGH SCHOOL MATHEMATICS STANDARD  
TEST SCORES AND ILLUSTRATION  
AND DESIGN TECHNOLOGY COURSES**

A Research Paper  
Presented to the Graduate Faculty of the  
Department of Occupational and Technical Studies  
Old Dominion University

In Partial Fulfillment  
of the Requirements for the  
Master of Science Degree

By  
Richard R. Dyer  
August 2004

## Signature Page

This research paper was prepared by Richard R. Dyer under the direction of Dr. John M. Ritz in OTED 636, Problems in Occupational and Technical Studies. It was submitted to the Graduate Program Director as partial fulfillment of the requirements for the degree of Master of Science in Occupational and Technical Studies.

Approved by: \_\_\_\_\_  
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## Table of Contents

|   |    |
|---|----|
| Signature Page.....   | ii |
| List of Tables.....   | iv |
| List of Figures .....   | v  |
| Chapters  |    |
| I. Introduction .....   | 1  |
| Statement of the Problem .....  | 3  |
| Hypothesis .....  | 3  |
| Back Ground and Significance .....  | 3  |
| Limitations .....   | 4  |
| Assumptions .....   | 5  |
| Procedures.....   | 5  |
| Definition of Terms .....   | 6  |
| Overview of Chapters.....   | 6  |
| II. Review of Literature .....  | 8  |
| Why the Standards of Learning .....   | 8  |
| Standards of Learning .....   | 9  |
| Correlation of Standards of Learning to Career and<br>Technical Education ..... | 11 |
| Statistical Data .....  | 13 |
| What Happened .....   | 14 |
| Summary.....  | 16 |
| III. Methods and Procedures .....   | 18 |
| Population .....  | 18 |
| Instrument Design .....   | 18 |
| Methods of Data Collection .....  | 19 |
| Statistical Analysis .....  | 20 |
| Summary.....  | 21 |
| IV. Findings .....  | 22 |
| T-Test Results.....   | 22 |
| Chi-Square Results .....  | 23 |
| Summary.....  | 23 |
| V. Summary, Conclusion, and Recommendations .....                               | 24 |
| Summary.....  | 24 |
| Conclusions.....  | 26 |
| Recommendations .....   | 27 |
| Bibliography .....  | 29 |

## LIST OF TABLES

| <i>Number</i> |   | <i>Page</i> |
|---------------|---|-------------|
| 1             | Graduation Requirements for Standard Diploma  | 2           |
| 2             | Percent of Secondary Students Enrolled in Career<br>and Technical Education Courses in Virginia Who<br>Passed the 2001-2002 Standards of Learning End-of-Course<br>Tests Subject Area | 14          |
| 3             | Competency Determination Results for the Class of 2004:<br>All Students and Selected Subgroups  | 15          |
| 4             | Composition of the Non-Illustration and Design<br>Technology and Illustration and Design Technology groups  | 22          |
| 5             | Mean and Standard Deviation Data for the Non-Illustration<br>and Design Technology and Illustration and Design<br>Technology Groups   | 22          |
| 6             | Chi-Square Data   | 23          |
| 7             | Composition of the Non-Illustration and Design<br>Technology and Illustration and Design Technology Groups  | 25          |

## LIST OF FIGURES

| <i>Number</i> |  | <i>Page</i> |
|---------------|--|-------------|
| 1             | SOL Correlation by Task                      | 11          |
| 2             | Example of a Crosswalk Page from VA Linkages | 12          |

## **Chapter I**

### **Introduction**

To graduate from high school in 2004, seniors in Virginia will have to pass at least six Standards of Learning (SOL) tests. Two tests are required in English and four in subjects of their choosing. This is in addition to earning the 22 credits for the standard diploma. A survey done in January 2004 by the Virginia Department of Education (VDOE) showed that 1841 of South Hampton Roads seniors seeking the standard diploma have yet to pass the required number of SOL tests. By 2007, graduating students will be required to pass five SOL tests in their core studies and one of their choosing (Bowers, 2004).

This year's graduating class is the first to have to pass at least six SOL tests to receive diplomas. In a June 2004 follow-up article, Bowers stated that only 74 local high school seniors had failed to earn diplomas due to not passing the required number of Standards of Learning exams. The news was better than expected. Projections estimated that 300 to 450 local students would be affected by the first year of Virginia's new graduation requirements (Bowers, 2004). See Table 1

This is not just a problem for the English, Mathematics, Science and Social Studies teachers, nor is it an administration problem or political problem. It is the concern of everyone: students, teachers, parents, administrators, and politicians. Teachers who teach elective courses have not felt the pressure yet, but they will soon find themselves defending their programs and their contribution to the total education of learners.

Gone are in-between accreditation ratings for schools based on improving scores; schools will be rated fully accredited or on warning, with two years before warned schools could lose accreditation altogether. And due to this and money being in short supply, some

Table 1. Graduation Requirements for Standard Diploma

| SUBJECT                       | CREDITS | VERIFIED* CREDITS REQUIRED | VERIFIED* CREDITS REQUIRED BEGINNING WITH CLASS OF 2007 |
|-------------------------------|---------|----------------------------|---|
| ENGLISH                       | 2       | 2                          | 2   |
| MATH                          | 3       | 0                          | 1   |
| LAB SCIENCE                   | 3       | 0                          | 1   |
| SOCIAL STUDIES                | 3       | 0                          | 1   |
| HEALTH AND PHYSICAL EDUCATION | 2       | 0                          | 0   |
| FINE OR PRACTICAL ARTS        | 1       | 0                          | 0   |
| ELECTIVES                     | 6       | 0                          | 0   |
| STUDENT-SELECTED TESTS        |         | 4                          | 1   |
| TOTALS                        | 22      | 6                          | 6   |

\*Credits are verified by the end-of-course Standards of Learning test  
 Data Source: Virginia Department of Education, 2004

schools are dropping elective programs that can not show added value and solid potential for a student's success in passing his/her SOL tests.

Elective course teachers, claim that their programs support the SOL testing standards; in fact, numerous hours have been consumed in creating correlations to the SOL testing standards (CTE Resource, 2003/2004). Yet, there has been little research into whether elective courses are helping students successfully pass the SOL tests. Hence, this study was undertaken to determine if there is a correlation to the mathematics SOL tests and the study of Technology Education courses.

The students that were involved in this study were from Granby High School in Norfolk, Virginia. The researcher collected data on students in grades 10 through 12 who had taken one or more Illustration and Design Technology courses and compared their SOL test scores and competency records to those who have not taken any such courses. These scores were compared to the student body's SOL mathematics results.



## **Statement of the Problem**

The problem of this study was to determine if high school students who completed technology education courses in illustration and design earned higher scores on Virginia's mathematics Standards of Learning examinations than the average school population.

## **Hypotheses**

To guide the solution of this problem, the following hypotheses were developed:

H<sub>1</sub>: Students who have taken illustration and design technology courses test better on their mathematics SOL tests than students that did not take technology courses.

H<sub>2</sub>: Students who have not passed the mathematics SOL tests will do better on their retake examinations if they take an illustration and design course.

## **Background and Significance**

The state of Virginia has led the way among states in adopting rigorous standards, developing tests based on those standards, and then insisting on holding students and schools accountable. The State Board of Education went so far as to threaten to remove accreditation from schools, beginning in 2007, where fewer than 70 percent of students passed the state tests (Hess & Ravitch, 2002). Despite an aggressive public campaign against the state's standards and tests, students registered steady annual gains on the state tests. In 1998, the first year the SOL tests were administered, only 40 percent of students passed Algebra I, but by 2001, 74 percent passed (Standards Work, 2003). By 2001, in every subject area, growing proportions of students were passing the state tests at every grade level (Hess, 2002).

With the advent of “No Child Left Behind (2001)” by the Bush administration, the researcher felt a need to compare technology education courses against the state’s SOL standards. The researcher chose Algebra I and Geometry since the Illustration and Design Technology course Competency Standards are closely related to the SOL standards for these courses as set forth by VDOE.

Recent articles in local newspapers helped re-enforce the need for this research study. Notably are several the articles by Matthew Bowers in the Virginia-Pilot, particularly the February 6, 2004, article titled “SOL Scores Could Keep Students from Jobs, College, Graduating Seniors May Lack Diplomas.” This article addressed the possibility of 1800 plus seniors in South Hampton Roads not meeting graduating standards which collaborates the need for this study.

Despite a spate of criticism of testing and accountability in the late 1990s, the public continues to support standards-based reform. Every public opinion poll, and particularly the polls and surveys reported by Public Agenda, 2003, has found that the public backs standards and testing; wants students who need extra help and time to get it, and wants to continue current efforts to improve student achievement.

With this in mind, elective teachers need to actively validate research and publicize how technology education courses significantly improve students’ preparedness for an SOL test.

### **Limitation**

The following limitations were placed on selecting subjects for this study:

- Student identified as Special Education with test results of 991 were omitted from the study since test scores for these students were not published.
- Only students who had taken Illustration and Design Technology courses in the past three years were involved in this research.
- Students were from Granby High School, and tested in the subjects of Algebra I and Geometry, during the 2003 school year.

### **Assumption**

For this study, several assumptions were made:

- There should be a noted increase in the number of students passing the Algebra I and Geometry SOL tests that have taken illustration and design technology courses.
- Students who did not pass the Algebra I and Geometry SOL tests are more likely to pass the retake exam if they took a technology education course closely related to the test subject.
- The Task/Competency lists for Illustration and Design technology courses developed by the Career and Technology Education Services, Virginia Department of Education, align properly with the mathematics SOLs.

### **Procedures**

Students records were reviewed to identify those who had taken Illustration and Design Technology courses. Once identified, it was determined if they passed the respective courses and then were compared to the SOL testing matrix provided by the

school system's Star Base database to verify what mathematics SOL tests were taken. The data were recorded for each student: what test(s) were taken, number of times having taken the test(s), and their scores (a score of 400 or greater is passing). The data were then statistically compared.

### **Definition of Terms**

The following terms are defined to assist the reader with this study.

**SOL:** Standards of Learning Tests

**Illustration and Design Technology Courses:** Courses covered under this area are Technical Drawing and Design (8356), Engineering Drawing and Design (8456) and Architectural Drawing and Design (8556)

**Core Classes:** English, Science, Social Studies, and Mathematics

**CTE:** Career and Technical Education

### **Overview of Chapters**

Chapter I outlines this research study, having covered several aspects on why it is important for technology education teachers to review and validate their course content. If anything is clear about these issues, it is that the public schools are in the midst of a major change. In Chapter II, the researcher reviews background research into the SOL tests and the development of the Technology Education Task/Competencies established by the VDOE. In Chapter III, the researcher introduces the methods and procedures used to understand this research. In Chapter IV and V the outcomes of the research and

recommendations and possible future insights into how teachers can improve our students' chances of being successful are revealed.

## **Chapter II**

### **Review of Literature**

In this chapter, the researcher reviews the reasoning behind the Standards of Learning, the development Standards of Learning, the correlation of the Standards of Learning to Career and Technical Education, and available statistical data from the Virginia Department of Education and the outcome of testing in the other states requiring exit examinations.

#### **Why the Standards of Learning?**

The Board of Education of the Commonwealth of Virginia in June 1995 adopted the Standards of Learning (SOL) for the four core subject areas: English, Science, Mathematics, and Social Studies/History. William C. Boshier Jr., Superintendent of Public Instruction, opened each SOL document with a special message. This message outlined the purpose and reasoning behind the SOLs.

In summary of Boshier's message, he stated the new Standards of Learning are important because they establish targets and expectations for what teachers need to teach and students needed to learn. The Standards of Learning were developed by a partnership of educators and citizens, under the leadership of four school divisions in April 1994. The SOLs are academic standards that let parents and teachers know what is expected of students, and each student's performance and achievement can be measured against the standards. The SOL requirements provide greater accountability on the part of the public schools and give the local school boards the autonomy and flexibility they need to offer programs that best meet the educational needs of students (Boshier, 1995).

## **Standards of Learning**

At the beginning of the twenty-first century, American public education was in various stages of what is commonly called standards-based reform. Almost every state had adopted state academic standards in major subject areas; these standards, which differed slightly from state to state, were intended to describe what students were supposed to learn. In addition, almost every state had developed (or purchased) assessments aligned to its standards, to ascertain whether their students had learned what was described in the standards. "Accountability" meant that public officials were supposed to review the results of assessments and establish consequences for students, teachers, schools, or school systems. For students, accountability might mean remedial assistance, summer school, promotion, retention, or a variety of other responses that would provide either help or incentives for schools. They might also mean reorganization, state intervention, or even closure. For teachers, accountability might entail merit pay or other rewards or assistance for those in need of it (in the midst of a national teacher shortage, buttressed by the political power of teacher unions, there was not much talk of sanctioning ineffective teachers) (Hess, 2002).

Standards-based reform has had bipartisan sponsorship. Governors, legislators, and past presidents (including the current administration) of both major political parties supported it, especially when the possibility of "consequences" for students, such as retention in grade, failure to graduate, and non-accreditation for schools was in the distant future. Standards based education got its biggest boost in 1983 with the publication of "A Nation at Risk," the report of the Reagan-era's National Commission on Excellence in Education (Hess, 2002). This report stirred many states to create their own studies and

commissions, leading to the bolstering of graduation requirements in many states. Those who support standards-based reform speak of "A Nation at Risk" as a clear call for action, and those who reject it treat the report as overstated, bombastic propaganda.

In 1989, President George H.W. Bush convened a national summit meeting of governors in Charlottesville, Virginia, to set national goals for education, which included a target of improved student performance in basic subject areas. In 1991 and 1992, the Bush administration supported the development of voluntary national standards. The latter became mired in controversy because the documents that came forth as "national standards" represented the aspirations of the professionals that wrote them, rather than goals, content, and methods that had been carefully tried and proved successful. In 1994, President Bill Clinton's Goals 2000 program allocated funding to the states to create their own standards and assessments (Hess, 2002).

By the late 1990s, almost every state was administering tests keyed to its own state standards. In the 2001 election, both presidential candidates supported standards-based reform, and the winner—Texas Governor George W. Bush—promoted a program called "No Child Left Behind." Its central theme was testing and accountability, based on the model that had been implemented for more than a decade in the state of Texas. President Bush proposed that every child in grades three through eight should be tested annually, and that the results of the annual testing should be used to focus on those who were lagging, to acknowledge and reward effective schools, and to sanction those schools that were unable to educate their students.



## Correlation of Standards of Learning to Career and Technical Education

Career and Technical Education (CTE) teachers have been utilizing Competency Based Education (CBE) as a set of standards to teach their students. The SOL was just one more welcomed step in the process of Competency Based Education (CBE). In 2000 the Career and Technology Education Service of VDOE developed crosswalks to the SOL associated to there particular programs. See Figure 1.

Technical Drawing a... > SOL Correlation By ...

### SOL Correlation By Task

A correlation between each state-approved CTE course and Virginia Standards of Learning (SOL) for English, History and Social Science, Mathematics, and Science has been completed by teams of CTE and academic specialists. The correlation identifies, on a statewide basis, standards reinforced by specific tasks/competencies within each course.

In this course, the following tasks/competencies reinforce the standards listed beside them. Teachers may identify additional reinforcements in locally developed instructional materials.


|                            |  |  |
|----------------------------|--|--|
| DTE8434.001<br>DTE8435.001 | Define technical drawing.  | English: 9.4, 10.4, 11.4, 12.4   |
| DTE8434.002<br>DTE8435.002 | Define design.   | English: 9.4, 10.4, 11.4, 12.4   |
| DTE8434.003<br>DTE8435.003 | Define the design process.   | English: 9.4, 10.4, 11.4, 12.4   |
| DTE8434.004<br>DTE8435.004 | Describe the history of drawing and design.  | English: 9.4, 10.4<br>History and Social Science: WHII.1, WHII.6, WHII.8 |
| DTE8434.005<br>DTE8435.005 | Use course experiences to participate in the TSA as a leader, manager, or team member. | English: 9.4, 10.1, 10.2, 10.4   |
| DTE8434.006<br>DTE8435.006 | Apply and use technical drawing and design standards.                                  | English: 9.4, 10.4, 11.4<br>Mathematics: A.5, G.12                       |
| DTE8434.007<br>DTE8435.007 | Use and maintain a reference library of files and technical data.                      | English: 9.8   |

Figure 1. SOL Correlation by Task

These crosswalks or correlations became part of the Task/Competencies and an important tool to encourage communities to support the academic programs. Soon after that, VDOE, in corporation with SkillNet, developed Virginia Linkages {<http://www.valinkages.net/>}.

See Figure 2.

---


Linking Academic and  
Career & Technical Education  
Standards

Academic Area: Math  
 VSOL: G. 1 - The student will construct and judge the validity of a logical argument consisting of a set of premises and a conclusion.  
 CTE Course: Technical Drawing and Design-36 wks.

**Please select the items you wish to save and/or use to build a Lesson Plan** (Scroll to bottom to save)

If nothing is being displayed below this message, please Refresh the page using the "F5" key on your keyboard.

**VTASI CODE CONNECTED TO VIRGINIA STANDARD OF LEARNING AND CAREER/TECHNICAL COURSE COMPETENCIES**

|                          | Competency ID | Competency Description   | VTASI Description   |
|--------------------------|---------------|--|---|
| <input type="checkbox"/> | DTE8435.1     | Define technical drawing.  | Understands Definitions                                     |
| <input type="checkbox"/> | DTE8435.2     | Describe the history of drawing and design.  | Converts Word problems<br>Mathematical expressions          |
| <input type="checkbox"/> | DTE8435.2     | Describe the history of drawing and design.  | Solves problems Generate<br>conclusions Deductive reasoning |
| <input type="checkbox"/> | DTE8435.3     | Use course experiences to participate in TSA as a leader, manager, or team member. | Calculates/Evaluates Reasoning<br>Invalid arguments         |
| <input type="checkbox"/> | DTE8435.3     | Use course experiences to participate in TSA as a leader, manager, or team member. | Constructs Charts/tables/graphs                             |
| <input type="checkbox"/> | DTE8435.3     | Use course experiences to participate in TSA as a leader, manager, or team member. | Distinguishes Deductive/inductive<br>reasoning              |
| <input type="checkbox"/> | DTE8435.3     | Use course experiences to participate in TSA as a leader, manager, or team member. | Interprets Charts/tables/graphs                             |

Figure 2. Example of a Crosswalk Page from VA Linkages

In the **Crosswalk** section, teachers go through a series of steps to find correlations between an academic course and a career and technical course. In the **Lesson Bank**, teachers can find model lesson plans that connect specific standards of learning in an academic course with specific career competencies in a career and technical course. In the **Lesson Builder**, teachers can create their own lesson plans, which give students the opportunity to put learning into practice in the context of the real world and submit the plan to the Department of Education for approval. Once approval is granted, the lesson is then warehoused in the Lesson Bank.

Virginia Linkages were developed to assist both Academic and Career and Technical educators to crosswalk their lesson plans to each other's course materials. The researcher found this to be a useful but an underutilized tool. Virginia Linkages is listed as a resource within course competencies with little if any other mention or publication of its existence or uses. With this tool, lessons gain value and are more meaningful to a student if they can see a useful application of the lessons being taught. In fact, lessons may be better taught by using the skill-based learning objectives rather than the clinical corresponding SOL.

With so many hours consumed on developing the Task/Competency correlations to the SOL by CTE Services of VDOE, it is surprising to find that the effort almost comes to a complete halt there. No further testing was done to insure the validity of the correlations. In the researcher's search for data showing validity amongst the academic standards and CTE Task Competencies, he was unable to find a single study testing the validity of the correlations. Numerous other disciplines have done correlation studies between courses such as English to Social Studies or Science to Mathematics and so on. Why we have gone almost ten years without doing a study on our own is unacceptable.

### **Statistical Data**

Some data on students taking Career and Technology education is available from the "Virginia Department of Education, Office of Career and Technical Education Services, Career and Technical Education Statewide Annual Performance Report." The last published report is for the 2001-2002 school year. Table 2 is the only reference to the SOL within the entire report. The remainder dealt with completers and career preparation statistics.

|             |                           |
|-------------|---------------------------|
| English     | 77.99% (58,230 of 74,666) |
| Mathematics | 64.48% (53,008 of 82,205) |
| History     | 69.74% (64,814 of 92,938) |
| Science     | 69.77% (59,944 of 85,922) |

**Table 2.** Percent of Secondary Students Enrolled in Career and Technical Education Courses in Virginia Who Passed the 2001-2002 Standards of Learning End-of-Course Tests Subject Area

This is a start but the statistic lacks relevance to anyone reviewing the data; they are not described in more detail. The first and most important detail would be a separation of subject based on end of course tests (i.e., Mathematics Algebra I). The second description should be by CTE course to the end of course tests. The report shows that the data are there, they just need to be correlated and put to the test. The effort needs to be made now before it appears technology teachers are trying to make up the data to suite a particular need. If the correlations are weak, the profession is obligated to strengthening or eliminated their existence.

**What Happened?**

To graduate in 2004 students within Massachusetts Regional Vocational Schools were required to pass the 10<sup>th</sup> grade Massachusetts Comprehensive Assessment System (MCAS) tests in English Language Arts (ELA) and Mathematics. The local media found no shortage of critics willing to express how unfair the exams were in regards to vocational/technical students. Among some of the most vocal critics were Kevin Hart, Principal of Holyoke's William J. Dean Technical High School, and James Hager,

Superintendent of Southeastern in Easton, who said, "We think our kids have intelligences that are not being tested by the strictly educational tests" (Haywood, 2003, p. 2). With all the commotion about how the MCAS exams would disenfranchise vocational students, they left out one important factor, the students themselves. Table 3 shows the cumulative percentage of students in the class of 2004 who passed the English Language Arts test/retest, Mathematics test/retest, and have attained the Competency Determination.

**Table 3.** Competency Determination Results for the Class of 2004: All Students and Selected Subgroups

|                              | March 2004 Enrollment | ELA           |               | Math           |                | Competency Determination |              |
|------------------------------|-----------------------|---------------|---------------|----------------|----------------|--------------------------|--------------|
|                              |                       | # Passing ELA | % Passing ELA | # Passing Math | % Passing Math | # Earning CD             | % Earning CD |
| <b>All Students</b>          | 61,338                | 59,547        | 97%           | 59,258         | 97%            | 58,756                   | 96%          |
| <b>Student Status:</b>       |                       |               |               |                |                |                          |              |
| - Limited English Proficient | 2,116                 | 1,717         | 81%           | 1,873          | 89%            | 1,652                    | 78%          |
| - Students with Disabilities | 7,426                 | 6,489         | 87%           | 6,379          | 86%            | 6,226                    | 84%          |
| - Regular Education          | 51,796                | 51,341        | 99%           | 51,006         | 98%            | 50,878                   | 98%          |
| <b>Race/Ethnicity</b>        |                       |               |               |                |                |                          |              |
| - African-American/Black     | 5,150                 | 4,691         | 91%           | 4,650          | 90%            | 4,517                    | 88%          |
| - Asian                      | 2,981                 | 2,872         | 96%           | 2,885          | 97%            | 2,833                    | 95%          |
| - Hispanic                   | 4,873                 | 4,355         | 89%           | 4,328          | 89%            | 4,142                    | 85%          |
| - Native American            | 145                   | 139           | 96%           | 139            | 96%            | 136                      | 94%          |
| - White                      | 48,189                | 47,490        | 99%           | 47,256         | 98%            | 47,128                   | 98%          |
| <b>Gender</b>                |                       |               |               |                |                |                          |              |
| - Female                     | 30,687                | 29,901        | 97%           | 29,701         | 97%            | 29,488                   | 96%          |
| - Male                       | 30,651                | 29,646        | 97%           | 29,557         | 96%            | 29,268                   | 95%          |
| <b>Vocational Technical</b>  | 12,698                | 12,349        | 97%           | 12,261         | 97%            | 12,114                   | 95%          |
| - Urban                      | 14,726                | 13,591        | 92%           | 13,483         | 92%            | 13,147                   | 89%          |
| - Non-Urban                  | 46,612                | 45,956        | 99%           | 45,775         | 98%            | 45,609                   | 98%          |

Urban Districts include: Boston, Brocton, Cambridge, Chelsea, Fall River, Fitchburg, Framingham, Haverhill, Holyoke, Lawrence, Leominster, Lowell, Lynn, Malden, New Bedford, Pittsfield, Revere, Somerville, Springfield, Taunton, and Worcester.

Data Source: Massachusetts Department of Education (June 2004), Progress Report on Students Attaining the Competency Determination Statewide and by School and District

The percentages were calculated using the number of students passing English Language Arts (ELA), Mathematics, or attaining the Competency Determination (CD) as the numerator and the March 2004 enrollment figures as the denominator (Massachusetts Department of Education, 2004). Vocational Technical students surprised everyone, by

doubling the MCAS pass rate from the previous year's practice examinations. "It's very encouraging because it proves what we have said all along, that vocational technical students are just as capable of meeting the academic standards that are set for traditional students," said Massachusetts Department of Education spokeswoman Heidi B. Perlman (Rothstein, 2004, p. 1).

### **Summary**

If anything is clear about these issues, it is that the public schools are in the midst of a major change. Testing is not new; schools have always given tests. Currently 26 states are using exit exams. They fall into three categories; the first group requires a minimum level of knowledge that should be acquired even before entering high school. The second batch tests students like Massachusetts at 10th or 11th-grade levels, and the third, like Virginia, utilizes end of course exams (Ornstein, 2001). But what is new is the emphasis on state-administered tests, and the increased demand that students demonstrate academic readiness before they can be promoted to the next grade or graduate from high school. Some critics are unhappy with the enlarged role of the state and the insistence upon accountability. Yet, the public's general enthusiasm for testing remains strong. And despite the current stress with high-stakes testing, no state has dropped its exam entirely. That's because legislators, business leaders and others say students should have a certain level of knowledge when they graduate. And solid majorities of educators believe that a common standard is needed to measure a student's learning.

In Virginia, Career and Technical Education students are not doing well on the end of course Mathematics SOL exams with only 64.48 % of the student shown in Table 2 passing the examinations. In contrast, Massachusetts Vocational Technical students have done

exceptionally well with 95% of the students from Table 3 receiving a Competency Determination. The underlying question is why? Are some courses not properly correlated to the standards identified? Does the course curriculum need to be revised to better incorporate SOL standards? Are instructors aware of the available resources to assist in developing lessons that are more comprehensive?

## **Chapter III**

### **Method and Procedures**

This chapter describes the methods and procedure used in this study. The population was identified using existing data from students records, the design of the test instrument used and the methods of data collection are described, as is the statistical analysis performed.

#### **Population**

The population for this study was composed of students from Granby High School, Norfolk, Virginia, in the 10<sup>th</sup>, 11<sup>th</sup> and 12<sup>th</sup> who had taken the Algebra I and/or the Geometry end of course SOL examinations taken during the 2002-2003 school year. There were 996 students fitting into the population criteria. They were separated into two groups for this study. The first group of students had taken one or more of the following Illustration and Design courses: Technical Drawing, Engineering Drawing, and Architectural Drawing. There were a total of 89 students in this group. All 89 students had taken Technical Drawing, with 39 having also taken Engineering Drawing, and 17 taken Architectural Drawing during the studies time frame. There were 907 students in the second group who had not taken any Illustration and Design Technology courses during the studies time frame.

#### **Instrument Design**

There were two instruments used in this study. The first was designed to compare the statistical differences between the scores achieved on the end of course Algebra I and



Geometry SOL examinations taken by both groups. The second instrument compared the statistical difference between students who took the Algebra I and Geometry SOL tests more than once to pass. They were compared to determine if there was any difference in the improvement of test scores after taking Illustration and Design Technology courses.

### **Methods of Data Collection**

The researcher utilized existing data obtained from student records. These data were collected from Granby High School's information data base (STAR Base) to generate a report of students who took the Algebra I and Geometry SOL tests during the 2002-2003 school year. The researcher's classroom and student's Task/Competency records for the same time period were compared.

Students' names were used only during the STAR Base query and sorting process and compared to researcher's records to identify the subjects for the Illustration and Design Technology group. After sorting was completed, names were removed from all retained data and replaced with Non-Illustration and Design Technology or Illustration and Design Technology to distinguish between the two groups. Names were not used in any of the reported data to protect the students' identity. Students were only identified by their groups and sub categories.

### **Statistical Analysis**

The following Statistical Analyses were used to test the study's hypotheses. A t-Test: was used to validate hypothesis  $H_1$ : Students who have taken illustration and design technology courses test better on their mathematics SOL tests than students that did not

take technology courses. The SOL scores of the Non-Illustration and Design Technology and Illustration and Design Technology groups were used to determine if there was a significant difference in the scores between the two groups

A Chi-square was used to validate hypothesis H<sub>2</sub>: Students who have not passed the mathematics SOL tests will do better on their retake examinations if they take an illustration and design course. The Non-Illustration and Design Technology and Illustration and Design Technology groups' number of times the SOL test was taken until passed was used as the test instrument to determine if there was a significant difference in the number of times, the test was taken between the two groups

Mean and Standard Deviation were also used. The mean and standard deviation data were used to show the quality of testing between the Non-Illustration and Design Technology and Illustration and Design Technology test groups.

## **Summary**

Though this study was limited to Granby High School students, it should reflect the effect technology courses have on preparing students for the SOL examinations. The researcher will utilize the collected data to support the hypotheses that Illustration and Design Technology courses help prepare students for the end of course SOL examinations.

## Chapter IV

### Findings

This chapter describes the data collected and the statistical analysis performed on the data in an attempt to answer the problems of this study. The problem of the study was to determine if high school students who completed technology education courses in illustration and design earned higher scores on Virginia's mathematics Standards of Learning examinations. There were two hypotheses used to guide the solution of this problem. They included:  $H_1$ : Students who have taken illustration and design technology courses test better on their mathematics SOL tests than students that did not take the technology courses.  $H_2$ : Students who have not passed the mathematics SOL tests will do better on their retake exams if they take an illustration and design course.

The two study groups were composed of 996 students from Granby High School. The calculated mean was used to show the quality of testing between the Non-Illustration and Design Technology and Illustration and Design Technology test groups. A t-Test was used to test the first hypothesis. The SOL scores of the Non-Illustration and Design Technology and Illustration and Design Technology groups will be used to determine if there is a significant difference in the scores between the two groups. The Chi-Square test of significance was used in determining if students will do better on their retake exams if they take an illustration and design course.

The two groups were composed of students from Granby High School who had taken the Algebra I and Geometry end of course SOL examinations. Table 4 shows the composition of the two groups and their pass/fail ratio. The Illustration and Design Technology group had a 71% passing rate which exceeded the state average for Career and

Technical Education students taking the mathematics SOL examinations, while the Non-Illustration and Design Technology group had a passing rate of 63%.

| Non-IDT Students |        |          | IDT Students |        |          |
|------------------|--------|----------|--------------|--------|----------|
| Totals           | Passes | Failures | Totals       | Passes | Failures |
| 907              | 661    | 246      | 89           | 69     | 20       |

Table 4. Composition of the Non-Illustration and Design Technology and Illustration and Design Technology groups

Table 5 shows the mean and standard deviation of test scores for the two groups. The Illustration and Design Technology group tested higher than the Non-Illustration and Design Technology group scoring on average 14 point above the Non-Illustration and Design Technology group. The standard deviation for the two groups shows that the Illustration and Design Technology group's test scores were more closely grouped indicating a possibly higher level of comprehension in the subject areas.

| Non-IDT Students |       | IDT Students |       |
|------------------|-------|--------------|-------|
| Mean             | 427   | Mean         | 441   |
| STDEV            | 49.34 | STDEV        | 45.32 |

Table 5. Mean and Standard Deviation data for the Non-Illustration and Design Technology and Illustration and Design Technology groups

### t-Test Results

The t-Test analysis was used to test the first hypothesis.  $H_1$ : Students who have taken illustration and design technology courses test better on their mathematics SOL tests than students that did not take technology courses. The calculated t-test value was 2.65; the value from the table of significance at the  $p > .01$  was 2.326.

## Chi-Square

The Chi-square test statistic was used to test the second hypothesis.  $H_2$ : Students who have not passed the mathematics SOL tests will do better on their retake exams if they take an illustration and design course. The students within the Illustration and Design Technology study group requiring a retake examination from the previous school year(s) was minimal with only 18 students having to take a retest. All 18 of the students subsequently took an Illustration and Design Technology course prior to passing the retake exam. The Non-Illustration and Design Technology group had 409 students requiring a retake examination from previous test cycles; 359 passed the retake exams. Table 6 shows the analysis of the retake examinations for each group. The calculated  $X^2$  value was 2.492, the value from the table of significance at the  $p > .05$  was 3.84.

| Number of retakes | Non-IDT | Number of retakes | IDT |
|-------------------|---------|-------------------|-----|
| 0                 | 301     | 0                 | 51  |
| 1                 | 251     | 1                 | 18  |
| 2                 | 109     | 2                 | 0   |
| >3                | 0       | >3                | 0   |
| Failed            | 50      | Failed            | 0   |

Table 6. Chi-Square Data

## Summary

Several tests were used to determine if high school students who completed technology education courses in illustration and design earned higher scores on Virginia's mathematics Standards of Learning examinations. The researcher collected data and performed statistical analyses on the data using the following tests: t-Test, Chi Square, Mean, and Standard Deviation.

## **Chapter V**

### **Summary, Conclusions, and Recommendations**

This chapter summarizes the data collected, draws conclusions and the researcher offers several recommendations on the statistical analysis performed on the data.

#### **Summary**

In this study, the researcher explored the problem of determining if high school students who completed technology education courses in illustration and design earned higher scores on Virginia's mathematics Standards of Learning examinations than the average school population. The problem of this study were guided by the following hypotheses: H<sub>1</sub>: Students who have taken illustration and design technology courses test better on their mathematics SOL tests than students that did not take technology courses. H<sub>2</sub>: Students who have not passed the mathematics SOL tests will do better on their retake examinations if they take an illustration and design course.

The researcher felt a need to compare technology education courses against the state's SOL standards. In particular, the mathematics SOL tests were compared to technology courses since they were heavily mathematics orientated by the Competency Standards set forth by VDOE. Notably were several articles by Matthew Bowers in The Virginian-Pilot, particularly the February 6, 2004, article titled "SOL Scores Could Keep Students from Jobs, College, Graduating Seniors May Lack Diplomas." This article addressed the possibility of 1800 plus seniors in South Hampton Roads not meeting graduating standards collaborates the need for this study.

The researcher set the following limits to direct the study and manage the selection of subjects.

1. Students identified as Special Education with test results of 991 were omitted from the study since test scores for these students were not published.
2. Only students who had taken Illustration and Design Technology courses in the past three years were involved in this research.
3. Students were from Granby High School and tested in the subjects of Algebra I and Geometry during the 2003 school year.

The study groups were chosen from 996 students, divided into two groups of students from Granby High School who had taken the Algebra I and Geometry end of course SOL examination. Students were identified using the school's (STAR Base) database. A search was made for students who took the Algebra I and/or the Geometry mathematics SOL examination during the 2002-2003 testing cycle. Students were selected using the following criteria: Students' name, Grade level, School year, Test taken (Algebra I or Geometry), Number of times taken, and score on SOL test. Students were then identified as Non-Illustration and Design Technology or Illustration and Design Technology utilizing the researcher's classroom Task/Competency records for the same time frame. Once sorted, the names of students were removed and replaced with Non-Illustration and Design Technology or Illustration and Design Technology. Table 7 shows the make-up of two groups and their pass/fail ratio.

| Non-IDT Students |        |          | IDT Students |        |          |
|------------------|--------|----------|--------------|--------|----------|
| Totals           | Passes | Failures | Totals       | Passes | Failures |
| 907              | 661    | 246      | 89           | 69     | 20       |

Table 7. Composition of the Non-Illustration and Design Technology and Illustration and Design Technology groups

The calculated mean and standard deviation was used to show the quality of testing between the Non-Illustration and Design Technology and Illustration and Design Technology test groups. A t-Test was used to test the first hypothesis  $H_1$ : Students who have taken illustration and design technology courses test better on their mathematics SOL tests than students that did not take technology courses. The SOL scores of the Non-Illustration and Design Technology and Illustration and Design Technology groups were used to determine if there was a significant difference in the scores between the two groups. This factor was used to determine acceptance or rejection of the first hypothesis. The Chi-Square test instrument was used in determining the acceptance or rejection of the second hypothesis  $H_2$ : Students who have not passed the mathematics SOL tests will do better on their retake examinations if they take an illustration and design course.

### **Conclusions**

*$H_1$ : Students who have taken illustration and design technology courses test better on their mathematics SOL tests than students that did not take technology courses.*

The calculated t-test value was 2.65. From the table for level of significance, the  $p > .01$  value was 2.326. The researcher accepts this hypothesis. Concluding there is a high level of significance between students who took Illustration and Design Technology courses and those that did not. Therefore students taking Illustration and Design Technology courses are more likely to pass the Algebra I and Geometry end of course mathematics SOL exams.



*H<sub>2</sub>: Students who have not passed the mathematics SOL tests will do better on their retake examinations if they take an illustration and design course.*

The students within the Illustration and Design Technology study group requiring a retake exam from the previous school year(s) was minimal, with only 18 students having to take a retest. All 18 of the students subsequently took an Illustration and Design Technology course prior to passing the retake exam. The Non-Illustration and Design Technology group had 409 students requiring a retake exam from previous test cycles; 359 passed the retake examinations should be noted that for this test the Illustration and Design Technology sample group is inadequate for an accurate comparison of the two groups.

The second hypothesis was tested using a Chi-square test. The calculated  $X^2$  value was 2.492. From the table for level of significance, the hypothesis is not accepted at the  $p > .05 = 3.84$ . The distribution is not significant, concluding there is not a significant difference between students taking Illustration and Design Technology courses and a student's ability to pass a retake examinations.

### **Recommendations**

During this study, the researcher developed an improved understanding of how his courses served his students. By evaluating course material against the corresponding Standards of Learning, the researcher developed several improvements to his courses, including the use of the Virginia Linkages site in developing future lesson plans.

Teachers need to take a more active role in verifying their course materials. Virginia only looks at Career and Technical Education all together and not as individual courses; every course has its strengths. These specific strengths need to be addressed and

advertised, so that councilors can assist students in choosing courses that are going to improve their educational success.

A successful course of instruction is one that has realistic standards and some form of self evaluation validating those standards. When VDOE developed the correlation of Standards of Learning to Career and Technical Education, no method was developed to verify the validity of the correlations. Having simple data in the state's annual report is not enough. The validity of these correlations needs to be measured. The SOL exams are a good test to start. By using, the examinations most closely related to courses materials, correlations can be made. An instructor can see if they are actually assisting students as advertised. It is far better to know the weaknesses in your course materials in regards to the correlations and developing improvements of instructional materials or developing new lessons to strengthen the correlations. Therefore, it is recommended that teachers perform a self evaluation of their courses to determine if they are adequately covering standards.

Elective teachers need to actively review research and publicize how their courses improve a student's preparedness for taking the SOL tests. Technology teachers need to step out of their labs and talk with academic teachers. Using the VA Linkages Crosswalk section, the researcher recommends that technology education teachers and academic teachers develop collaborative lessons. To do this teachers will need to solicit and/or assist each other in developing new lessons, which give students the opportunity to put learning into practice in the context of the real world.

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