# The Effect of Math Course Completion and Socio-economics on the Washington Assessment of Student Learning (WASL)

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A Special Project

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FACULTY APPROVAL

The Effect of Math Course Completion and Socio-economics on the Washington Assessment of Student Learning (WASL)

Approved for the Faculty

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ABSTRACT

The purpose of this study was to investigate how the completion of basic algebra and/or geometry courses by grade ten affected student success on the grade ten math Washington Assessment of Student Learning (WASL). The study controlled for mobility and socio-economic status and ultimately allowed the district to focus on decisions of curriculum and instruction with regards to low-socioeconomic students. The results supported the hypothesis that lower-socioeconomic students score significantly lower than their counterparts on the WASL, even when these students completed math through at least the district adopted algebra curriculum. It was then recommended that a deeper look into the nature of this achievement gap be taken, especially in regards to instruction and curriculum.

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# CHAPTER 1

## Introduction

### Background for the Project

It was common knowledge at both the national and state levels that an achievement gap in mathematics existed between white and non-white minority students. National data suggested that this gap even increased during the last twenty years (National Center for Educational Statistics). With the desegregation of public schools there was a decrease in the achievement gap between Black and Anglo students, but that soon changed during the late 1980's when an increase began again. This reality that many years of data supported raised many questions about the nature of public education. It also forced leaders of all levels to examine best practices and to try new innovations.

As part of the lower-end of this national achievement gap were often students of low-economic status. Even with the introduction of various federal and state-wide funding models throughout the last thirty years, low-income students—many for which also fit minority status across the country—statistically scored lower on standardized tests and had much higher drop-out rates then their counterpart student colleagues. In Washington State this reality was also evident. With the rising tide of high-stakes testing and increased graduation requirements, both students of color and low-income status experienced difficulty in meeting standards as defined by the state. The introduction and presence of the Washington State Assessment of Student Learning (WASL) raised major questions about how public education served all students. As part of this obstacle for students were questions about what constituted effective instruction, proper funding and teacher pay, early learning, and curriculum.

As a consequence to rising standards, a major discussion across the country began regarding how students learn math. Some identified two camps: traditionalist and constructivist. While these two seemingly competing modes of learning influenced decisions within states, some research suggested that successful student achievement in algebra was a key indicator for success in college. Algebra was described as the gate-keeper, as educators noticed that success in this course often predicted student success or failure in graduating high school. One study showed that for low-income students "71% of students who complete both algebra and geometry enroll in college. Only 27% of those who do not take these courses go on to college." (Quattrohiocchi, 2002). This logic likely suggested that students who failed to complete algebra alone would find even greater difficulty in enrolling in college.

In this study the data examined was isolated to The comparison between low-income and non-low-income students who completed basic algebra and/or geometry by the completion of grade ten. The usefulness of this comparison was striking since much research was done on assessing achievement gaps in dropout rates and standardized testing, but much can be gained by considering the effect of course-completion on the testing results for both groups.

Statement of the Problem

Two related problems existed within the Olympia School District (OSD) in Olympia, WA. First, students who qualified for free & reduced lunch (FR) generally scored lower on standardized testing than non-free & reduced (NFR) students. Second, FR students had a higher failure rate then NFR students. A failure to better address these two issues would have likely increased the achievement gap with growing pressures and graduation demands on these students.

## Purpose of the Study

The purpose of this study was to investigate whether NFR students achieved significantly higher on the grade ten math WASL then FR students for particular conditions. The outcome of this study better informed future decisions in regards to instruction, school structure, and K-12 math curriculum alignment.

## Delimitations

The 356 students in this study were selected from the OSD graduating class of 2009 who fit specific criteria. Of these 356 students, 47 had identified FR lunch status as of September 2006, and 309 students did not have identified FR status. Each of the two data sets represented the entire subpopulations of their respective FR status from the total population of 869 students. Each student within the 356 student set must have or been:

1. Attended the OSD since grade five or earlier.
2. Have taken the grade 10 math WASL at least once.
3. Taken math using the district adopted algebra and/or geometry curricula by the completion of their tenth grade year. Students completing lower and higher math classes were not considered, e.g. only prealgebra or at least advanced algebra.
4. Enrolled in an algebra or geometry course in grade ten.
5. A student in the 2009 graduating class.
6. Used the textbook Algebra 1. Glencoe. 2003. This text was used district-wide in all middle and high schools.

Assumptions

Given the above population, the following assumptions were made:

1. Differing feeder grade and middle schools did not impact mathematical achievement.

2. All students in the study completed the full year of math in their algebra or geometry class.
3. All teachers were highly qualified at the time of instruction.
4. Students may have repeated a math class in order to improve their grade or for other reasons. Only the latest course was considered in choosing the data set.
5. Special education students who completed algebra and/or geometry were included in the study.

## Hypothesis

Consider OSD students from the graduating class of 2009. Of this group who in grade ten completed and passed Algebra 1 or Geometry, NFR students significantly outperformed FR lunch students on the grade ten math WASL test. The statistical threshold of significance was $p \geq .05$.

Null Hypothesis

This study considered students from the graduating class of 2009. Of this group who in grade ten completed and passed Algebra or Geometry, NFR students did not significantly outperform FR students on the grade ten math WASL test. The statistical threshold of significance was $p \geq .05$.

Significance of the Project

The analysis of math WASL data was extremely important to the school and district as various local decisions depended on student success on this test. Some decisions related to across-district curricular choices, instructional practices, hiring practices, and diversity. The outcome of this study indicated some non-anecdotal evidence in regards to mathematical courses in middle and high schools and their possible impact on student success on the WASL.

Procedures

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

1. A review of selected literature was conducted in the OSD, Heritage University, and articles

collected through the use of various texts, journals, and internet search engines.

2. Verbal permission was granted by the district assessment coordinator for the analysis of district math WASL data for the population of interest.
3. The collection of data was done along-side the assessment coordinator. Given the confidential nature of FR data, names were deleted and only the data for the students chosen was allowed to leave the building.
4. The data was analyzed by means of a Microsoft Excel spreadsheet. Statistical measures such as t-score, mean, and tests for significance were then calculated and discussed.

<u>Definition of Terms</u>

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

1. <u>Free & reduced lunch</u>. Students who qualified for free breakfast and lunch based on low-economic status as per the federal program.

2. Non-free & reduced lunch. Students who did not qualify or did not apply for the free breakfast and lunch plan within the district.

Acronyms

1. WASL. Washington Assessment of Student Learning
2. FR. Free & reduced lunch status
3. NFR. Non-free & reduced lunch status
4. OSPI. The Washington State Office of the Superintendent of Public Instruction

## CHAPTER 2

## Review of Selected Literature

### Introduction

The review of literature naturally began with a look into the achievement of schools that dealt with poverty. This research also included what schools currently were focused on in terms of raising their achievement levels, regardless of socio-economic status. Some research on student attitudes towards learning from varying socio-economic classes was then done in order to identify best-practices on addressing this important issue. Next followed a look into current national standards and curricula for mathematics instruction. The emphasis on accountability and both national and state standards had a large impact on testing in schools. And finally, the debate in regards to how mathematics was best taught was highlighted. This so-called math war between constructivist and traditionalist thought impacted many areas of math education.

Mathematics Achievement of Students and Schools in Poverty

Much research was conducted during the last 30 years on schools with high populations of low-income students. This data presented valuable insights into how and why students of different ethnic, racial, gender, and socioeconomic status achieved at different rates. The work of Ruth Johnson (2002) suggested that some major factors affected these differences, such as:

1. High goals, standards, expectations, and accountability for adults and students.
2. Highly-qualified and culturally competent teachers.
3. Content of curriculum (standards) and rigor.
4. Monitoring of achievement data.

The work of Johnson focused largely on high populations of low-income students. This was in contrast to the community and schools within the Olympia School District (OSD). A natural question arose when considering a smaller population of low-income students, in particular a school where test scores were naturally very high and where feeder schools were generally also high achieving. One might question as to whether high achieving students raised the achievement bar and naturally helped to increase learning for other students.

A report titled the "Nine Characteristics of High Performing Schools" synthesized conclusions from 25 state and national reports into nine recommended traits for schools. This work incorporated the work of Johnson from above, but it also emphasized parent and community involvement and deep teacher professional development as well. A second difference of OSD schools and more highly low-income populated schools was the ability for teachers and staff to focus on less low-income students. This reality resulted in a more homogenous learning environment and the ability for teachers to communicate with less parents when trying to address the low-income population. Given these interactions there may have been less distinguishing data between low and non-low income students for schools with smaller low-income populations.

Student Attitudes Towards Learning From Varying Socio-Economic Classes

The developed and perceived attitudes of students cannot be ignored when considering students from differing socio-economic classes. One research group titled the International Center for Leadership Education completed a study on 75 schools from ten different states. The initiative titled "Models, Networks and Policies to Support and Sustain Rigor and Relevance for AU Students" investigated how students can meet high standards when they do not believe in their abilities (Kim, 2001).

This research suggested that the combined effects of rigor, relevance, and relationships were paramount for success of students of all ability levels and socio-economic classes. The group argued that just like successful companies, schools must "offer something beyond financial stability to employees—a pleasing and compelling environment and a supportive atmosphere" (Kim, 2001). The study also commented on the importance of linking each student to the common mission, vision, and goals of the organization. For large schools and districts particularly, the challenge of making relationships with all students was difficult, especially for students with socio-economic challenges who did not arrive at school with basic needs met.

Student attitudes were strongly related to teacher preparation and willingness to address the needs of students of poverty according to six traits stated by Woolfolk (2004):

1. Love children.
2. Respect all children and parents in all circumstances.
3. See potential in all children.
4. Motivate children to reach their highest potential.
5. Be a spontaneous and creative educator who is able to see teachable moments and seizes them.
6. Have a sense of humor (p.21).

Even though students with an economic advantage tended to score higher on standardized testing, it could have been argued that students of all socio-economic classes who received the above traits might have scored higher.

In any case, the author reinforced the importance of addressing student attitudes across socio-economic class, particularly in regards to the role of the teacher.

A five-year research initiative that looked at 75 high schools in ten states identified two key areas that must be addressed in order to improve student attitudes towards learning in general (McNulty, 2007). First, student engagement must be incorporated in order to build relationships with adults, peers, and parents. Engagement was defined by McNulty as "the extent to which students are motivated and committed to learning, have a sense of belonging and accomplishment, and have standing relationships with those supporting learning". Second, "personal skill development" is defined as "measures of personal, social, service and leadership skills and demonstrations of positive behaviors and attitudes". McNulty therefore suggested that the success of students relied on a community of support for the student, and that deliberate work must be done inside and outside the classroom in order to address student attitudes in respect to learning and achievement. It was not enough, according to McNulty, to address behavior and relationship-building at home. Skilled instruction that prioritizes these ideas should not be isolated to outside the classroom or core curriculum. According to McNulty these ideas should be integrated if students are to make the most out of their education.

National Standards and Curricula for Mathematics Instruction

Mathematical achievement and developed student attitudes were results of conditions that existed in districts and classrooms across the country. The nuts and bolts of these conditions were driven by curricular decisions. At the heart of mathematical decision-making were national standards, for which during the 1980's and 1990's there was much discussion and revision to what students should know and be able to do (Martin, 2007).

In the 1980's there was developing concern about mathematical illiteracy in the U.S. One study done by the National Research Council (NRC, 1989) described the current state of mathematics education (during the

1980's) as being a filter in our system. This implied that schools filtered out students from pursuing occupations needing mathematics. This was in contrast to the metaphor of mathematics education as being a pump by creating opportunities. In response to this problem, in 2000 the National Council of Teachers of Mathematics (NCTM) developed the Curriculum and Evaluation Standards for School Mathematics, which represented the "first comprehensive set of mathematics standards" (NCTM, 2000). These standards made up the framework for math education across the country for the following years.

Following the above push for the standardization of curriculum during the 1990's, the NCTM revisited their standards and revised them in the form of what were called "focal points" for grades K-8 (Cavanagh, 2006). This new vision for the NCTM aimed to narrow down mathematics standards to a "number of crucial, agreed-upon concepts" (Cavanagh, 2006). Shortly following the release of the focal points in Sept 2007 were many positive responses from states and textbook publishers who commended the NCTM for providing guidance on the topic of "essential math skills and basic arithmetic", which was lacking according to some experts and state officials.

<u>The Constructivist Versus Traditionalist Mathematics Debate</u>

Across the country a national debate developed regarding the nature of mathematics instruction in our public schools. With its roots from various philosophers during the nineteenth and twentieth centuries, constructivist teaching and learning centered its basis on a learning environment with a fundamental different interaction between teacher and student than prior traditional instruction. In constructivist methods the student experienced opportunities to find their own meaning about a presented topic, and this often in public schools implied consistent interactions with other students with opportunities to explore and discuss topics. This was in contrast to the understood traditionalist method of teaching where the learner was told the meaning of a topic through various media.

To illustrate the topic of constructivism, consider the case of training the blind to navigate through busy city blocks. One group called the National Federation of the Blind (NFB) developed methods for cane travel, or the use of particular methods and thinking for finding ones way around (Maurer, Bell, Woods, Allen, 2006, p.305). The developed method of instruction was called the structured discovery method. Although not explicitly called constructivist instruction, the method of structured discovery was a form of constructivism in that the teacher posed a situation for which the student was to ask questions and find their own answers based on their senses and careful feedback along the way. Answers were often framed as questions back so that students would construct their own answers and build their own meaning to the problem situation.

One leader, Elliot Eisner, in the discussion of constructivism discussed the topic in a unique way:

> In a sense, all teachers can do is to "make noises in the environment." By this I mean that we have in education no main line into the brains of our

> students. We are shapers of our environment, stimulators, motivators, guides, consultants, resources. But in the end, what children make of what we provide is a function of what they construe from what we offer. Meanings are not given, they are made (Eisner, 1999, p.658).

Within the context of cane travel, constructivism presented itself as being an opportunity for the teacher to be the shaper of the environment, the consultant, motivator, and the various other roles from the description of Eisner. The curriculum was one of learning to navigate, and the scope and sequence was deliberate but flexible. The learner ultimately had strong ownership in both what and how they learned by the questions that asked and conclusions they found from the experience presented.

The debate between constructivism and traditionalist methods in the mathematics classroom was found largely in the methods of instruction. Constructivism implicitly allowed for ambiguity in results or findings during an investigation of a mathematical concept. Traditionalists believed that there are factual, correct answers to mathematical problems and that students must practice chosen fundamental skills towards the end of mastery, with the teacher as leader and guide (Lee, 2003, 450). Traditionalists generally believed that more fact-based learning was important for moving ahead in further studies. This was in contrast to the constructivist belief that experience in applied situations would bring about questions to students for them to answer on their own or with fellow students.

During the late 1980's and 1990's much work went into what was called reform mathematics, which to a large extent was dominated by more or less constructivist types of texts. The math war between constructivists and traditionalists began to present some data amidst all of the bantering of right and wrong from both sides. One leader in the research and reform for children of color and poverty was Robert Moses, who was an advocate for success in algebra in high school (Schoenfeld, 2002, 13). Schoenfeld's research and findings demonstrated that students who complete algebra in high school had much higher graduation rates, not to mention further success in college. Moses discussed that the issue of math literacy "...in urban and rural communities throughout this country is an issue as urgent as the lack of Black voters in Mississippi was in 1961" (Moses, 2001, p.5). Moses (2001) thus made strong statements about mathematical literacy and its importance in reform efforts. The means of instruction—constructivist vs. traditionalist forms—was a topic his research also addressed.

Schoenfeld (2002) commented on the fairly comprehensive, available data from reform efforts in the 1990's as:

1. On tests of basic skills, there were no significant performance differences between students who learned from traditional or reform (constructivist) curricula.
2. On tests of conceptual understanding and problem solving, students who learned from reform curricula consistently outperformed students from traditional curricula by a wide margin.

3. There was some evidence that reform curricula could narrow the performance gap between Anglos and under-represented minorities. (Schoenfeld, 2002, p.16)

In considering the information given by leading researchers it was clear that the debate between constructivists and traditionalists was finally receiving some answers in terms of follow-up data. The complexities of political, philosophical, and economic factors would become important in both the analysis of data and future decisions from the math debate.

## Summary

In order to understand potential differences in the achievement of students from varying socio-economic backgrounds in the OSD, it was important to identify recent trends across state and national levels. This review of literature supported the idea that students of low-economic status generally suffer academically in the area of mathematics. This was clear when examining research that suggested that areas of family involvement, teacher preparation, methods of instruction, and a focus on student attitudes were key to addressing the achievement gap in mathematics. Where these areas were lacking, achievement for low-income students suffered.

The nature of mathematics curricula changed through the 1980's through the early 2000's, and literature suggested that a shift towards constructivist teaching methods and curriculum were important considerations when addressing the best means for teaching low-income students. Some research supported this mode of instruction over more traditional techniques. Tied to what was called a math war between constructivist and traditionalist advocates were the national and state standards that shaped curricular decisions and were a large topic of debate from both schools. These standards were in constant flux and debate as states moved forward with instruction and testing. In the early 2000's there was evidence to suggest that states were beginning to embrace more of the constructivist view of instruction.

# CHAPTER 3

## Methodology and Treatment of the Data

### Introduction

This chapter was organized by first identifying the study-type and a description of past testing scores in the Olympia School District (OSD). The participants used for this study were described in detail in relation to the stated hypothesis. Techniques used for data-collection and statistical analysis followed. A detailed set of procedures used for identifying the population and sub-populations of interest were listed.

### Methodology

The research method used for this study was causal-comparative. It was well known within the OSD that free & reduced lunch (FR) students scored lower than non-free & reduced lunch (NFR) students on the grade 10 math WASL. The results of the spring 2007 testing reinforced this fact when the percentage of passing scores was 40% and 71% respectively. Given this known socio-economic effect on test scores, the independent variable for this study was the algebra and/or geometry course(s) the two groups completed.

Participants

The two sets of data for this study were extracted from a large district database. With the aid of the district assessment director, data was acquired by addressing the delimitations. The completed math classes and FR status were the main factors that limited the total district class of 2009 population of 869 students down to sub-populations of 309 NFR and 47 FR students. Random sampling from these sets was initially considered, but given the relatively low number of FR students in comparison to NFR students, it was sufficient to use the total sub-populations of 309 NFR and 47 FR students for this study. It was noted that sample sizes of at least 172 NFR and 42 FR students would have been recommended for satisfactory random-sample representations of the NFR and FR sub-populations (Gay, Mills, Airasian, 2006).

Instruments

There were no surveys or formal instruments necessary for the collection of data. The raw WASL data was initially collected and documented by OSPI and eventually forwarded to the district. The district assessment director then supplied the author with spreadsheet data in order to extract appropriate information. Given correct data from OSPI, the reliability of the data was high.

Design

The design for this study was limited. Given student FR and NFR information, math WASL scores for grade ten were then downloaded from a state database, statistical methods applied, and percentages summarized in table format for the desired students.

Procedures

The following procedures were followed in this study:

1. A spreadsheet of student information from the state Office of the Superintendent of Public Instruction (OSPI) with the following fields was obtained from the district assessment coordinator for the graduating class of 2009: math WASL scores, FR status, and math courses completed by spring 2007.
2. The population of 869 students was sorted electronically and then shortened to include

only those students who completed math through Algebra 1 and/or Geometry. This data represented the 356 students for this study.

3. The sub-population of 356 students was then sorted into FR and NFR students. These sets contained the 47 FR and 309 NFR students for this study.
4. Finally, sub-populations were sorted by WASL score and saved in table form.

Treatment of Data

All data in this study was recorded and analyzed by means of a Microsoft Excel spreadsheet. Once population data was sorted and filtered as outlined in the procedures, various WASL percentages were calculated for various subgroups—ethnicity, sex, FR, Special Services, and ELL. The appendix includes this information for possible future analysis.

For purposes of this study, however, percentages of students who met standard on the grade ten math WASL were calculated from raw data. Values for both FR and NFR students completing algebra and/or geometry were calculated in order to address the hypothesis of this study. These percentages were also compared to the overall district averages of 40% FR and 71% NFR rates as a means for discussion and recommendations. Statistical measures were done by the Data Analysis Tool in Microsoft Excel. In particular, calculations for mean scores, a comparative t-test, and a test for significance for various confidence levels were done by means of Excel.

Summary

This causal-comparative study incorporated little experimental or descriptive techniques. Since data already existed in the form of raw data scores, the procedures of this study required mainly computerized techniques in order to identify the necessary data for analysis. Microsoft Excel was used to filter out the students of interest. By starting with the entire class of 2009 math WASL data, students were separated by both FR status and by their math classes taken. Only those students who completed Algebra 1 and/or Geometry by grade ten were included.

Following the saving of data in tabular form, the data was analyzed by means of the statistical tools in

Excel, namely mean scores, a comparative t-test, and a test for significance for various confidence levels were completed. The statistical measures were recorded in table form for analysis. Also sorted and placed in tabular form in the Appendix were various WASL passing percentages for students broken out by demographic profile. This information was included for informational purposes and possible further study.

# CHAPTER 4

## Analysis of the Data

### Introduction

This chapter first describes the study environment in terms of background information from the Olympia School District (OSD) and the narrowing down of data according to the delimitations in Chapter 1. Math testing data was listed in tabular form for free & reduced (FR) and non-free & reduced (NFR) students. In response to the hypothesis, statistical measures were done to compare these two groups, and findings were made as a result.

### Description of the Environment

The parameters of the project, as specifically defined in the Chapter 1 delimitations, consisted of the graduating class of 2009 students in the Olympia School District (OSD) who completed Algebra 1 and/or Geometry by the end of their tenth grade year. This set of students was also limited to only those students who attended the OSD during middle school and at least one year of grade school.

Hypothesis

Consider OSD students from the graduating class of 2009. Of this group who in grade ten completed Algebra 1 or Geometry, non-free & reduced lunch (NFR) students significantly outperformed free & reduced lunch (FR) students on the grade ten math WASL test.

Null Hypothesis

This study considered students from the graduating class of 2009. Of this group who in grade ten completed Algebra 1 or Geometry, NFR students did not significantly outperform FR students on the grade ten math WASL test. The statistical threshold of significance was $p \geq .05$.

Results of the Study

Table 1 lists the math WASL results in descending order for the 309 NFR students. Again, this set of students represented those NFR students graduating in 2009 who had taken math through Algebra 1 and/or Geometry by spring 2007. It should be noted that a score of 400 represented a passing (or meeting standard by state definition) score.

Table 1

NFR Algebra 1/Geometry Student Math WASL Scores, n=309

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 470 | 434 | 424 | 416 | 409 | 405 | 400 | 392 | 383 | 372 |
| 470 | 434 | 422 | 414 | 409 | 405 | 400 | 392 | 383 | 371 |
| 470 | 434 | 422 | 414 | 409 | 405 | 400 | 392 | 383 | 371 |
| 458 | 434 | 422 | 414 | 409 | 405 | 400 | 392 | 383 | 370 |
| 458 | 434 | 422 | 414 | 409 | 405 | 400 | 392 | 383 | 370 |
| 458 | 434 | 422 | 414 | 409 | 405 | 400 | 392 | 381 | 370 |
| 453 | 434 | 422 | 414 | 409 | 405 | 398 | 392 | 381 | 370 |
| 453 | 434 | 422 | 414 | 409 | 405 | 398 | 390 | 381 | 370 |
| 453 | 432 | 422 | 414 | 409 | 405 | 398 | 390 | 381 | 368 |
| 453 | 430 | 422 | 414 | 409 | 405 | 398 | 390 | 381 | 368 |
| 453 | 430 | 422 | 414 | 408 | 405 | 398 | 390 | 381 | 368 |
| 449 | 430 | 422 | 414 | 408 | 405 | 398 | 390 | 381 | 368 |
| 449 | 430 | 422 | 412 | 407 | 405 | 398 | 390 | 381 | 365 |
| 449 | 430 | 422 | 412 | 407 | 405 | 396 | 390 | 381 | 363 |
| 449 | 428 | 419 | 412 | 407 | 405 | 396 | 390 | 379 | 363 |
| 449 | 427 | 419 | 412 | 407 | 403 | 396 | 390 | 379 | 363 |
| 449 | 427 | 419 | 412 | 407 | 403 | 396 | 388 | 379 | 363 |
| 449 | 427 | 419 | 412 | 407 | 402 | 394 | 388 | 379 | 360 |
| 445 | 427 | 419 | 412 | 407 | 402 | 394 | 388 | 377 | 360 |
| 445 | 427 | 419 | 412 | 407 | 402 | 394 | 388 | 377 | 360 |
| 444 | 427 | 419 | 412 | 407 | 402 | 394 | 388 | 375 | 357 |
| 441 | 425 | 419 | 412 | 407 | 402 | 394 | 388 | 375 | 352 |
| 441 | 424 | 419 | 412 | 407 | 402 | 394 | 388 | 375 | 352 |
| 441 | 424 | 419 | 412 | 407 | 402 | 394 | 388 | 375 | 349 |
| 441 | 424 | 416 | 412 | 407 | 402 | 394 | 385 | 375 | 349 |
| 441 | 424 | 416 | 411 | 406 | 402 | 394 | 385 | 375 | 342 |
| 441 | 424 | 416 | 411 | 405 | 401 | 392 | 385 | 375 | 342 |
| 437 | 424 | 416 | 411 | 405 | 400 | 392 | 385 | 375 | 342 |
| 437 | 424 | 416 | 409 | 405 | 400 | 392 | 385 | 375 | 334 |
| 437 | 424 | 416 | 409 | 405 | 400 | 392 | 385 | 375 | 325 |
| 437 | 424 | 416 | 409 | 405 | 400 | 392 | 383 | 372 | |

Table 2 lists the math WASL results in descending order for the 47 FR students. Again, this set of students represented those FR students graduating in 2009 who had taken math through Algebra 1 and/or Geometry by spring 2007.

Table 2

FR Algebra 1/Geometry Student Math WASL Scores, n=47

| | | | |
|---|---|---|---|
| 453 | 412 | 396 | 376 |
| 445 | 412 | 394 | 372 |
| 437 | 412 | 392 | 370 |
| 434 | 407 | 388 | 370 |
| 427 | 405 | 388 | 368 |
| 422 | 405 | 388 | 365 |
| 419 | 405 | 385 | 365 |
| 416 | 402 | 383 | 360 |
| 416 | 402 | 381 | 357 |
| 414 | 402 | 379 | 352 |
| 414 | 400 | 379 | 334 |
| 414 | 396 | 377 | |

A statistical analysis on Table 1 and 2 data was listed in Table 3. Values for both mean WASL scores and overall passing percentages were shown. Note that a score of 400 represented meeting standard.

Table 3

Statistical Analysis of Table 1 and 2 Students

| | NFR WASL Scores | FR WASL Scores |
|---|---|---|
| n | $n_1$ = 309 | $n_2$ = 47 |
| Mean Raw Score | 404.4 | 395.5 |
| % Passing | 62% | 46% |

A t-test was done with the Table 1 (NFR) and Table 2 (FR) data. The resulting t-score was shown with the defined parameters given:

$n_1 = NFR\ population$

$n_2 = FR\ population$

$\overline{X}_1 = NFR\ mean$

$\overline{X}_2 = FR\ mean$

$$SS = \Sigma X^2 - \frac{(\Sigma X)^2}{n}$$

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\left(\frac{SS_1 + SS_2}{n_1 + n_2 - 2}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$$= \frac{404.4 - 395.5}{\sqrt{\left(\frac{189894 + 29256}{309 + 47 - 2}\right)\left(\frac{1}{309} + \frac{1}{47}\right)}} = 2.26$$

The resulting t-score provided for the basis of a test of significance as referenced in Table 4. The t-score value of t = 2.26 with degrees of freedom (df): $df = n_1 + n_2 - 2 = 309 + 47 - 2 = 354$

were used for comparison with the distribution of t as referenced by Gay, Mills, Airasian (2006).

Table 4

Distribution of t with Test for Significance of Mean WASL Scores

| | P | | |
|---|---|---|---|
| df | .05 | .01 | .001 |
| 354 | 1.96 | 2.58 | 3.29 |
| Null hypothesis | Reject | Accept | Accept |
| Hypothesis | Support | No support | No support |

In this test the hypothesis and null hypothesis were addressed in respect to the levels of confidence of p=.05, p=.01, and p=.001. The t-score was compared to threshold values as given in Table 4. The null hypothesis was rejected for the confidence level of p=.05 only. The hypothesis was therefore supported for p=.05 but not for values of p=.01 and p=.001.

Findings

In analyzing the results of this study the null hypothesis was accepted for p=.05 and rejected for values greater than p=.05. The hypothesis was supported at a confidence level of p=.05, but not for values greater than p=.05.

For the scope of this study, the results from above indicate that NFR students who completed math courses through algebra and/or geometry significantly outperformed their counterpart FR students who completed similar courses with a confidence level of p=.05.

A second finding was in regards to the performance of all students (those students who completed more or less math courses) in comparison to the students in this study. It should be recalled that if the math courses were not considered as a controlled variable that the rates of meeting standard on the math WASL for NFR and FR were 71% and 40% respectively. The results of this study still showed an achievement gap of 60% and 43% respectively.

Discussion

The findings in this study seemed to fit with national and state trends in regards to the achievement gap in mathematics. Even after controlling for math courses taken (Algebra 1 and/or Geometry), students of FR status achieved significantly lower than their NFR counterparts. The mobility of students was somewhat controlled in that students within the chosen sample must have resided in the district since at least grade five. This factor did not seem to differ from across-district data of the total student population.

Summary

As a result of the analysis of data, the hypothesis was supported and null-hypothesis rejected for a confidence level of p=.05. For this study it was demonstrated that NFR students outperformed FR students even after controlling for certain math classes taken. The achievement gap between FR and NFR students on the math WASL was lessened compared to the overall district percentage when neglecting math courses taken. This was given by 60% and 43% versus 70% and 41% respectively. This suggested that FR students who completed math through Algebra and/or Geometry increased their ability to pass the WASL, but not to the same rate as their NFR counterparts.

CHAPTER 5

Summary, Conclusions, and Recommendations

## Introduction

In response to the results in Chapter 4, it was clear in the Olympia School District (OSD) that an achievement gap still existed in mathematics when socio-economic status was the variable. As described in this section, the discrepancy between mean scores from students in this study was less, however, then for when the courses taken were not considered. Recommendations in this section follow from this result, with suggestions as to where to improve and study in regards to economic class and closing the achievement gap.

## Summary

The basis of this study was a look into the performance of students on a standardized test when controlling for socio-economics and the math courses taken. Data was collected from across the Olympia School District for the grade ten math Washington Assessment of Student Learning (WASL) test. Results were given for samples of free & reduced lunch (FR) students and non-free & reduced lunch (NFR) students.

This data was then analyzed by comparing mean WASL scores through a t-test. The analysis of data supported the hypothesis and rejected the null hypothesis. The support for the hypothesis reinforced national and state trends in that students from lower socio-economic status perform lower on standardized testing than their higher-economic status counterparts.

Conclusions

Based upon the results of the collected data and data analysis, the following conclusions were drawn in regards to grade ten students in the OSD:

1. Students from lower-socioeconomic status score significantly lower than their upper-socioeconomic counterparts on the grade ten math WASL.
2. When controlling for math classes completed through at least algebra and at most geometry (standard classes offered within the OSD), lower-socioeconomic status students still score significantly lower on the grade ten math WASL.

3. When controlling for math classes completed through at least algebra and at most geometry, the achievement gap lessened between the two socio-economic groups. The 31% difference in passing rate lessened to 17%.
4. A secondary note that deserved attention (in this study and others in the future) was the issue of mobility. This study addressed students who resided in the district since at least grade five. It was concluded that the mean values for both economic groups concurred with the achievement gap amongst the total student population. That is, non-mobility did not close the achievement gap in this situation.

Recommendations

Based on the conclusions, the following items are recommended:

1. It was clear within the OSD that students who completed geometry by grade ten were successful on the grade ten math WASL. This study suggested that a closer look must be taken at

lower-socioeconomic students in regards to how to best support them in the classroom, at home, and ultimately on the math WASL.

2. Given the limited size of this study, it would increase reliability to consider a larger population. The analysis of multiple years would likely have been sufficient to increase this reliability.
3. The mobility of students was somewhat controlled in that students within the chosen sample must have resided in the district since at least grade five. Data collected (although not submitted in this study) hinted to a large impact of mobility on grade 10 math WASL scores.
4. WASL data for various subgroups of the total class of 2009 population are listed in the Appendix. From this data it was noted that the passing percentages for FR and NFR students can be broken out into further detail, and that an analysis on the achievement gaps of some

subgroups might be worthwhile. One gap might be the Caucasian subgroups (85% NFR/62% FR).

5. Lastly, one piece of the math WASL not discussed in this research is in regards to the scoring of the test and how students are categorized by their raw score. Students are broken into levels one through four. Meeting standard is designated by scoring into level three or four. What was noted in the data for this study was that the mean score for FR students was between levels one and two. The mean score for NFR students was just below level three. A challenge for schools and districts will be in regards to how to address the diversity of academic deficits in any given classroom. An analysis of classroom instruction and best-practices will be necessary for addressing the varying needs of students.

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## APPENDIX

Olympia School District Class of 2009 Math WASL

Percentages by Demographics

| Demographic | District Total | FR | NFR% Alg 1/Geom Taken | FR% Alg 1/Geom Taken |
|---|---|---|---|---|
| # of Students | 869 | 130 | 309 | 47 |
| %Boys | 50 | 52 | 47 | 50 |
| %Girls | 50 | 48 | 53 | 50 |
| %American Indian or Alaskan Native | 1 | 2 | 1 | 4 |
| %Asian or Pacific Islander | 9 | 14 | 9 | 15 |
| %Black or African American | 2 | 6 | 2 | 8 |
| %Hispanic | 4 | 12 | 3 | 12 |
| %Caucasian or White | 82 | 66 | 85 | 62 |
| %Multiracial or Not Provided | 2 | 1 | 1 | 0 |
| %Free-Reduced Lunch | 15 | 100 | 0 | 100 |
| %Special Ed | 11 | 19 | 8 | 8 |
| %ELL | 0 | 1 | 0 | 0 |
| %Passed Math WASL | 66 | 40 | 62 | 46 |