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Technology Education Effects on High School Student's Test Scores

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TECHNOLOGY EDUCATION'S EFFECTS ON HIGH SCHOOL STUDENT'S TEST SCORES

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SIGNATURE PAGE

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CHAPTER I

INTRODUCTION

There is more need than ever for secondary school students to finish school being technologically literate citizens (Bybee & Starkweather, 2006). Scientists and engineers are not created overnight so the push to prepare students for these careers needs to stay in the foreground. With many warning signs present that the United States may be losing its competitive edge, more than ever, the public school must inspire and prepare students for complex jobs of the future (Bybee & Starkweather, 2006).

In public schools, technology education is the prominent vehicle through which students become technologically literate. With the push for tougher academic standards, will technology education be pushed aside as schools focus on helping students pass rigorous academic standards tests? This will not occur if technology educators and their teaching support core area academics. This research study will investigate the impact that technology education classes have on students' academic test scores.

Statement of the Problem

The problem of this study was to determine what impact the completion of technology education classes at Woodrow Wilson High School has on students' Standards of Learning (SOL) scores. The researcher will compare the SOL test scores of students who did and did not take technology education courses. These comparisons will be analyzed by SOL subject area to determine which subject areas technology education has the greatest and least lasting effect.

Research Goals

The researcher will attempt to answer four specific questions with this study:

1. Do technology education classes have a positive impact on students' SOL scores?
2. On which academic subject's SOL test scores do technology education classes have the greatest impact?
3. On which academic subject's SOL test scores do technology education classes have the least impact?
4. What can technology education teachers do to increase their positive impact on academic test scores?

Background and Significance

Currently in Portsmouth City Public Schools, the future of technology education seems to be in jeopardy. Due to Portsmouth's bad educational image and historically low salaries, many teachers have left for other districts and few others starting their careers consider Portsmouth as a viable option. While Portsmouth's image and salaries are on the rise, this may not be happening fast enough to help technology education.

At the end of the 2005-2006 school year, the technology education programs at all three middle schools were closed and the space they occupied renovated into regular classroom space. Many reasons can be speculated for this change: teacher quality, outdated curriculum, outdated equipment, but the researcher believes ultimately the reason was lack of program efficacy.

Currently, the three Portsmouth high schools still have somewhat viable technology education programs. In order to keep and expand these programs, their worth must be proven. These programs should have a positive effect on students' academic performance not just so the program will not be closed, but because part of technology education's goal is to prepare students for post-secondary education.

In their 2004 article, Berry and Ritz (2004) write about how technology education can be used to support other academic subjects in the school, particularly mathematics. They explain ways that the mathematics and technology education curriculums intersect. They also present this convincing argument for keeping data on students' academic achievement (2004):

> With data in hand, you have tools available to prove the value of your studies in technology education. You can use it to get technology education as a required subject in your school system or state. You can position yourself as a member of the education team at your school. You can use it as leverage to get more resources to support your program. What school board would deny you additional resources if you can show that your teaching in technology education can improve the test scores of students in your school system? (p. 24)

There is currently no research on the effect technology education classes have on students meeting their academic goals at Wilson High School in Portsmouth. This research will contribute to the literature and either show that technology education is essential or will suggest need for change in the program.

Limitations

The limitations of the study were as follows:

1. This study only looks at scores of students at Wilson High School in Portsmouth, Virginia.
2. Wilson High School only offers the following technology education classes:
    a. Architectural Drawing and Design
    b. Basic Technical Drawing
    c. Communication Systems
    d. Graphic Communications Systems
    e. Production Systems
    f. Technology Foundations
    g. Technology Transfer
3. This study only looks at scores in the following school years:
    a. 2003-2004
    b. 2004-2005
    c. 2005-2006
    d. 2006-2007
4. Algebra II scores were not studied. Most students take the Algebra II SOL in the tenth or eleventh grade. There were not enough students who took technology education in the ninth or tenth grade to create a sample group.

Assumptions

The assumptions of the study were as follows:

1. Taking technology education classes at Wilson High School may or may not have a positive effect on students' SOL scores.
2. Taking technology education classes at Wilson High School will not have a negative effect on students' SOL scores.

Procedures

Two groups of the Wilson High School population will be selected: one who has taken technology education classes and one who has not. Average SOL scores in different subjects will be computed. The SOL scores of the two groups will be compared using t-test statistical analysis.

Definition of Terms

The following terms are defined to assist the reader:

- Academic subject tests – Under the broad heading of SOL, there are separate academic subject tests for each subject.
- Architectural Drawing and Design - Architectural drawing and design is a technology education course that prepares students for careers in the architecture and construction industry. The course focuses on duties and tasks performed by professionals in architecture, as well as pre-employment and employment skills.
- Basic Technical Drawing – Basic technical drawing is a technology education course that teaches students the basic language of technical design. They will design, sketch, and make technical drawings,

models, or prototypes of real design problems. The course is suited for future engineering and architecture students.

- Career and Technical Education (CTE) – CTE refers to the cluster of classes offered in public secondary schools that teach students skills needed to be successful in work and college.
- Communication Systems – Communication systems is a technology education course that provides experiences related to various modes of communicating information, using data, technical design, optics, graphic production, audio and video, and integrated systems. Students solve problems involving input, process, output, and feedback processes. Also, students learn about potential career choices related to communication and impact of communication on society.
- Graphic Communications Systems – Graphic communications systems is a technology education course that provides experiences related to a wide range of tools and materials used to reproduce information and images. Several mediums are used, including paper, metal, plastic, and fabric. Students develop competencies in message design, composition and assembly, film conversion and assembly, and message transfer and product conversion.
- No Child Left Behind (NCLB) – The education reform effort by the Bush administration that aims to improve the performance of primary and secondary public schools.

- Production Systems – A technology education course where students assess the relationship between production and society as they compose design portfolios, construct production prototypes, and apply automation to evaluate their solutions to technological problems.
- Standards of Learning (SOL) – SOL refers to Virginia's set of NCLB mandated standardized tests that all public school students must pass.
- Technology Education – Technology education refers to the cluster of classes offered in public secondary schools that teach students skills needed to be technologically literate citizens. Technology education classes are a subset of CTE classes.
- Technology Foundations – Technology foundations is a technology education course where students acquire a foundational knowledge in technological material, energy, and information, and apply processes associated with the technological thinker.
- Technology Transfer – Technology transfer is a technology education course where students work with various computers, materials, and systems to build a project that will combine systems such as production, energy, communication, transportation, and other technologies.

In this paper, CTE and technology education may be used interchangeably to refer to the classes under study.

Overview of Chapters

Chapter I provided the reader with basic information needed to understand this study. Information about the problem, why it was chosen, and why it is significant was presented. The reader was presented with the limitations and assumptions that were in place as this study was prepared. The reader was also presented with the terms necessary to understand this study.

Chapter II presented the reader with current literature that explored topics relating to the study. Critical issues in technology education were identified. The need for integration of academic subjects into the technology education curriculum was discussed. Literature describing a situation where academic and technology education integration was successful was discussed.

Chapter III outlined the methods and procedures that were followed when conducting this study. Chapter IV reported the data that was found as a result of this study. Finally, Chapter V summarized results of the study, made conclusions about the implications of this study, and made recommendations for future improvements in the technology education program at Wilson High School and at large.

CHAPTER II

REVIEW OF LITERATURE

The purpose of this chapter was to review the current literature related to the effect that taking technology education classes has on the standardized test scores of students' academic classes. Technology educators have long known that technology education is an important part of the overall school curriculum. The challenge is in proving this to educational decision-makers.

Critical Issues in Technology Education

Wicklein (2005) conducted a study to determine what critical issues and problems face those in the field of technology education. Classroom teachers, university professors, and supervisors of technology education were surveyed to ascertain this information. Those surveyed were asked to rate and rank a list of eighteen common issues facing technology education. Those surveyed were also asked to rate and rank twenty-one common problems facing technology education. Overwhelmingly, the most urgent issue was judged to be the recruitment of teachers in teacher education programs and the most urgent problem was judged to be insufficient numbers of qualified teachers. However, also ranked high was the issue of positioning technology education within the whole school curriculum and integration of technology education with other school subjects.

These concerns, which represent views of individuals working in the field of technology education, stress the urgent need for studies that draw attention to the positive impact technology education has on students' academic

achievement. When this feature is realized by more school leaders, integrating technology education into the whole school curriculum will become a higher priority. Along with this new emphasis will come increased funding and support.

The Need for Integration

More than at any other time, entry-level workers who are proficient problem-solvers are needed. Studies show that many students are leaving high school without the basic skills needed for employment. Many students also require remediation when entering college or technical schools after graduation (Stone, Alfeld, Pearson, Lewis, & Jensen, 2005).

A problem found is that many students finished taking high school mathematics courses by tenth grade, thus leaving a gap between the time they learn mathematics skills and the time they need to use those skills for work or college. The researcher also found that most students take some career and technical education (CTE) classes in high school, many during their eleventh and twelfth grade years. CTE classes have an abundance of mathematics in the curriculum and are well known for their experiential and applied learning environments. With this in mind, the researcher's study was designed to use the context of CTE classes for directly teaching mathematics skills.

The researcher discovered through the use of pre- and post-tests and the monitoring of students' college entrance exam scores that students who were explicitly taught mathematics skills in CTE classes improved their overall mathematics skills without missing the career preparation content that is unique to CTE.

A more urgent view of the need for technology education's integration with science and mathematics is presented in Zuga's essay (2000). She asserts that the only way for technology education to stay alive is through integration. This is not viewed as a negative alternative. Integration provides for situated learning of mathematics and science skills and all contribute to student understanding and growth. She also does not see this as the end of technology education programs as they are now known.

> It is a winning situation for all concerned. Students gain exposure to an organized and established body of knowledge about technology and at the same time can explore the relationships of scientific constructs and mathematics principles in a realistic context through technology education laboratory activities. (p. 226)

Technology Education's Benefits on the Academic Curriculum

Research results are mixed on the effect of technology education on students' SOL scores. A study by Culbertson, Daugherty, and Merril (2004) looked at the effects of modular technology education on junior high students' achievement on the TerraNova Performance Assessment. Between students who completed a unit of modular technology education and those who did not, the researchers found no significant difference between students' pre-test and post-test scores in reading, language arts, mathematics, science and social studies. Although the researchers cited several significant limitations to the study, they generalized the results to technology education across the field due to other studies with similar results (Culbertson, Daugherty, & Merril, 2004).

Conversely, school officials in Chesapeake, Virginia, set up courses that instruct CTE teachers on how to integrate the Standards of Learning (SOL) into their classes. Officials reported a rise in test scores in English, mathematics and history (Reese, 2003).

A key feature of this program was the training and support CTE teachers received. Rather than just being told they needed to help students raise achievements levels in all area, the teachers were trained with specific strategies and skills needed to be successful. This has helped CTE teachers feel more a part of helping students achieve on the SOL tests.

Chesapeake's tech prep initiative with CTE classes also helped students to more wisely choose their elective courses. The added emphasis from the school on the benefits of CTE and the creation of tech prep sequences that lead to advanced diplomas all added to the quality of instruction students were offered and the professionalism of the CTE program in that city (Reese, 2003).

Summary

Chapter II presented the reader with an overview of current literature that deals with the topic of study. Critical issues and problems that those associated with technology education perceive were discussed and the need for integration of technology education with other school subjects was identified as a critical issue. The need for academic subjects' content to be integrated with technology education was discussed. Situations where this has happened and been successful were presented. Chapter III presents the methods and procedures used to complete this research study.

CHAPTER III

METHODS AND PROCEDURES

Chapter III discussed the methods and procedures the researcher used to determine what impact the completion of Technology Education classes has on students SOL test scores at Woodrow Wilson High School. This chapter will discuss the population chosen for this study, the instrument design, the procedures by which the data were collected, and the methods of statistical analysis.

Population

The population used for this study was graduates from the 2007 class of Woodrow Wilson High School, a public high school in the Portsmouth City Public School district in Portsmouth, Virginia. A sample of 132 students who completed Architectural Drawing and Design, Basic Technical Drawing, Communication Systems, Graphic Communications Systems, Production Systems, Technology Foundations, or Technology Transfer then completed the selected SOL test was taken. Another sample of 301 students who had taken the selected SOL test but had never taken a technology education class was taken.

Instrument Design

The instrument by which scores were determined was the Virginia SOL subject tests. The researcher gathered this data and used SPSS, a statistical computer software package to conduct t-tests on the means of the sampled groups.

Data Collection

By permission of Portsmouth Public School's Research and Evaluation Department and Woodrow Wilson High School's principal, access to SOL test data was granted. The SOL test data for all students sampled were collected and stored in a computer spreadsheet program. When data were collected, student names were not attached to the culled data. Only data regarding the SOL test name, test score, and which sample group the data were for was collected. Data for all SOL test subject areas were collected.

Statistical Analysis

The SOL test scores of each sample group were analyzed using the t-test statistical method. The result was used to determine whether there was a significant statistical difference between the means of the two sampled groups.

Summary

The participants in this study were students sampled from 2007 graduates of Woodrow Wilson High School. SOL test score data were collected for the sampled students and the means of each sample group were compared using the t-test statistical method. Chapter IV will describe the findings from the data collected.

CHAPTER IV

FINDINGS

In Chapter IV, the data from this research study are presented. The problem of this study was to determine what impact the completion of technology education classes at Woodrow Wilson High School has on students' SOL scores. Technology education's effects on students' Chemistry, Virginia and United States History, and Writing SOL tests were measured. Scores of students who took a technology education class prior to the SOL test and scores of students who did not take a technology education class prior to the SOL test were compared using *t* tests. Figure 1 displays the process the researcher followed when selecting and compiling data during this study.

Figure 1 – Process of Selecting and Compiling Data

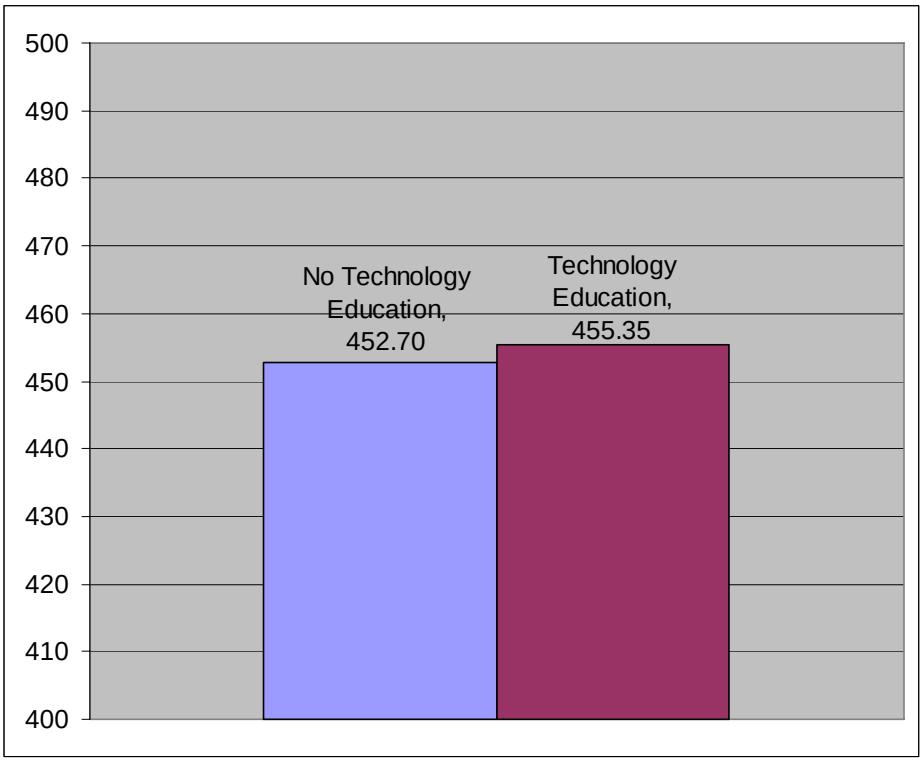
Chemistry		Virginia and United States History		Writing	
Technology Education class(es) completed	No Technology Education classes completed	Technology Education class(es) completed	No Technology Education classes completed	Technology Education class(es) completed	No Technology Education classes completed
↓	↓	↓	↓	↓	↓
Chemistry SOL completed	Chemistry SOL completed	History SOL completed	History SOL completed	Writing SOL completed	Writing SOL completed
↓	↓	↓		↓	↓
SOL Scores Compiled	SOL Scores Compiled	SOL Scores Compiled	SOL Scores Compiled	SOL Scores Compiled	SOL Scores Compiled
↓	↓	↓	↓	↓	↓
T-test performed on data sets –statistical difference of two groups determined		T-test performed on data sets –statistical difference of two groups determined		T-test performed on data sets –statistical difference of two groups determined	

Chemistry

The first SOL test scores investigated were Chemistry. This study looked at the scores of 84 students who took the Chemistry SOL test. Sixty-seven of these students had not previously taken a technology education class and 17 had. The scores of students who had not previously taken a technology education class ranged from 372 to 600 with 400 being a passing score and 600 being a perfect score. The scores of students who had previously taken a technology education class ranged from 411 to 532. The mean scores of students who had not taken a technology education class was 452.70 and the mean scores of students who had taken a technology education class was 455.35. Appendix A lists the scores studied. The standard deviation of scores of students who had not taken a technology education class was 46.259 and the standard deviation of scores of students who had taken a technology education class was 32.328. See Figure 2.

An independent samples *t* test of the scores showed a *t* value of 0.222. Given a degree of freedom of 82, the significance at the 0.05 level was 0.825. Since the *t* of 0.222 did not exceed the level of significance, no difference is shown between the means of the group of students who did and the group of students who did not take technology education classes before completing the Chemistry SOL test.

Figure 2 - Means of Students' Chemistry SOL Scores



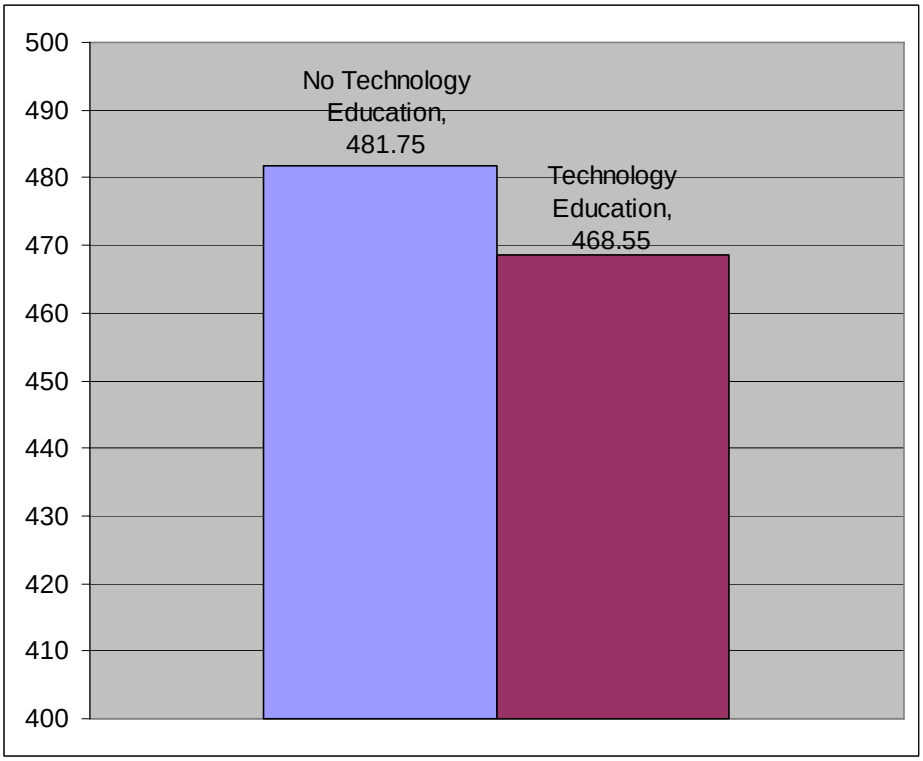
Virginia and United States History

Next, Virginia and United States History SOL test scores were investigated. One hundred and seventeen of these 173 students had not previously taken a technology education class and 56 had. The scores of students who had not previously taken a technology education class ranged from 375 to 600 and the scores of students who had previously taken a technology education class ranged from 369 to 600. The mean of the scores of students who had not taken a technology education class was 481.75 and the mean of the scores of students who had taken a technology education class was 468.55. Appendix B lists the scores studied. The standard deviation of scores of students who had not taken a technology education class was 59.075 and the

standard deviation of scores of students who had taken a technology education class was 54.865. See Figure 3.

A *t* test yielded a *t* value of -1.406. Given a degree of freedom of 171, the level of significance was 0.161 at the 0.05 level. No significant difference was shown between the means of the two groups of Virginia and United States History SOL test scores.

Figure 3 - Means of Students' Virginia and United States History SOL Scores



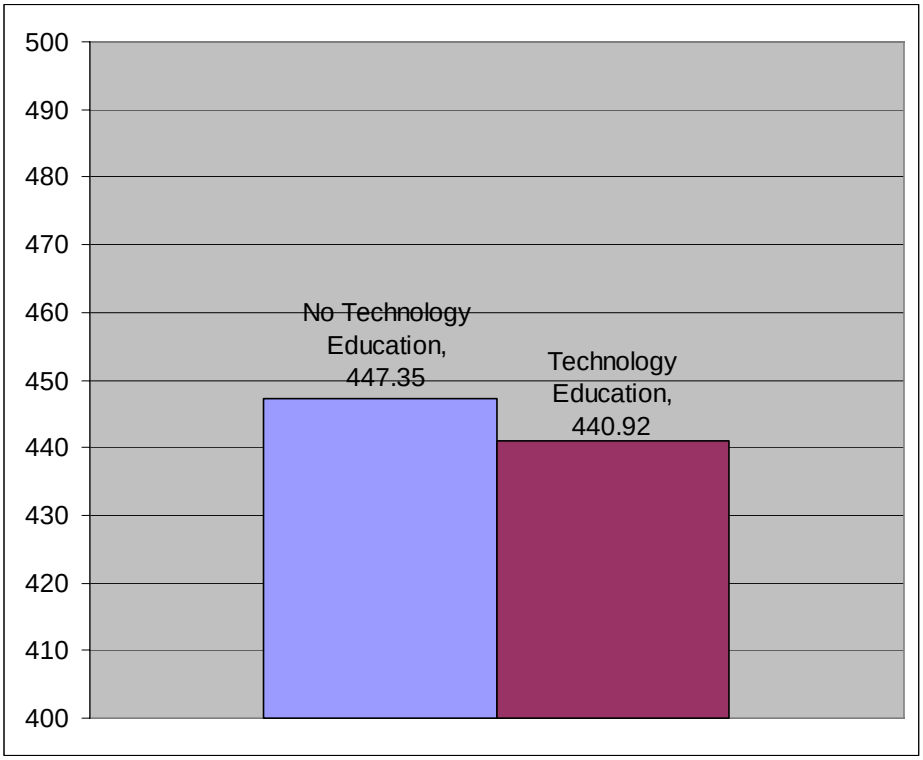
Writing

Finally, 176 students' Writing SOL test scores were investigated. One hundred and seventeen of these students had not previously taken a technology education class and 59 had. The scores of students who had not previously taken a technology education class ranged from 351 to 600 and the scores of students who had previously taken a technology education class ranged from

375 to 600. The mean of the scores of students who had not taken a technology education class was 447.35 and the mean of the scores of students who had taken a technology education class was 440.92. Appendix C lists the scores studied. The standard deviation of scores of students who had not taken a technology education class was 45.168 and the standard deviation of scores of students who had taken a technology education class was 39.887. See Figure 4.

A *t* test yielded a value of -0.927. Given a degree of freedom of 174, the level of significance was 0.355 at the 0.05 level of significance. Since the level of significance was higher than 0.05, no significant difference was shown between the means of the two groups of Writing SOL test scores.

Figure 4 – Means of Students' Writing SOL Scores



Summary

The mean of students' Chemistry SOL scores was higher for students who took technology education classes prior to the test. Scores were lower for Virginia and United States History and Writing students who took technology education classes prior to taking the SOL test. According to the *t* tests, no significant differences existed between the means of each group being studied.

In Chapter V, a discussion of study results will occur. The writer will interpret study data, draw conclusions from that data, and make recommendations for change and further study.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

In Chapter V, the study is reviewed and summarized. Conclusions are drawn from the results of the study. Finally, recommendations for change and additional studies are discussed.

Summary

The problem of this study was to determine what impact the completion of technology education classes at Woodrow Wilson High School had on students' SOL scores. The researcher compared the SOL test scores of students who did and did not take technology education courses. These comparisons were analyzed by SOL subject area to determine which subject areas technology education had the greatest and least effect. The goal of this study was to answer four specific questions:

1. Do technology education classes have a positive impact on students' SOL scores?
2. On which academic subject's SOL test scores do technology education classes have the greatest impact?
3. On which academic subject's SOL test scores do technology education classes have the least impact?
4. What can technology education teachers do to increase their positive impact on academic test scores?

Currently in Portsmouth City Public Schools, the future of technology education seems to be in jeopardy. Due to Portsmouth's bad educational image

and historically low salaries, many teachers have left for other districts with few others starting their teaching careers in Portsmouth. While Portsmouth's image and salaries are on the rise, this may not be happening fast enough to help technology education.

At the end of the 2005-2006 school year, the technology education programs at all three middle schools were closed and the space they occupied renovated into regular classroom space. Many reasons can be speculated for this change: teacher quality, outdated curriculum, outdated equipment, but the researcher believes ultimately the reason was lack of program efficacy.

Currently, the three Portsmouth high schools still have somewhat viable technology education programs. In order to keep and expand these programs, their worth must be proven. These programs should have a positive affect on students' academic performance not just so the program will not be closed, but because part of technology education's goal is to prepare students for post-secondary education.

Since there is currently no research on the effect technology education classes have on students meeting their academic goals at Woodrow Wilson High School, the researcher intends to add research to the field of knowledge that will either show that technology education is essential or suggest need for change in the program.

This study was undertaken with several limitations:

1. This study only analyzed scores of students at Wilson High School in Portsmouth, Virginia.

2. Wilson High School only offered the following technology education classes:
    a. Architectural Drawing and Design
    b. Basic Technical Drawing
    c. Communication Systems
    d. Graphic Communications Systems
    e. Production Systems
    f. Technology Foundations
    g. Technology Transfer
3. This study only looked at scores in the following school years:
    a. 2003-2004
    b. 2004-2005
    c. 2005-2006
    d. 2006-2007
4. Algebra II scores were not studied. Most students take the Algebra II SOL in the tenth or eleventh grade. There were not enough students who took technology education in the ninth or tenth grade to create a sample group.

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taken. Another sample of 301 students who had taken the selected SOL test but had never taken a technology education class was taken.

The instruments by which scores were determined was the Virginia SOL subject tests. The researcher gathered this data and used SPSS, a statistical computer software package to conduct t-tests on the means of the sampled groups. By permission of Portsmouth Public School's Research and Evaluation Department and Woodrow Wilson High School's principal, access to SOL test data was granted. The SOL test scores of each sample group were analyzed using the t-test statistical method. The result was used to determine whether there was a significant statistical difference between the means of the two sampled groups.

Conclusions

The following section describes conclusions that were drawn from this research. The conclusions are arranged by research goals.

Research Goal 1: Do technology education classes have a positive impact on students' SOL scores?

The results of this study showed that the completion of technology education classes at Woodrow Wilson High School has a slightly positive effect on students' Chemistry SOL test scores. The data showed a negative effect on the SOL test scores of Virginia and United States History and Writing students. These effects are slight and *t* tests showed that they are statistically insignificant.

Research Goal 2: On which academic subject's SOL test scores do technology education classes have the greatest impact?

The greatest positive impact on SOL score data was had upon the Chemistry SOL test. Although statistically insignificant, students who first took a technology education class scored an average of 2.65 points higher on their SOL test.

Research Goal 3: On which academic subject's SOL test scores do technology education classes have the least impact?

Technology education classes had the least positive impact on the Virginia and United States History SOL test. Students who first took a technology education class scored an average of 13.2 points lower than those who did not. Again, these differences are statistically insignificant.

Research Goal 4: What can technology education teachers do to increase their positive impact on academic test scores?

Technology educators should focus on teaching academic skills that relate to their technology education subject.

Recommendations

The results of this study showed that technology education at Woodrow Wilson High School is lacking in positive effects on students' core academic achievement. Since there is no significant statistical difference in students' SOL test scores who take technology education classes and those who do not, some changes are in order.

In an effort to support students' core academic subjects, the technology education teachers at Woodrow Wilson should better collaborate with core academic teachers (Clark & Ernst 2007). This should involve the planning of co-

curricular student activities. These activities should involve the use of knowledge from both subject areas. This will help students see the connection between the content of both classes helping them to make better connections in their minds, thus, helping them to better remember the information (Schafer, Sullivan, & Yowell, 2003).

Technology education teachers should also specifically focus on core academic content in their classes. When students are required to write in technology education, it should be evaluated as an English teacher would evaluate. When a technology education class is studying the history of inventions and innovations, they should specifically review what else was going on in history that made certain inventions possible and desirable. The technology education teacher should have a general idea of core academic classes' content so connections to the technology education curriculum can be made. In addition, the technology education teacher should be aware of what SOL testing areas students are having difficulty with so those areas can be stressed.

Further studies of this sort at Woodrow Wilson High School could add some components that would make the study more accurate and informative. Often, a complaint of technology teachers is that schools place slower learning, non-college bound students into technology education. If this were true, the results of such a study could be skewed. Measures could be built into the study to control for students' GPA so the results would take into account the students'

overall academic achievement. Inclusion of more students from more school years could increase the accuracy of the study.

Finally, study results of this nature may prompt administrators and supervisors to examine teaching practices of technology education teachers. Professional development addressing collaboration with core academic teachers and integration of core academic material could be developed.

References

Berry, R. Q., III & Ritz, J. M. (2004). Technology education – A resource for teaching mathematics. *The Technology Teacher*, 63(8), 20-24.

Bybee, R. W. & Starkweather, K. N. (2006). The twenty-first century workforce: A contemporary challenge for technology education. *The Technology Teacher,* 65(8), 27-32.

Clark, A & Ernst, J. (2007). A model for the integration of science, technology, engineering, and mathematics. *The Technology Teacher,* 66(4), 24-26.

Culbertson, C., Daugherty, M., & Merril. C. (2004). Effects of modular technology education on junior high students' achievements scores. *Journal of Technology Education,* 16(1).

Reese, S. (2003). A role to play in school reform. *Techniques*, 78(6), 39-41.

Schafer, M.R., Sullivan, J.F., & Yowell, J.L. (2003). Standards-based engineering curricula as a vehicle for k-12 science and math integration. Published Proceedings of the American Society for Engineering Education Frontiers in Education Conference, Boulder, CO, Session F3A.

Stone, J. R., III, Alfeld, C., Pearson, D., Lewis, M. V., & Jensen, S. (2005). Building academic skills in context: Testing the value of enhanced math learning in CTE (Pilot Study). St. Paul: National Research Center for Career and Technical Education. (National Dissemination Center for Career and Technical Education Research Report No. RR5001).

Wicklein, R. C. (2005). Critical issues and problems in technology education. *The Technology Teacher*, 64(4), 6-9.

Zuga, K. F. (2000). Technology education as an integrator of science and mathematics. In E. E. Martin (Ed.), *Technology education for the 21st century* (pp. 223-227). New York: Glencoe McGraw-Hill.

Appendix A

Chemistry SOL Test Results

Students who did take technology education prior to SOL test	Students who did not take technology education prior to SOL test
480	473 407
466	532 407
411	466 429
473	454 434
444	430 517
434	449 466
411	473 460
483	411 439
532	486 390
439	473 439
429	454 425
430	473 480
454	449 387
456	404 425
487	600 417
425	425 398
487	429 495
	434 416
	496 460
	473 450
	439 439
	412 466
	496 400
	439 449
	439 444
	407 473
	434 466
	407 403
	517 404
	496 372
	532 584
	584 466
	404 454
	480
Samples: 17 Mean: 455.35	Samples: 67 Mean: 452.70

Appendix B

Virginia and United States History SOL Test Results

Students who did take technology education prior to SOL test		Students who did not take technology education prior to SOL test			
463	470	544	425	437	
392	544	483	463	473	
463	478	600	468	445	
397	533	501	600	533	
573	421	379	417	429	
438	463	468	557	425	
524	441	463	600	473	
483	489	454	429	405	
544	429	405	600	516	
441	369	483	454	409	
468	533	478	600	473	
495	516	421	439	508	
429	405	458	449	458	
405	516	495	417	468	
400	463	508	587	557	
441	442	445	437	533	
544	489	489	557	425	
478	458	468	473	463	
429	557	415	489	508	
483	386	473	394	483	
478	600	516	533	495	
449	425	516	544	445	
479	413	596	509	409	
524	425	533	429	557	
441	557	596	433	489	
508	573	441	458	483	
448	401	455	379	573	
421	405	600	508	557	
		544	433	405	
		566	375	398	
		495	508	429	
		478	461	421	
		501	402	501	
		508	437	385	
		557	437	495	
		557	437	402	
		533	493	596	
	Samples: 56	478	497	495	Samples: 117
	Mean: 461.32	381	483	517	Mean: 478.66

Appendix C

Writing SOL Test Results

Students who did take technology education prior to SOL test	Students who did not take technology education prior to SOL test
421 467	539 461 375
600 461	461 417 443
410 416	457 443 467
395 447	472 478 451
436 390	355 417 440
446 429	436 478 409
447 414	421 380 429
485 446	461 600 416
404 467	439 457 457
410 430	431 500 461
491 404	402 452 436
410 431	409 565 443
422 452	416 404 443
440 424	472 443 417
416 457	506 408 485
467 415	410 443 478
439 427	408 429 467
426 439	472 410 500
408 404	416 461 447
472 532	433 447 467
485 375	417 374 563
405 491	443 454 416
402 472	522 522 417
410 390	428 436 457
455 470	522 436 470
447 522	467 410 472
447 522	566 404 439
424 410	398 390 424
457 417	414 457 408
416	443 464 431
	457 429 431
	452 478 351
	398 410 403
	417 457 457
	485 443 457
	567 422 404
	416 561 506
Samples: 59	410 489 491 Samples: 117
Mean: 434.55	360 424 461 Mean: 444.55