A STUDY OF THE RELATIONSHIP BETWEEN AND AMONG SCHEDULING, GROUPING, GRADING, CURRICULUM AND MATHEMATICS ACHIEVEMENT IN PENNSYLVANIA PUBLIC SECONDARY SCHOOLS

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ABSTRACT

Widespread access to technology facilitates the sharing of effective classroom practices across disciplines. The implementation of successful practices is essential; particularly in this era of educational accountability, most notably the adequately yearly progress (AYP) goals of the federal No Child Left Behind (NCLB) legislation. In addition to bottom-up classroom practices, teachers and other educational stakeholders are entitled to information about top-down policies to enhance teaching and learning. This study examines the correlation between policies in four areas and outcomes on one specific component of AYP in Pennsylvania public secondary schools. The policies considered herein are scheduling (traditional or block), grouping (homogeneous or heterogeneous), grading (weighted or not), and secondary math curriculum (U.S. Department of Education cited *standards*-based or traditional). This study quantifies the correlation between school district polices in these areas and results on the 11th grade mathematics portion of the 2006 Pennsylvania System of School Assessment (PSSA).

Standard and Poor's recognizes school districts in Pennsylvania and across the country whose students have achieved NCLB testing outcomes that exceed expectations. In 2005, 55 Pennsylvania districts were cited by Standard and Poor's as being "outperforming school districts." The 60 secondary schools in these districts served as the population for this study. The study quantifies the correlation between the specific combinations of the four policies utilized by the 40 participating high schools and PSSA results. Evidence is discovered that, of the four policies, only block scheduling correlated with higher PSSA 11th grade math outcomes.

TABLE OF CONTENTS

LIST OF TABLES

ABBREVIATIONS

ANCOVA ....Analysis of Co-variance

APA .... Augenblick, Palaich and Associates

AYP...Adequate Yearly Progress

CPM ....College Preparatory Mathematics

CPMP ....Core-Plus Mathematics Project

DRC ....Data Recognition Corporation

ESEA... Elementary and Secondary Education Act

HumRRO .... Human Resources Research Organization

IMP .... Interactive Mathematics Project

NCLB...No Child Left Behind

NCSL .... National Conference of State Legislatures

NCTM .... National Council of Teachers of Mathematics

NSF ....National Science Foundation

NSREM.......................................New Standards Reference Examination in Mathematics

NYC HOLD...........New York City Honest Logical Decisions on Math Education Reform

PDE ....Pennsylvania Department of Education

PHI ....Packard Humanities Institute

PSSA .... Pennsylvania System of School Assessment

RFP ....Request for proposals

SAT .... Scholastic Assessment Test

SEM ....Standard error of measurement

SPSS..Statistical Package for the Social Sciences

UCLA..University of California at Los Angeles

UCSMP...University of Chicago School Mathematics Project

USDE ....United States Department of Education

CHAPTER 1

INTRODUCTION

Overview

School board members across the Commonwealth of Pennsylvania are anticipating an impending “perfect storm” to be caused, not by the collision of opposing weather fronts, but by the convergence of federal education mandates with local school funding issues. The mandates hereto referred are the adequate yearly progress (AYP) goals of the 2002 re-authorization of the Elementary and Secondary Education Act (ESEA). This re-authorization of the 1965 ESEA law is commonly known as No Child Left Behind (NCLB).

Statement of the Problem

The primary objective of the NCLB legislation is that all students, across all grades, will be proficient in reading and mathematics by 2014. The emperor, or in this case George W. Bush, and the 107th Congress “has no clothes.” This goal, while commendable, will not be achieved. Full employment is defined as: at least 93.6% of the work force to be employed (www.oecd.org). It is no solace to a factory worker whose livelihood has been outsourced overseas to tune in CNBC and hear that the United States is at “full employment.” So it will be for students tested in 2014. What will be the threshold for the government to declare “full proficiency?” This is not to condemn the spirit of the legislation. Stakeholders in education; students, parents, teachers, employers, etc., must embrace the pursuit of 100% proficiency in reading and mathematics. The NCLB legislation has been effective in "stirring the pot." Light has been shed on the educational progress, or lack thereof, particularly with regard to specific sub-groups. However, substantial administrative costs, unrelated to instruction, loom for school districts that do not keep pace with imminently rising AYP standards.

In Pennsylvania, and throughout the United States, this federal goal for education is converging with local public school funding challenges. The Pennsylvania legislature passed the Taxpayer Relief Act, Special Session Act 1 in 2006 (www.pde.state.pa.us). Local property taxes are the primary source for funding education in Pennsylvania. Retirees, living on fixed incomes, are particularly burdened with rising property tax obligations. Act 1 created a complex algorithm for indexing each school district. Each year the burden on local property owners is prohibited from exceeding the index without the voters approving additional spending by a referendum.

Also in 2006, the Commonwealth of Pennsylvania State Board of Education selected the firm of Augenblick, Palaich and Associates (APA) to address the adequacy and equity of school funding. The request for proposal included the determination of the level of spending required for all students to demonstrate proficiency on state reading and math tests by 2014. The APA report was based on 2005-06 data and excluded food service, capital costs and debt service, transportation, community services, and adult education. The report quantified a base cost; additional weights for students with disabilities, children in poverty, English language learners, and gifted students. Modifications for district size, enrollment growth and decline, and geographic cost of living adjustments were also quantified. Table 1.1 contrasts actual spending in 2006 with the results of the costing-out study.

Table 1.1 ***Costing-out Study***

	Per-pupil	Total
actual	$ 9,512	$17.25 billion
cost	$11,926	$21.63 billion

The spending shortfall exceeded twenty-five percent. APA found that 471 of 501 Pennsylvania school districts spent below their adequacy levels.

The costing-out study conducted on behalf of the Pennsylvania Board of Education exposes the AYP goals of NCLB as unfunded mandates. While the goals are noble, these goals may be counter productive. As more school districts fail to achieve AYP, more financial resources will be shifted away from instructional support toward administrative costs associated with the punitive aspects of NCLB. Federal legislators have failed their constituents. The initial NCLB sanction is the labeling of a school as being “in need of improvement.” In 2014, we will learn the new meaning of “100% proficiency.” Until then educational stakeholders, seeking to delay the sanctioning of their schools, covet data driven policy decisions to help maximize standardized testing outcomes. This study represents an attempt to uncover cost-neutral and cost-effective educational policies that correlate with student learning.

Need for the Study

The idea for the study resulted from witnessing specific educational policy decisions made during the 1990s in one suburban Philadelphia school district. Do the length of high school classes, the manner in which the classes are composed, the way students receive grades in these classes, and the high school mathematics curriculum interact to impact student learning? Are certain combinations of these policies complimentary to educational outcomes while other combinations inhibit learning? Before NCLB, the reason for asking these questions was inquisitiveness. The goals of NCLB and the funding challenges for Pennsylvania school districts have combined to make what may be been interesting, important.

The focus of this study is on the correlation between four predictors and one specific PSSA measure, 11^{th} grade mathematics achievement. Standard and Poor's has developed a model to predict the percentage of students in a school district who will achieve satisfactory outcomes on the reading and math portions of the Pennsylvania System of School Assessment (PSSA) as a function of the socio-economic status of students in that district. The PSSA is the instrument utilized in Pennsylvania to document AYP. Outcomes for individual students are categorized as advanced, proficient, basic and below basic. The percentage of students who achieve advanced or proficient is used to determine if AYP was met. According to Standard and Poor's, 55 school districts in Pennsylvania achieved beyond expectations in 2005. Unlike corporate research and product development which rely on the protection of copyrights and patents, maximizing the outcomes of education depends upon the unlimited exchange of successful policies and practices. So why focus on these particular predictors: scheduling (traditional or block); grouping (homogeneous or heterogeneous); grading (weighted or not); and secondary math curriculum (U.S. Department of Education cited or not)? And how does evidence of a correlation between and among these four predictors and student learning as measured by the PSSA impact the funding challenges facing school boards across the Commonwealth?

Why examine scheduling, grouping, grading and secondary math curriculum? Pre-NCLB, high school administrators recommended, and the school board approved, policies regarding these four predictors: scheduling (1996), grouping (1998), grading (1998), and secondary mathematics curriculum in one suburban Philadelphia school district that was not among those cited by Standard and Poor's. Since 1994, a *standards*-based text series, the University of Chicago School Mathematics Project (UCSMP) has been utilized at the only high school in this suburban Philadelphia school district. In 1999, UCSMP was among ten elementary and secondary mathematics programs that were recognized as "exemplary" or "promising" by a USDE panel. A 4 X 4 block scheduling format was introduced into this high school in 1996. Non-advanced placement courses meet for 85 minutes every day for a semester. The format refers to the four classes that are scheduled in the fall followed by four different classes scheduled in the spring. In 1998, administrators agreed to implement weighted grades at this high school. This occurrence was concurrent with the introduction of an inclusionary special education model. Many parents of special education children wanted their children to learn side-by-side with the child's peers. Special education co-teachers in regular education classrooms would provide support. Other parents reacted to this focus on special education by making demands for their own regular education children. Among these demands was the implementation of weighted grades. A multiplier is used to enhance the value of advanced placement and honors level courses to increase a student's grade point average. Full inclusion of special education students and weighted grades were introduced simultaneously to this high school in 1998. These policy changes and the manner in which they were introduced brought to mind questions: do scheduling, grouping, grading, and mathematics curriculum impact each other? Would altering the policy regarding one or more of these predictors affect the equilibrium among all the predictors? What can school board members and school administrators in this district, and across Pennsylvania, learn about the policies in the Standard and Poor's elite districts regarding these predictors? In anticipation of the raising of the AYP hurdles of NCLB, the questions evolve to: is there a specific combination of these four predictors that correlates with satisfactory student performance on the PSSA in "outperforming school districts?"

What does the existence of a correlation among scheduling, grouping, grading, secondary math curriculum and PSSA outcomes have to do with the funding challenges facing school boards? Extensive research has been conducted in an attempt to identify and quantify specific influences on student learning. A qualitative examination of classroom practices in the Standard and Poor's cited districts may be helpful in identifying specific classroom practices that could be disseminated throughout the Commonwealth by in-servicing teachers. However, this would involve tangible costs, and providing in-servicing for teachers about successful classroom practices does not ensure that these practices will be implemented. This study represents an attempt to share educational policies being utilized in "outperforming school districts." This macro perspective does not depend on additional spending. Two of the predictors, scheduling and secondary mathematics curriculum, have a concrete impact on every school district budget. As will be detailed, block scheduling is a more efficient allocation of personnel resources than a traditional schedule. As to curriculum, most districts seek to utilize a five year cycle. There is a lack of research comparing and contrasting the effectiveness of the USDE cited programs with PSSA outcomes. It is a fiduciary responsibility of the parties that choose to maintain or change the secondary mathematics curriculum to select a program that correlates with successful student learning as measured by the PSSA. District policies regarding grouping and grading can be adjusted without increasing costs. This study will have practical relevance within and beyond the research setting. School district administrators and taxpayers will gain a perspective on the relationship among scheduling, grouping, grading, and curriculum. Policy decisions in these areas should not be made in a vacuum without regard to the impact these decisions have on other educational issues and classroom practices. When district administrators consider adopting or abandoning block scheduling, heterogeneous grouping, weighted grades, and/or a *standards*-based math programs cited by the USDE, those administrators should have access to data about if and how each of these policies alone, and in concert, correlate with student learning. The results of this study are potentially important for district administrators and parents when developing, refining, and supporting a cost-efficient macro-educational model to support student learning in the Commonwealth of Pennsylvania.

In 2007, there were 1,273 publicly funded “regular” secondary schools in Pennsylvania. This includes K-12, 9-12, and 10-12 schools. The 1,273 did not include publicly funded alternative, vocational, or charter schools. The population for the study was the 11th grade PSSA participants enrolled in 60 high schools in the 55 school districts identified by Standard and Poor’s as being “outperforming school districts.” Analysis of co-variance (ANCOVA) and separate samples t-tests were performed on the responses to an electronic survey distributed to the high school mathematics facilitators in the 60 Standard and Poor’s out-performers to determine the correlation of scheduling, grouping, grading, and mathematics curriculum with a specific PSSA component. For the purpose of this study, the independent or predictor variables are considered to be dichotomous. The dependent or criterion variable is the percentage of students in participating districts who achieved proficient, or higher, scores on the11th grade mathematics PSSA in 2006.

Research Questions

1. What combinations of scheduling (block or traditional), grouping (heterogeneous or homogeneous), grading (non-weighted or weighted) and secondary mathematics curricula (USDE cited or not) exist in Pennsylvania public high schools in school districts that Standard and Poor’s cited as “outperforming school districts”?

Before we begin to analyze the compartmentalization of the sample regarding the predictor variables, it is important to identify which combinations of the predictors exist and which combinations are most common.

2. What policies regarding scheduling, grouping, grading, and secondary mathematics curricula in Pennsylvania public high schools in school districts that

Standard and Poor's cited as "outperforming school districts" correlated with students achieving advanced or proficient designation on the 11th grade PSSA math sections in 2006?

Considered individually, do any or all of the predictors correlate with successful outcomes on the PSSA?

3. What combinations of scheduling, grouping, grading, and secondary mathematics curricula in Pennsylvania public high schools in school districts that Standard and Poor's cited as "outperforming school districts" correlated with students achieving advanced or proficient designation on the 11th grade PSSA math sections in 2006?

Considered collectively, does any combination of the predictors correlate with successful outcomes on the PSSA?

4. Which specific mathematics curricula designated by USDE as "exemplary" or "promising" utilized in Pennsylvania public high schools in school districts that Standard and Poor's cited as "outperforming school districts" correlated with advanced or proficient student performance on the11th grade PSSA math sections in 2006?

After addressing the correlation of all the predictors, individually and collectively, with PSSA outcomes, the focus shifts to one specific predictor. There are five secondary mathematics programs that meet the USDE criteria. Just as all of the predictors were considered collectively and individually, the same was done for secondary mathematics curricula. After examining the USDE group collectively, which of these five correlated with the highest PSSA outcomes?

Limitations

The study is limited by the validity of the PSSA in measuring student learning. Since the PSSA is not administered outside Pennsylvania, the conclusions of the study would not apply beyond the borders of the Commonwealth. There were no limitations on the data collection in regard to the criterion variable. The PSSA categorical results are available to the public on the Pennsylvania Department of Education website. Per-pupil instructional spending in districts is also publicly disclosed and was utilized as a co-variate in the ANCOVA. While all of the participants qualify as being an "outperforming school district," it is important to point out that this does not mean the percentage of students in all participating districts exceeded expectations on the criterion variable. The 11^{th} grade mathematics portion of the PSSA is only one component of the formula used by Standard and Poor's, the percentage of all district students who met the proficient threshold in all required math and reading sections across all grades. It is possible, and actually likely, that high schools in some of the "outperforming school districts" may have had less than impressive results on the specific criterion for the study, 11^{th} grade PSSA mathematics.

Delimitations

The most obvious delimitation is the restricted population. There are only 60 high schools in the 55 districts cited by Standard and Poor's. The population size is insufficient to apply multiple regression to responses. Separate samples t-tests and ANCOVA were utilized. Other delimitations include the categorization of the predictor variables. For example, the schedule of a high school may reflect more characteristics of a traditional schedule than a block schedule. Hybrid bell schedules are categorized as block schedules for the purpose of this study. Accuracy in categorizing schools with regard to the predictor variables depends on the cooperation of respondents. In regard to grouping, tracking carries a negative connotation. High school math facilitators, particularly concerned with political correctness, may be hesitant to admit their classes are homogeneously grouped. The weighting of grades is clearly binary. The classification of secondary mathematics curriculum as dichotomous also poses a potential complication. It is possible for schools that homogeneously group math classes to utilize a USDE cited *standards*-based program for some students and a traditional program for others. For example, if students are tracked in a particular district, the lower tracks may be taught with text books that are very different from texts used in the same school by upper tracks. Under this circumstance, the school would be categorized by the curriculum in use by the lowest achieving group of students.

Definition of Terms

1) **Advanced –** Superior academic performance indicating an in-depth understanding and exemplary display of the skills included in Pennsylvania's Academic Standards (a scaled score > 1508, mean = 1300, standard deviation = 100).
2) **Basic –** Marginal academic performance, work approaching, but not yet reaching, satisfactory performance. Performance indicates a partial understanding and limited display of the skills included in Pennsylvania's Academic Standards, and the student may need additional instructional opportunities and/or increased

student academic commitment to achieve the Proficient level (a scaled score 1167 – 1303).

3) **Below Basic –** Inadequate academic performance that indicates little understanding and minimal display of the skills included in the Pennsylvania Academic Content Standards. There is a major need for additional instructional opportunities and/or increased student academic commitment to achieve the Proficient level (a scaled score < 1167).

4) **Bookmark method –** Teachers and parents as well as business and higher-education representatives examined PSSA test booklets that were printed with questions ranked from easiest to hardest. They then made determination of advanced, proficient, basic or below-basic work by placing a “bookmark” at the point in the booklet that best represented each level.

5) **Borderline groups method –** Teachers determined the level (advanced, proficient, basic or below-basic) at which students were performing, and if the students’ work fell at the borderline of two levels. These ratings were then related to the students’ actual PSSA score.

6) **Carnegie unit –** a traditional high school bell schedule where classes are each approximately 45 minutes in length and meet daily during a 180-day school year (Carroll, 1994, p.106).

7) **Copernican Plan –** a high school bell schedule in which classes meet for much longer periods, than in a Carnegie unit, for only part of the school year. Students are enrolled in significantly fewer classes each day and teachers deal with significantly fewer classes and students each day (Carroll, 1994, p.106).

8) **Correlational research –** A type of research used to explore correlation between two or more variables (Charles & Mertler, 2002, p.380).

9) **Criterion variable –** In prediction studies using correlation, the variable that one attempts to predict (Charles & Mertler, 2002, p.380)

10) **Delimitations –** Restrictions that the researchers impose in order to narrow the scope of the study (Charles & Mertler, 2002, p.380).

11) **Dichotomous –** divided or dividing into two sharply distinguished parts or classifications (http://dictionary.reference.com/search?r=2&q=dichotomous).

12) **Heterogeneous grouping –** Diverse assortment of students randomly assigned to different sections of a course.

13) **Homogeneous grouping –** Segregating student into sections of a course according to perceived ability.

14) **Inclusion –** Integrating special education students, with their regular education peers, into heterogeneously grouped classes.

15) **Instructional spending –** salaries and benefits of teachers, supplies, books, certain maintenance costs and contracting services and equipment (www.pde.state.pa.us).

16) **Limitations –** Natural conditions that restrict the scope of a study and may affect its outcomes (Charles & Mertler, 2002, p.382).

17) **Mean –** The arithmetic average of a set of scores (Charles & Mertler, 2002, p.382).

18) **Multiple regression –** A correlational procedure in which a criterion variable is predicted from a combination of two or more predictor variables (Charles & Mertler, 2002, p.382).

19) **RaMP –** Reading and Math Proficiency. A ratio developed by Standard and Poor's as a component of an "outperforming school district." The sum of all reading and math tests taken that scored proficient or higher: sum of all reading and math tests taken.

20) ***p* < .05; *p* < .01 –** Levels of probability (significance) most frequently used by researchers when testing hypotheses. The .05 level indicates a less than 5 percent chance that a finding is occurring because of sampling error; the .01 level indicates a less than 1 percent chance that a finding is occurring because of sampling error (Charles & Mertler, 2002, p.383).

21) **Predictor variable –** In correlation, the variable used in attempting to predict the criterion variable (Charles & Mertler, 2002, p.383).

22) **Proficient –** Satisfactory academic performance indicating a solid understanding and adequate display of the skills included in Pennsylvania's Academic Standards (a scaled score 1304 – 1508).

23) **Standard deviation –** A stable measure of dispersion of scores from the mean. In a normal distribution, 68.26 percent of all scores lie in the area between plus one standard deviation and minus one standard deviation from the mean; 95.40 percent are included between plus two and minus two standard deviations from the mean; and over 99 percent are included between plus three and minus three standard deviations from the mean (Charles & Mertler, 2002, p.385).

Summary

The challenge for all stakeholders in education is facilitating nation-wide improvements in teaching and learning necessary for today’s students to compete and succeed in the global economy of the twenty-first century. In response to this challenge, the federal government re-authorized the ESEA in 2002. This law is commonly referred to NCLB and provides for AYP goals that increase incrementally from 45% in 2009 through 100% in 2014.

This study is an attempt to identify policies, in four specific educational areas, utilized in Pennsylvania school districts that have achieved beyond expectations on the PSSA. Just over ten percent of the 501 school districts in Pennsylvania were cited by Standard and Poor’s as being “outperforming school districts.” What can educational leaders throughout Pennsylvania learn about how students are scheduled, grouped, graded, and about secondary math curriculum from these “outperforming school districts”?

CHAPTER 2

REVIEW OF THE LITERATURE

Introduction

Shortly after his inauguration, President Ronald Regan assigned his Secretary of Education, T.H. Bell, the task of "assessing the quality of teaching and learning in our nation's public and private schools, colleges, and universities" (www.ed.gov.pubs/NatAtRisk). Bell created the National Commission on Excellence in Education. In 1983, this commission issued their report, "A Nation at Risk." School policies regarding the four predictor variables for this study – scheduling, grouping, grading, and mathematics curriculum – were impacted, and the criterion variable for this study, the Pennsylvania System of School Assessment (PSSA), was eventually developed in response to "A Nation at Risk." Among the recommendations of the report are the following:

> The teaching of mathematics in high school should equip graduates to: (a) understand geometric and algebraic concepts; (b) understand elementary probability and statistics; (c) apply mathematics in everyday situations; and (d) estimate, approximate, measure, and test the accuracy of their calculations. In addition to the traditional sequence of studies available for college-bound students, new, equally demanding mathematics curricula need to be developed for those who do not plan to continue their formal education immediately.
>
> (www.ed.gov.pubs/NatAtRisk)

In 1989, the National Council of Teachers of Mathematics (NCTM), an international professional organization, published Curriculum and Evaluation Standards for School Mathematics. This publication represented the birth of the *standards*-based movement in mathematics education in the United States. Elementary and secondary teachers had a source "to ensure quality, to indicate goals, and to promote change" (NCTM, 1989, p.6). Early in the next decade, the National Science Foundation (NSF) helped to fund the development of thirteen comprehensive mathematics curricula to address the recommendations in Curriculum and Evaluation Standards for School Mathematics.

In 1995, NCTM administrators appointed a Commission on the Future of the Standards. The product of the commission was published in 2000, Principles and Standards for School Mathematics. The principles addressed six themes: equity, curriculum, teaching, learning, assessment and technology. Ten standards are presented through four chronological phases: Pre K-2, grades 3-5, grades 6-8, and grades 9-12. These standards include: algebra, geometry, measurement, and data analysis and probability, areas specifically addressed in the recommendations of "A Nation at Risk." The NCTM standards begot the Pennsylvania Department of Education Academic Standards for Mathematics (Appendix A), which also included each of the areas addressed in the recommendations of the National Commission on Excellence in Education.

In 1985, landmark research was published about grouping policies in high schools across the United States. Jeannie Oakes authored "Keeping Track." The work of the University of California at Los Angeles professor created a new perspective on the composition of high school classrooms. Oakes built upon the work of a mentor at the University of California at Los Angeles (UCLA). John Goodlad was dean of the Graduate School of Education at UCLA in the 1970s. He conducted a study, "aimed at finding out, in a very detailed way, what was actually happening in and around American schools" (Oakes, 1985, p.41). Thirty-eight diverse schools composed

Goodlad's sample. Data were collected on "teaching practices, subject matter content, instructional materials, physical environment, activities, human and material resources, evaluation, time, organization, communication, decision making, leadership goals, issues and problems, implicit curricula, and controls or restraints" (Oakes, 1985, p.42). Oakes focused her follow-up study on the grouping policies in 25 of the middle and high schools from her mentor's sample. The practice of segregating students by perceived ability levels is believed to have been the predominant policy nation-wide. Homogeneity was viewed as appropriate for all learners. To support students who learned at different rates, these children were surrounded by peers who learned at a similar pace. Oakes attacked the policy of tracking as both a means and as an end. Labeling students by perceived ability was condemning the population of slower tracks. The "dye had been cast" for late bloomers. These students were being systematically denied the opportunity to share learning with all their peers. Oakes exposed the policy of tracking as not an attempt to customize learning, but to customize instruction. Tracking was a teacher-centered policy. Oakes called for heterogeneous classes to facilitate student-centered learning. She actually went as far as to label the policy of tracking as racist, since the lower tracks of the schools in her sample had a disproportionate share of minority students.

At the same time that Oakes was publishing her critique of homogeneous grouping, a school district superintendent in Massachusetts was preparing to radically alter the length of classes in the high school in his district. Joseph Carroll was the superintendent of the Broxton School District. He introduced a block, also known as an intensive, schedule to the district high school. This was an attempt to replicate the length of summer school classes that had proven effective in the remediation of students. The same students who had failed courses during the school year were benefiting from extended class meetings during the summer. Carroll hypothesized that having all the students meet for extended classes during the regular school year would reduce the number of course failures while giving all the students the benefits of extended classes.

At the beginning of the last decade of the twentieth century, the NSF began funding mathematics curricula based upon the NCTM standards. An abundance of experimental and quasi-experimental research has been conducted on the length of high school classes, the manner in which high school students are grouped, and specific mathematics curricula based on the NCTM standards. This study represents an attempt to build upon this existing research by examining how school district policies in the areas of scheduling, grouping and math curriculum impact each other. As detailed in chapter one, the policy of offering weighted grades as incentives to students for taking honors level and advanced placement courses is also included among the predictors.

Before considering the collective impact of policies regarding these four areas; each of the predictor variables and the criterion variable for this study, the 11^{th} grade mathematics portion of the PSSA, will be examined.

Predictor Variable – Scheduling

Traditionally, a high school student’s day consists of six to eight classes that meet for between 45 and 55 minutes per day. This Carnegie unit of instruction was useful when the focus of education was to ensure “students learned punctuality, obedience to authorities, and tolerance of repetition, boredom, and discomfort…during the 18th and 19th centuries, students were trained for farm and industrial work" (Cushman, 1989, p.35). Most high schools in Pennsylvania and in the United States continue to adhere to this model, despite evolving demands for "judgment, decision-making, creativity, high technical knowledge and independence" (Edwards, 1991, p.398). Block scheduling creates fewer classes each day, meeting for longer periods of time. One of the most common versions is the 4 X 4 plan. Standard yearlong courses meet for half of the school year in classes of about 90 minutes. Students and teachers begin a new schedule at midyear. The 4 X 4 A/B plan is similar except that classes meet every other day all year long. For the purpose of pre-emptive remediation, some schools offer classes across both models. That is, courses meet for an extended time in classes that meet every day of the school year. While the variations seem endless, they share a common thread. Students spend more time in fewer classes each day. Block scheduling offers financial incentive to districts. Teachers typically teach six sections of a course (three blocks per semester in a 4 X 4 plan). In a traditional model, teachers are usually accountable for five sections per year. Teachers are responsible for an additional class with block scheduling. Proponents of block scheduling emphasize the opportunity for student-centered learning with varied activities. Less time is lost at the beginning of class and between classes, which should equate to less discipline issues since most discipline problems occur in the hallways between classes. Opponents point out that student and staff absences are more problematic than in a traditional schedule, it is difficult to meet the needs of students transferring during the school year, and to a lack of data to support a deeper understanding of subject matter by students.

In 1989, a high school in Boxford, Massachusetts began to implement a scheduling pilot referred to as the "Copernican Plan." The schedule was so named to associate it with Nicolas Copernicus, a 16th century scholar who proposed that the sun, not the earth, was the center of the universe. The superintendent of the Masconomet Regional School District believed that moving away from the traditional Carnegie unit schedule would show evidence of similar enlightenment. After reviewing the pilot for two years, Harvard University evaluators concluded, "students were better known by their teachers, were responded to with more care, pursued issues in greater depth, enjoyed their class time more, felt more challenged, and gained deeper understandings" (Carroll, 1994, p.108). The plan was expanded to seven additional high schools in the United States and Canada. The high school communities varied among urban, suburban, and rural. A significant reduction in suspension and drop out rates was credited to the various Copernican models. The wider study confirmed the Harvard evaluators' conclusion that, "implementing a Copernican-style schedule can be accomplished with the expectation of favorable pedagogical outcomes" (Carroll, 1994, p.110).

In the mid 1990s, Lawrence and McPherson studied the effects of block scheduling using standardized end-of-course outcomes from students in two high schools in the same North Carolina school district. The researchers found that students in the school that utilized the traditional bell schedule scored significantly higher than students in the block scheduled school across four subjects, including

Algebra I. One of the weaknesses of the North Carolina study was the absence of a value-added assessment. Without a pre-test, there was no baseline against which to compare outcomes. The researchers expressed surprise that their finding contradicted those of Carroll, but suggest that may be because the criterion variable used by Carroll was students' final classroom grades while Lawrence and McPherson utilized a standardized instrument. The conflicting data certainly support a conclusion of the North Carolina study, "wholesale block scheduling alone, may not be the most productive long-term solution to inadequate academic achievement for high school students" (Lawrence & McPherson, 2000, p.181).

Predictor Variable – Grouping

Grouping refers to the composition of classrooms. Homogeneous grouping is the compartmentalization of students within classes by perceived aptitude. The subsets of homogeneity are tracking and ability level grouping. The distinction between tracking and ability level grouping is determined by student and parent input. Tracking involves the labeling of students by various standardized assessments. Students attend classes across all subjects with peers judged to have similar aptitude. With ability grouping, students' classifications would vary depending on subject area. Students could choose more or less challenging courses in different disciplines. Heterogeneous grouping refers to the random assignment of students across the curriculum.

> Within the last dozen years an anti-tracking movement has emerged. A growing public demand for excellence in education has united politically divergent forces. Proponents of purely heterogeneous grouping have aligned with groups seeking more rigorous academic standards and those advocating school choice (Loveless, 1998, p.6).

Beginning in 1990, Loveless conducted three surveys in California and Massachusetts. The surveys asked questions of principals pertaining to the development and implementation of tracking policy. Surveys were completed in California in June 1991 and June 1994. The Massachusetts survey was completed in June 1995. Advocates of tracking reform faced very different challenges in the two states. The Department of Education played a strong role in crafting policy in California schools. Massachusetts, where Horace Mann had been the first secretary to the state board of education in 1837, continues to be dominated by localism and suspicion of state control. Despite these differences, participation was consistent on both coasts. Urban schools, schools serving poorer students, and low-achieving schools were more likely to de-track than suburban schools, schools that serve wealthier students, and high-achieving schools.

Today, the rigidity of tracks has softened. Class assignments are usually made on a subject-by-subject basis. Many barriers to entering high tracks have fallen. Academic achievement, not perceived aptitude, dictates most placements. More importantly, tracking decisions are frequently negotiable. "Parents and students who are willing to risk lower grades for a more rigorous education routinely gain access to the courses that they want" (Loveless, 1998, p.11).

Other researchers found that the placement of students in ability groups in and of itself increases the gap between students beyond what would be expected on the basis of the initial differences between them. The researchers sought to answer two questions. "Is this growth in inequality avoided in mixed-ability settings? Does this gap in achievement occur because tracking helps students in higher-ability groups, harms students in lower-ability groups or because of some combination of the two?" (Linchevski, 1998, p.534). Separate studies dealt with these questions.

An earlier study of tracking in mathematics in Israeli junior high schools had led the researchers to conclude that the effect of the group level was greater than the effect of the initial differences among the students. In their study, the researchers found that the grade of a student in a higher ability group was always higher than the grade he or she would have received if he or she had hypothetically been placed, with the same initial data, in the next lower ability group. Their conclusion is that the achievement of students close to the cutoff points is largely dependent on the students being arbitrarily assigned to a lower or higher group level. These findings contradict Loveless' observation about students and parents having to "risk lower grades" when grouped with higher achievers.

Confident that they had established that growth in inequality could be avoided in mixed-ability settings, the researchers focused on their second question. A thirteenth school was studied. At the beginning of seventh grade, all 150 students were new to the school. They were randomly assigned to one of four mixed-ability homeroom classes. Two of the homerooms were tracked into three smaller separate same-ability mathematics classes. The other two classes studied math in their mixed-ability homerooms. There were five math classes, three same-ability classes and two mixed-ability classes. Following the procedure of the first study, students in the mixed-ability classes were assigned to hypothetical ability groups. At the end of eighth grade, two forms of tests were administered. All of the students were given the same test as well as a second test designed for their ability level. The average score of high-level students in the same-ability classes was higher, but not substantially, than those of students in mixed-ability classes on both versions of the assessment. The average scores of intermediate and lower level students in the same-ability grouping system were significantly lower than those in the mixed ability systems on both versions. The conjecture of the researchers that the achievement of lower and middle level students who learned in heterogeneous settings would be higher than those who learned in homogeneous settings was confirmed.

The Israeli studies are not included as a definitive endorsement of heterogeneous grouping in all circumstances. Research is inconclusive. “Tracking is not a moral litmus test; both tracking and de-tracking are morally legitimate” (Loveless, 1999, p.57). “Two opposing orientations are in conflict in the tracking controversy: a social orientation that values educational practices for their social impact, especially their impact on social equality and a fundamentalist orientation that values practices for making school more efficient” (Loveless, 1999, p.40).

“Math teachers and their colleagues tend to view mathematics as a hierarchical sequence of concepts requiring mastery” (Loveless, 1999, p.119). However, this perspective of the views of math teachers is not shared by NCTM. As pointed out in *Principles and Standards for School Mathematics*, “students who encounter enriched curricula in heterogeneous classes will tend to seek different levels of understanding. They will, over time, learn new ways of thinking from their peers” (National Council of Teachers of Mathematics, 2000). Today, the momentum of the continuum supports heterogeneous grouping. The spiral learning approach of *standards*-based mathematics curricula is contrary to Loveless' outdated generalization of math teachers' views about the necessity of mastery of concepts.

Predictor Variable – Weighted Grades

Weighted grades refers to the practice of using a multiplier to increase the value of grades, for the purpose of class ranking, earned in courses deemed to be particularly challenging. For example, advanced placement courses afford high school students the opportunity to achieve collegiate credit by earning an acceptable score on standardized examinations issued by the College Board. Advocates of weighted grades believe that students should be rewarded within their school for accepting additional educational challenges. Opponents question the benefits of compartmentalizing students in such detail and believe that the practice is harmful. Students may be denied the opportunity to discover the inherent value of the pursuit of academic challenges.

In 2004, weighted grades were used in 56 of the 66 (85%) high schools in these four Pennsylvania counties: Bucks, Chester, Delaware, and Montgomery (Report Card on the Schools. 2004. *The Philadelphia Inquirer*). There is a lack of research on the policy, which may have played a part in the school district referred to in chapter one acquiescing to the demands of vocal parents of regular-education students. In that district the shift to a more heterogeneous grouping policy may have been paved by compromising on a grading policy that may prove irrelevant to PSSA outcomes.

Predictor Variable – Mathematics Curriculum

In 1999, a group of educators, scientists, mathematicians, and policymakers empanelled by the U.S. Department of Education issued a report recognizing ten elementary and secondary mathematics programs. The ten were from among 61 programs that were voluntarily submitted to the committee for consideration. Each of the curricula was evaluated on four specific characteristics: quality of the program, usefulness to others, educational significance, and evidence of effectiveness and success. These characteristics were composed of specific criteria (Appendix B). The expert panel (Appendix C) identified five programs as "exemplary" and five as "promising." Convincing evidence of effectiveness and success in multiple sites differentiated the exemplary programs from the promising ones. Of the five curricula labeled as exemplary, four were secondary: Cognitive Tutor, College Preparatory Mathematics (CPM), Core-Plus Mathematics Project (CPMP), and Interactive Mathematics Project (IMP). Of the five additional programs that were identified as promising, one is for use in grades 9-12: the University of Chicago School Mathematics Project (UCSMP). For the purpose of this study, these five programs will be considered collectively and individually as contributing components to mathematics achievement as measured by the criterion variable, the PSSA. Ample time has elapsed since the publication of the panel's recommendations for these programs to be successfully implemented.

Cognitive Tutor was developed at Carnegie Mellon University in the early 1990s. It consists of courses intended for students in grades six through 12. CPM originated during the same time as a grant-funded curriculum and assessment project in Sacramento, California. It likewise is designed for middle and high school learners. In 2006, CPM is used in over 900 schools nationwide, 31 of which are in Pennsylvania. CPMP was developed at Western Michigan University with funding by the National Science Foundation (NSF). The project materials are published by McGraw-Hill. IMP is also NSF funded. IMP is marketed by Key Curriculum Press. The UCSMP began in 1983 with a grant from the Amoco Foundation. The project is directed by the Departments of Education and Mathematics at the University of Chicago. The publisher is McGraw-Hill. UCSMP is a secondary curriculum that is designed to follow another “promising” curriculum, Everyday Mathematics.

In addition to being aligned with the NCTM *Principles and Standards for School Mathematics*, the USDE cited curricula share other characteristics. Topics are integrated through courses. A spiral approach delays the expectation of mastery until the students have learned the *standards*-based material in successive courses. Problem solving is accentuated at the expense of symbol manipulation. Technology is stressed at the expense of paper and pencil calculation competency. These three features have been the focus of notable criticism. A California foundation, Packard Humanities Institute (PHI), is responsible for the most prominent attack. The foundation paid for a full-page advertisement in the November 18, 1999 edition of the *Washington Post.* The ad included an open letter to then Secretary of Education, Richard W. Riley, asking for the withdrawal of U.S. Department of Education’s endorsement of the ten programs. The letter was signed by about 200 mathematicians and scientists. The ad and the intense debate, much of it over the internet, have led to some unlikely alliances. Traditionalists and critics of the accentuation of technology, that these programs feature, have been joined by advocacy groups that appeal to parents who do not agree with the evolution of mathematical instruction. Two prominent electronic clearinghouses for the criticism of the expert panel's findings are New York City Honest Logical Decisions on Mathematics Education Reform (NYC HOLD) and Mathematically Correct. Administrators at the National Council of Teachers of Mathematics (NCTM) have called for civility between the sides. Brad Peterson is the mathematics department head at the Breck School in Minneapolis, Minnesota. He summarized the NCTM efforts to promote professional collaboration by stating "research mathematicians not otherwise engaged in school mathematics might take a less superior tone…similarly, we school folks would do well to take seriously the reasoned, respectfully expressed concerns of those at the frontiers of our discipline" (http://www.nctm.org/news/acticles/2000-02cover.htm).

Organizations like PHI, NYC HOLD, and Mathematically Correct seek to exploit the reluctance of parents, particularly less educated parents, to support a *standards*-based mathematics curriculum for their children. Lubienski detailed the introduction of one of the USDE cited curricula, CPMP, into a Midwestern school district earlier in this decade. CPMP was offered in the high school as an alternative to a traditional sequence of mathematics courses. College educated parents were significantly more likely than less educated parents to enroll their children in CPMP "to better understand mathematics" (Lubienski, 2004, p.351). Parental advocates of the traditional course sequence placed a priority on college preparation above student understanding and enjoyment of math. NYC HOLD and their ilk have enjoyed limited success in conveying a fear mongering message that the USDE cited mathematics curricula will hinder the college prospects for students. Lubienski identified the importance of building support for these curricula before their introduction into a school district. Actually, that was the intention behind the manner in which CPMP was introduced in the school district in her study. By continuing to offer a traditional sequence of courses at the time CPMP was initially offered, administrators were able to portray themselves as promoting choice instead of imposing CPMP on the high school community.

One particular aspect of the USDE cited curricula; the integrated approach is not a new idea. While the formulation of the standards and placing an emphasis on technology, particularly graphing calculators, is relatively recent, an integrated approach to mathematical concepts dates back at least three decades. The ancestor of integrated mathematics curricula is referred to as “unified math.” Mastery of key ideas is delayed, and those concepts are re-visited in successive units or courses. Before NSF funding, this was viewed as too progressive and failed to gain the popularity necessary to receive the financial commitment of text publishers. However, when NCTM was able to build consensus on the standards to be emphasized, the approach of successively re-visiting key concepts became an important component of *standards*-based curricula. Parents are often perplexed by this macro approach. They may recall their own learning as involving the exhaustion a topic until mastery was achieved. However, parents often have to be reminded about the brief span of that mastery.

In 2001 and 2002, Hartwell et al. studied six predominantly suburban school districts in Minnesota that were using NSF funded, *standards*-based curricula. The mathematics programs included two that were USDE cited, CPMP and IMP. Another NSF funded program, Mathematics: Modeling Our World that was not USDE cited was utilized by two of the six districts in the study. This was a non-experimental design, but there was an important component lacking in previous studies, particularly those funded by the NSF. The six participating districts all used published editions, as opposed to field-test versions, which are often taught by teachers who volunteer to participate in the research. Consequently all the teachers in the study were required to implement the curriculum. These teachers had completed an average of 144 hours of professional development over three years. This speaks to the fidelity with which they could be expected to properly implement the curriculum.

After utilizing the *standards*-based curricula exclusively throughout high school, the 11th grade subjects took either the Stanford Achievement Test, ninth edition (SAT-9) or the New Standards Reference Examination in Mathematics (NSREM). “The NSREM was designed to reflect *Standards*-based curricula, whereas the SAT-9 is a traditional standardized norm-referenced test that was not specifically designed to be sensitive to *Standards*-based curricula” (Hartwell, 2007, p.79). The performance of the subjects on the SAT-9 “was generally above average as determined by the test publisher’s cutoff” (Hartwell, 2007, p. 83). On the NSREM, “ninety-eight percent of the students achieved the standard (advanced or proficient) compared to fifty percent in the norming group” (Hartwell, 2007, p.89). In one Minnesota district where all of the secondary students used CPMP;

> the number of its high school students taking the BC level of the AP Calculus exam jumped from 50 to 67 between 1999 and 2003. The passing rate with a score of 3 or better during this period increased from 64% to 87%. For AB calculus, the number of students increased from 10 to 16, and there was an

> increase in the percentage with a grade of 3 or more from 30% to 81%. Similarly, the number of students taking the AP Statistics exam increased from 31 to 71 between 1999 and 2003. The passing rate, with a score of 3 or higher, during this period also increased slightly from 74% to 76% (Hartwell, 2007, p. 94).

Increased participation and success in advanced placement courses correlate with students taking "more high school mathematics courses…significantly higher ratings in confidence and usefulness of mathematics…and more positive attitudes toward mathematics" (Hartwell, 2007, p.76).

While advanced placement results for the students in Lubienski's study were not available; it is clearly the hope of those parents who supported the introduction of CPMP that the intrinsic benefits of a *standards*-based curriculum would be rewarded with the same extrinsic benefits enjoyed by the Minnesota students.

Criterion Variable – PSSA

In 2007, there were 1,273 publicly funded regular secondary and regular kindergarten through twelfth grade (K-12) schools in 501 districts in the Commonwealth of Pennsylvania. This total excludes cyber, charter, and alternative schools. Of the 1,273 schools, 711 were secondary and 562 were K-12. (http://www.pde.state.pa.us/k12statistics)

> The Pennsylvania System of School Assessment (PSSA) is a statewide test, which is administered as required under the Chapter 4 regulations of the State Board of Education. The test is designed to assess academic levels of students, schools and districts as well as to assist in identifying their strengths and weaknesses and foster improvements in academic achievement. The basis of the PSSA is the content contained in Pennsylvania's Academic Standards in Reading, Writing, Speaking and Listening, and Mathematics. (http://www.pde.state.pa.us/assessment)

Through 2005, the mathematics portion of the PSSA was administered annually to students in grades three, five, eight, and eleven. In 2006, testing in math and reading was added for grades four, six, and seven. All public school students are required to participate in the assessment unless they are excused by their parents for religious reasons. The criterion variable for this study is the eleventh grade mathematics PSSA. To enhance reliability, the assessment has three sections. Each section has objective and subjective components. For math, the 1996 PSSA was the base year. The 1997 through 2004 assessments were statistically equated with the 1996 reference year. The 1996 scaled scores were approximately normally distributed with a mean of 1300 and a standard deviation of 100.

The PSSA is *standards*-based and criterion-referenced. The criteria are descriptors for the four performance categories; advanced, proficient, basic and below basic. Beginning in 1999, scaled scores were used to categorize students' performance in regard to the Pennsylvania Department of Education (PDE) Academic Standards for Mathematics. The PDE, along with more than 1200 educators, parents, and community and business leaders, used two statistical-setting procedures to develop the performance levels.

- **Advanced:** Superior academic performance indicating an in-depth understanding and exemplary display of the skills included in Pennsylvania's Academic Standards;
- **Proficient:** Satisfactory academic performance indicating a solid understanding and adequate display of the skills included in Pennsylvania's Academic Standards;
- **Basic:** Marginal academic performance, work approaching, but not yet reaching, satisfactory performance. Performance indicates a partial understanding and limited display of the skills included in the Pennsylvania's Academic Standards, and the student may need additional instructional opportunities and/or increased student academic commitment to achieve the Proficient Level;

- **Below Basic:** Inadequate academic performance that indicates little understanding and minimal display of the skills included in the Pennsylvania Academic Content Standards. There is a major need for additional instructional opportunities and/or increased student academic commitment to achieve the Proficient Level.

(http://www.pde.state.pa.us/assessment)

The Bookmark and Borderline group method were used to develop the reading and math levels. The Bookmark method required participants to arrange sample items in sequence by perceived difficulty and then to place, in this case, three bookmarks to determine the categorical cut-offs. The Borderline method was performed by teachers on the actual work of their students. The participating teachers divided their students' work into seven categories, the four performance categories and three more categories which represented the "borderlines" between the established categories. Results of the two methods were summarized and averaged. Those agreed upon levels were then raised by one-quarter standard error to endorse rigorous student expectations.

In January 2002, President Bush reauthorized the Elementary and Secondary Education Act (ESEA), commonly referred to as No Child Left Behind (NCLB). Administrators in the PDE began to use the PSSA as evidence that students in the Commonwealth were meeting the goals of ESEA. The focus of the PSSA results shifted from scaled scores to categorical results. District administrators and teachers became primarily concerned with maximizing the percent of students meeting the proficient threshold as evidence of adequate yearly progress (AYP), an accountability aspect of ESEA. Table 2.1 is composed of the results of the eleventh grade population which achieved advanced or proficient designation on the mathematics sections of the PSSA.

Table 2.1 ***PSSA AYP Goals and Outcomes for 11th grade mathematics***

	2007	2006	2005	2004	2003	2002	2001
AYP target	.45	.45	.45	.35	.35	.35	.35
Actual Adv. & Proficient	.537	.520	.509	.491	.491	.496	.479

The AYP targets for the percentage of students, in all sub-groups within each school district, earning an advanced or proficient score will remain at forty-five percent through 2008. The sub-groups are: white, African-American, Latino, Asian, American Indian, Socio-economic status (receive free or reduced price meals), Special Education, and English as a Second Language. The target will then be incrementally increased until the goal reaches 100% of students achieving advanced or proficient scores by 2014.

There are two important components regarding the quality of an assessment: reliability and validity. Reliability refers to how likely a student would be to achieve a similar score if he or she took the test multiple times. PDE contracted with Data Recognition Corporation (DRC) to produce the PSSA. DRC provided test-retest Pearson coefficients from 0.92 to 0.94. Since reliability is significantly influenced by test length, the findings which reveal reliability was higher for all items ($0.93 < r < 0.94$) than for common items only ($r = 0.92$) is logical and expected.

Validity is the other component of the quality of an assessment. Validity refers to how well a test measured what it was intended to measure. For this purpose, PDE contracted with a Virginia firm to quantify the validity of the PSSA. In May

2004, Human Resources Research Organization (HumRRO) published findings and recommendations after analyzing the 2001-03 PSSA.

Here are the five questions on The PDE Request for Proposals (RFP) and a summary of the conclusions and recommendations made by HumRRO of the mathematics PSSA in 2002.

1) Does the PSSA adequately measure the academic content specified by the State Standards contained in Chapter 4?
2) Are the PSSA tests internally consistent and replicable?
3) Does the PSSA produce results that support decisions required by Chapter 4 regulations?
4) Do the scores produced by PSSA correlate positively and significantly with pertinent scores produced on relative tests such as Terra Nova, Stanford Achievement Test, etc.?
5) Were the methodologies used to determine the performance levels reasonable and technically competent?

(Thacker, 2004, p.3)

Does the PSSA adequately measure the academic content specified by the State Standards contained in Chapter 4? HumRRO researchers concluded that the overall difficulty is similar by form; however, item difficulty is not similar by type. "Multiple-choice items tended to discriminate best at the lower and middle portions of the scale" (Thacker, 2004, p.3). The subjective performance-task items did not discriminate well because so few students achieved scores from three to five. Most students earned scores of zero, one, or two. Among the suggestions by HumRRO was the inclusion of more difficult multiple-choice items to better discriminate across all cut scores and revisions to the performance task item rubrics and scoring. PDE accepted these recommendations, and beginning with the 2005 PSSA, the performance tasks were scored from zero to four. Also, beginning in 2005, PDE narrowed the focus of the PSSA. In mathematics, the eleven eleventh grade standards

(Appendix A) were merged into five reporting categories. The standards are comprised of seventy “benchmarks.” These benchmarks have been streamlined into fifteen “anchors” (Appendix D) which make up the reporting categories.

Are the PSSA tests internally consistent and replicable? DRC reports very high test-retest coefficients. The recommendation of HumRRO was limited to PDE monitoring the internal reliability measures provided by DRC.

Does the PSSA produce results that support decisions required by Chapter 4 regulations? Question three was part of the RFP; however, PDE administrators chose to address this internally. Recommendations were not sought as to the extent to which PSSA provides evidence of the specifications of Chapter 4 regulations being met.

Do the scores produced by PSSA correlate positively and significantly with pertinent scores produced on relative tests such as Terra Nova, Stanford Achievement Test, etc.? HumRRO found “correlations among PSSA and comparison assessments are nearly identical from year to year” (Thacker, 2004, p.6). The comparison assessment data were secured from seven of the 25 most populous school districts. The norm referenced, commercially available assessments included CTBS/Terra Nova, SAT-9, and the New Standards Reference Exam. For comparison with the eleventh grade PSSA, the College Board provided state-level Scholastic Assessment Test (SAT) data for two years. For 2002, HumRRO was able to match 78% of the SAT subjects with their corresponding PSSA results. For 2003, 76% were matched. Because the two tests purport to measure different content, the strength of the Pearson correlations is limited. “Correlations between PSSA and SAT should fall in the not-too-high and not-too-low category” (Kroger, Thacker, & Dickinson, 2004, p.2). Table 2.2 quantifies the PSSA and SAT correlations.

Table 2.2 ***PSSA & SAT Correlations***

	2003	2002
Pearson Correlations	0.865	0.846

It is certainly debatable as to whether the correlations in excess of 0.845 confirm the need for the Commonwealth to require their own test versus utilizing the SAT as the culminating examination.

Were the methodologies used to determine the performance levels reasonable and technically competent? HumRRO acknowledged that both methods, Bookmark and Borderline Groups, have been used in other states and that in combination the methods are reliable and lead to low standard deviations compared to other methods. The impact of raising the cut scores by one-quarter standard error was not investigated by HumRRO. As with question three in the RFP, the PDE did not seek feedback on this issue.

HumRRO did quantify the existing cut scores by examining the standard error of measurement (SEM) curve. The SEM represents the difference between a student’s reported score and that student’s “true” score. In regard to performance levels, the SEM should be minimized at the cut scores. Table five details the cut scores for the eleventh grade mathematics PSSA in 2002 and 2003. The likelihood that a student in either of the bordering categories correctly answers a multiple choice question should be fifty percent.

Table 2.3 ***Standard Error of Measurement "Cut Scores"***

	2003	2002
Advanced/Proficient	.52	.50
Proficient/Basic	.49	.50
Basic/Below Basic	.50	.51

Through the 2002 reauthorization of the ESEA, the federal government has greatly impacted education across the country. A catchy phrase, No Child Left Behind (NCLB), made it political folly to oppose the act in 2002. However, advocates and detractors of NCLB continue to promote or assail the legislation from conflicting perspectives. The Bush administration cites rising test scores as evidence of the macro success of NCLB. Local school boards point to the unfunded punitive aspects of the law as proof of the micro failings of NCLB. A school improvement plan is required for schools that fail to meet AYP targets for any of the sub-groups in consecutive years. The components of this school improvement plan increase each year the school remains below any of the AYP targets. The requirements of the plan begin with public school choice in year three. Supplemental services, corrective action, and restructuring must be offered in years four through six of AYP deficiency. The National Conference of State Legislatures (NCSL) issued a bipartisan statement early in 2005 which focused on the unintended consequences of NCLB. Among these consequences identified by NCSL is the lowering of academic standards. This is precisely where the PDE may be headed as districts begin to deal with the punitive consequences of NCLB.

Summary

This study is an attempt to identify, quantify and recommend a macro educational policy regarding scheduling, grouping, grading, and secondary mathematics curriculum. How many “outperforming school districts” in Pennsylvania have implemented Carroll’s (1994) “Copernican Plan”? Have they achieved higher 11th grade PSSA math outcomes than those out-performers who continue to adhere to a traditional high school bell schedule?

Jeannie Oakes (1985) took the United States public school system to task for segregating students by perceived ability during the mid 1980s. How many school districts recognized as being an “outperforming school district” have followed Oakes’ leadership? Has following that heterogeneous vision resulted in higher 11th grade PSSA math results? The policy of weighting grades has not been the subject of experimental studies. How many “outperforming school districts” utilize this policy? Is there a statistically significant difference among high schools in the Standard and Poor’s “outperforming school districts” that choose not to apply a multiplier to grades for advanced placement and honors courses?

Today, the second or third editions of NCTM *standards*-based curricula are in print. How many “outperforming school districts” depend on these curricula? Has following the NCTM recommendations resulted in higher 11th grade PSSA math results? The successful implementation of block scheduling, heterogeneously grouped classes, and USDE-cited math curricula have each been independently quantified. The common thread throughout each of these policies is a focus on student-centered learning. We don’t know how progressive school districts in Pennsylvania have been in implementing these policies. Since Standard and Poor's identified "outperforming school districts" in Pennsylvania, can evidence be uncovered in these districts about the combination of block scheduling, heterogeneous grouping, non-weighted grades and NCTM *standards*-based materials that have been recognized by the USDE and how that combination correlates with student achievement on the 11th grade PSSA mathematics sections?

CHAPTER 3

METHODOLOGY

Introduction

This chapter addressed how data were collected from the Standard and Poor's "outperforming school districts." The research design, research questions, how the participants achieved the notoriety from Standard and Poor's, the instrumentation and data collection procedures are presented.

Research Design

This is a non-experimental design. The study was primarily quantitative. For the purpose of maximizing participation from professionals who are primarily answerable for 11th grade PSSA mathematics results in their district, the questionnaire was succinct. Math department chair-persons were asked to dichotomously categorize their high school in regard to each of the four predictors: scheduling, grouping, grading, and secondary math curriculum. Qualitative responses were solicited about any research-supported classroom practices that the chair-persons believe were contributing to their status as an "outperforming school district."

Research Questions

As the AYP hurdles of NCLB are about to be raised, this study represents an attempt to reveal a cost-effective macro educational plan for scheduling, grouping, grading, and curricular policies in Pennsylvania secondary schools. The research questions were:

1. What combinations of scheduling (block or traditional), grouping (heterogeneous or homogeneous), grading (non-weighted or weighted) and secondary

mathematics curricula (USDE cited or not) exist in Pennsylvania public high schools in school districts that Standard and Poor's cited as "outperforming school districts"?

2. What policies regarding scheduling, grouping, grading, and secondary mathematics curricula in Pennsylvania public high schools in school districts that Standard and Poor's cited as "outperforming school districts" correlated with students achieving advanced or proficient designation on the 11th grade PSSA math sections in 2006?

3. What combinations of scheduling, grouping, grading, and secondary mathematics curricula in Pennsylvania public high schools in school districts that Standard and Poor's cited as "outperforming school districts" correlated with students achieving advanced or proficient designation on the 11th grade PSSA math sections in 2006?

4. Which specific mathematics curricula designated by USDE as "exemplary" or "promising" utilized in Pennsylvania public high schools in school districts that Standard and Poor's cited as "outperforming school districts" correlated with advanced or proficient student performance on the11th grade PSSA math sections in 2006?

The answers to these questions will inform school board members, school district administrators and all educational stakeholders about the role of scheduling, grouping, grading, and secondary mathematics curricular policies and how specific policies and specific combinations of these policies correlated with PSSA outcomes in school districts that earned recognition from Standard and Poor's for consistently outstanding PSSA performance.

Participants

The population for the study was the 11th grade PSSA participants enrolled in the graduating class of 2007 (tested in 2006) in the 60 high schools in 55 "outperforming school districts" in Pennsylvania. This accolade was bestowed upon these school districts by Standard and Poor's as part of a continuing analysis of public schools in all fifty states. Standard and Poor's lists three criteria to qualify for this recognition:

1) School districts must achieve higher levels of student proficiency than peers.
2) School districts must perform at a level that significantly exceeds statistical expectation.
3) School districts must outperform consistently.

(www.schoolmatters.com)

The 2004-05 school year is the most recent for which Standard and Poor's published their findings. In that year, 496 districts in Pennsylvania produced sufficient data for analysis. Fifty-five of 496 met all three criteria.

School districts must achieve higher levels of student proficiency than peers. Standard and Poor's has developed their own index. Reading and Math Proficiency (RaMP) is the ratio of successful test takers to total test takers. In Pennsylvania, this means the sum of all district students who score advanced or proficient in PSSA reading and math across all grades divided by the sum of all those who took the PSSA reading and math across all grades. As in this study, and for the purpose of meeting AYP in Pennsylvania, Standard and Poor's has merged the advanced and proficient designations and considered the sum of these outcomes to be success on the PSSA.

School districts must perform at a level that significantly exceeds statistical expectation. Analysts at Standard and Poor's calculated a linear model with RaMP outcomes dependent on the percentage of economically disadvantaged students in a district. The line which best fits the inverse relationship is widened to a "performance zone" parallelogram by adding and subtracting one standard deviation of residuals to the regression line. To meet the second criterion, school districts must produce RaMP values above the "performance zone."

School districts must outperform consistently. Districts with eligible RaMP scores are only designated as an "outperforming school district" when they repeat this performance for two consecutive years. This threshold was met by only 55 of 496 Pennsylvania school districts. However, 38 of the 55 met the criterion for three consecutive years and 29 of those for four consecutive years.

Instrumentation

The quantitative component of the survey instrument (Appendix E) was piloted by eight members of the mathematics department of the high school referenced in chapter one. Conflicting responses about the grouping policy in the high school led to clarification in the wording of that section of the survey. The responses across the scheduling, grading, and curriculum sections were consistent and accurate. The four predictors were considered to be dichotomous and defined in this way.

Schedule for Math Classes (S)

S_0 : classes that meet for 60 minutes or less every school day for the entire school year.

S_1 : not traditional, describes schools which utilize any aspect of extended class meetings (e.g., 4 X 4, 4 X 4 A/B, periodically scheduled extended classes).

Grouping (P)

P_0 : characterized by limitations in course selection, in addition to pre-requisites (e.g., policy of tracking, different texts utilized by different sections of the same course).

P_1 : not homogeneous, characterized by student choice in course selection and randomly assigned sections of a course.

Grading (D)

D_0 : grades earned in courses designated as honors and/or advanced placement are enhanced to increase the effect of that grade on class rank.

D_1 **:** not D_0

Mathematics Curriculum (C)

C_0 : not recognized by the U.S. Department of Education in 1999 as "exemplary" or "promising," typically characterized by an emphasis on symbol manipulation and repetition of algorithmic steps. Mastery of topics and concepts is expected before new ones are introduced.

C_1 : utilizing a text series recognized by the U.S. Department of Education as "exemplary" or "promising" specifically, Cognitive Tutor, College Preparatory Mathematics, Core-Plus Mathematics Project, Interactive Mathematics Project, and the University of Chicago School Mathematics Project. These curricula are characterized by an emphasis on mathematical modeling, the promotion of collaborative work and the integration of algebra, geometry, statistics, probability and discrete mathematics across courses. The integration of topics is presented in a spiral approach. Topics are revisited in progressively greater depth through successive courses.

A qualitative section follows the dichotomous choices. Respondents were queried about positive and negative punishments and/or positive and negative rewards that were offered or imposed upon test takers.

Table 3.1 ***Positive and Negative Punishments and Rewards***

	Punishment	Reward
Positive	impose requirements on students who score basic or below basic (i.e. web-based remediation)	provide incentives for students who meet or exceed proficient threshold (i.e. exclusive privileges)
Negative	remove opportunities for students who score basic or below basic (i.e. electives)	remove obstacles for students who meet or exceed proficient threshold (i.e. web-based instruction)

Data Collection

An internet search and phone calls identified math department chairpersons or senior teachers in each of the 60 high schools in the 55 Standard and Poor's cited school districts. An electronic mailing to these contacts in the spring of 2007 was used to solicit responses to the survey instrument. Six of the math department chairs or senior teachers were unreachable. Facsimile requests were forwarded to these contacts. The final participation rate was 66.7%, information from 40 math department chairs of the 60 that were contacted.

The criterion variable for the study was the percentage of students in participating schools that achieved a scaled score at or above 1304 on the 2006 11th grade math PSSA.

Table 3.2 ***PSSA Categorical Results 2001-04***

Category	2004	2003	2002	2001
Advanced (> 1489)	24.8	23.1	22.7	21.1
Proficient (1310 – 1489)	24.3	26.0	26.9	26.8
Basic (1180 – 1309)	19.8	20.9	21.4	21.7
Below Basic (< 1180)	31.0	30.0	29.0	30.4

Tables 3.2 and 3.3 contain the PSSA 11th grade mathematics outcomes from 2001 through 2007. In response to the HumRRO validity study, the categorical "cut scores" were re-centered beginning in 2005.

Table 3.3 ***PSSA Categorical Results 2005-07***

Category	2007	2006	2005
Advanced (> 1508)	24.2	28.1	26.3
Proficient (1304 – 1508)	29.5	23.9	24.6
Basic (1167 – 1303)	19.8	17.7	18.7
Below Basic (< 1167)	26.6	30.4	30.5

Summary

This non-experimental study sought to quantify a correlation between policies about scheduling, grouping, grading, and secondary mathematics curriculum and 2006 11th grade PSSA mathematics outcomes for "outperforming school districts." The population was identified by Standard and Poor's for exceeding expectation, based on the socio-economic status of their students, in 2004 and 2005. A primarily quantitative instrument was electronically mailed to the math department chair-person at all 60 high school in the 55 “outperforming school districts.” Participants were asked to dichotomously categorize their school in terms of these policies: scheduling (traditional or block); grouping (homogeneous or heterogeneous); grading (weighted or not); and secondary math curriculum (traditional or *standards*-based). A qualitative section asked the participants to identify research-based classroom practices in place at their school that they believe contribute to their status as an “outperforming school district.”

CHAPTER 4

ANALYSIS OF DATA

Purpose Statement

The purpose of this study was to examine and quantify the correlation between scheduling, grouping, grading, and mathematics curriculum and mathematics achievement in Pennsylvania secondary schools as measured by the Pennsylvania System of School Assessment (PSSA). Binary data were solicited from math department facilitators in 60 high schools in 55 Pennsylvania districts identified by Standard and Poor's as being "outperforming school districts."

Overview of Data Analysis

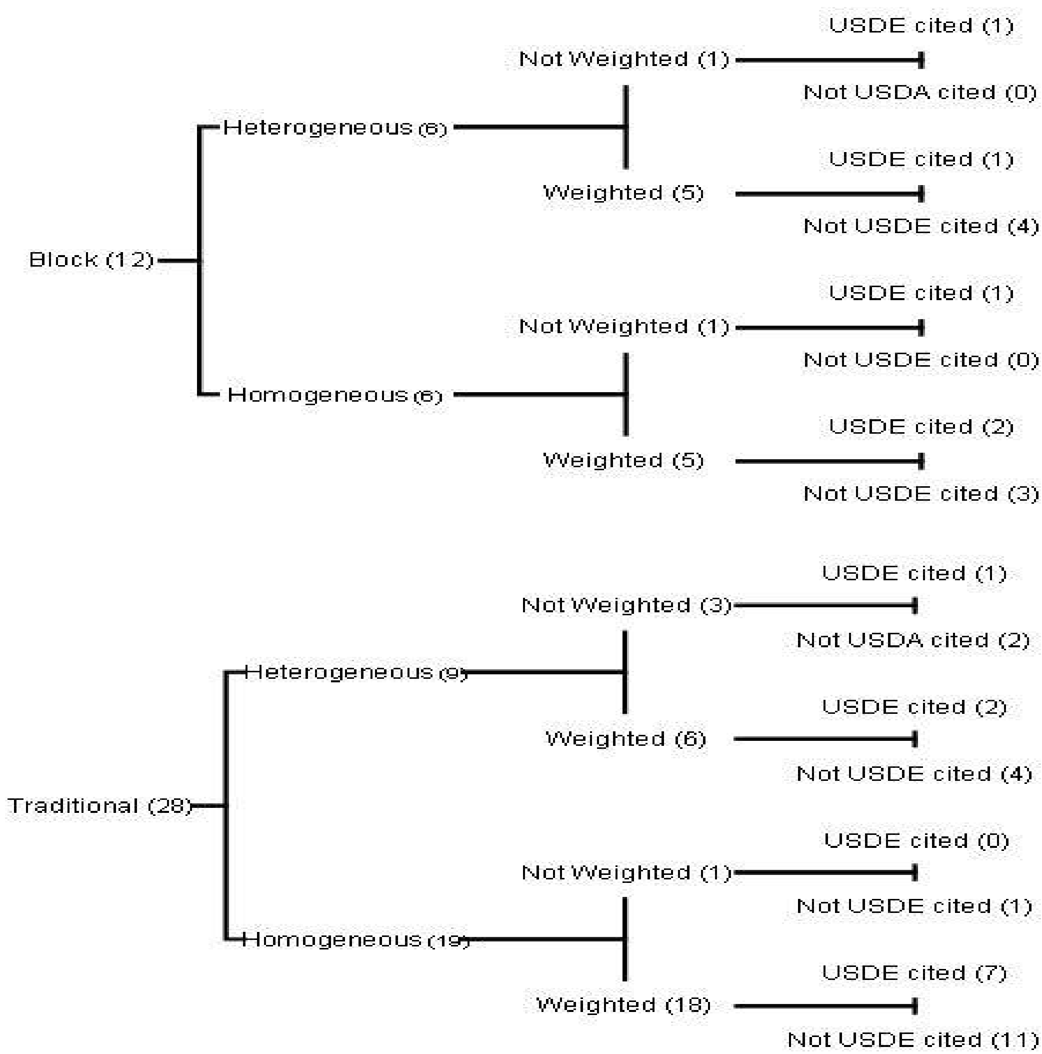
All data were analyzed using the Statistical Package for the Social Sciences (SPSS). Separate samples t-tests and ANCOVA were used to measure the correlation between the predictors for the respondents (Appendix F) and the criterion variable for the respondents (Appendix G). HumRRO found "for the full population of PSSA takers…non-economically disadvantaged students outscore(d) economically disadvantaged students to a large degree on all components and all years." (Kroger, Thacker, & Dickinson, 2004, p.33). Per-pupil instructional spending during the 2005-06 school year (Appendix H) was used as a co-variate in the ANCOVA to compensate for the socioeconomic effect.

Results for Question One: *What combinations of scheduling (block or traditional), grouping (heterogeneous or homogeneous), grading (non-weighted or weighted) and secondary mathematics curricula (USDE cited or not) exist in Pennsylvania public* *high schools in school districts that Standard and Poor's cited as "outperforming school districts"?*

Table 4.1 is composed of the specific combinations of the predictors.

Table 4.1 ***Combinations of the Predictors***

Scheduling	Grouping	Grading	Curriculum



Results for Question Two: *What policies regarding scheduling, grouping, grading, and secondary mathematics curricula in Pennsylvania public high schools in school districts that Standard and Poor's cited as "outperforming school districts" correlated with students achieving advanced or proficient designation on the 11th grade PSSA math sections in 2006?*

Table 4.2 ***Predictor Variable: High School Schedule***

Scheduling	N	Unadjusted Mean	SD	Adjusted Mean	Std. Error
Block	12	72.9	11.4	74.3	3.8
Not Block	28	63.2	15.2	62.6	2.5

$F_{(1, 37)} = 6.66$; $p = .014$

As an initial analysis, a two-group analysis of co-variance (ANCOVA) with per-pupil instructional spending as a co-variate was used for each of the variables. Using instructional spending data obtained from the Pennsylvania Department of Education (PDE), it was determined that the mean score on the 2006 11th grade math PSSA for "outperforming school districts" that utilize block scheduling was significantly higher than the mean score for "outperforming school districts" that do not utilize block scheduling. The partial eta value was 0.153. Thus, the power of the analysis to detect the effect of block scheduling is in excess of 84% (1 – 0.153). The mean score is the average of the sums of percentage of students achieving advanced or proficient in each of the participating school districts.

Table 4.3 ***Predictor Variable: High School Grouping Policy***

Grouping	N	Unadjusted Mean	SD	Adjusted Mean	Std. Error
Heterogeneous	15	66.8	14.8	67.8	3.7
Homogeneous	25	65.8	15.0	65.1	2.9

$F_{(1, 37)} = 0.32$; $p = .576$

It was determined by an ANCOVA that there was no significant difference between the mean score on the 2006 11th grade math PSSA for "outperforming school districts" that were self-identified as using homogeneous grouping practices in secondary math classes and the mean score for "outperforming school districts" that were self-identified as using heterogeneous grouping practices in high school math classes.

Table 4.4 ***Predictor Variable: High School Grading Policy***

Grading	N	Unadjusted Mean	SD	Adjusted Mean	Std. Error
Weighted	34	66.2	14.8	66.3	2.4
Not Weighted	6	65.9	15.6	65.3	5.8

$F_{(1, 37)} = 0.03$; $p = .868$

It was determined by an ANCOVA that there was no significant difference between the mean score on the 2006 11th grade math PSSA for "outperforming school districts" that use weighted grades and those "outperforming school districts" that do not use weighted grades.

Table 4.5 ***Predictor Variable: High School Mathematics Curriculum***

Curriculum	N	Unadjusted Mean	SD	Adjusted Mean	Std. Error
USDE cited	15	71.6	12.1	69.4	3.5
Not USDE cited	25	62.8	15.4	64.0	2.9

$F_{(1, 37)} = 1.34$; $p = .255$

It was determined by an ANCOVA that there was no significant difference between the mean score on the 2006 11th grade math PSSA for "outperforming school districts" that utilize a secondary mathematics curriculum that has been cited by the U. S. Department of Education (USDE) as "exemplary" or "promising" and those "outperforming school districts" that do not use one of these curricula.

Results for Question Three: *What combinations of scheduling, grouping, grading, and secondary mathematics curricula in Pennsylvania public high schools in school districts that Standard and Poor's cited as "outperforming school districts" correlated with students achieving advanced or proficient designation on the 11th grade PSSA math sections in 2006?*

Since scheduling was the only predictor variable that proved to significantly impact the criterion variable, this question becomes moot. As illustrated in Table 4.1, thirteen of 16 possible combinations of the four dichotomous predictors are utilized by the participants. The hypothesis that block scheduling, heterogeneous grouping, non-weighted grades, and a secondary mathematics curriculum cited by USDE as "exemplary" or "promising" would produce significantly higher PSSA math scores cannot be quantified. Only one school utilized that specific combination of the predictors. The PSSA results for that school were in the 68th percentile for the forty respondents while the per-pupil instructional spending for that high school was in the 38th percentile for the respondents.

Table 4.6 ***Schools utilizing traditional bell schedule and homogeneous grouping and weighted grades***

	N	Mean	SD	Median
Traditional schedule & Homogeneous grouping & Weighted grades	18	66.43	15.5	61.95
Total Sample	40	66.14	14.7	64.0

($t = 0.068$, $p = 0.946$, $df = 56$)

The plurality of schools in the study utilize a combination of a traditional bell schedule, homogeneous grouping, and weighted grades regardless of the secondary mathematics curriculum. This is logical since this combination of three of the predictors offers familiarity to the stakeholders.

Results for Question Four: *Which specific mathematics curricula designated by USDE as "exemplary" or "promising" utilized in Pennsylvania public high schools in school districts that Standard and Poor's cited as "outperforming school districts" correlated with advanced or proficient student performance on the11th grade PSSA math sections in 2006?*

There was no significant difference among the mean scores on the 2006 11th grade math PSSA for "outperforming school districts" that use different secondary mathematics curricula that have been cited by the U. S. Department of Education (USDE) as "exemplary" or "promising."

Table 4.7 ***Predictor Variable: High School Mathematics Curriculum***

Curriculum	N	Mean	SD	Max.	Min.
Cognitive Tutor	9	72.3	12.1	89.6	52.6
CPM	3	68.6	14.2	80.9	48.7
CPMP	1	77.0			
IMP	0				
UCSMP	3	76.9	9.8	89.6	65.7

($t = 0.447$, $p = 0.662$, $df = 13$) [1]

Qualitative data were also collected regarding remediation for at-risk students, those who entered high school with marginally proficient, basic or below basic performance on the 8th grade math PSSA. Twenty-nine of the 40 respondents had positive or negative rewards and/or punishments in place for those at-risk students.

Table 4.8 ***Schools with punishments and/or rewards***

	N	Mean	SD	Median
Punishments and/or Rewards	29	62.8	15.1	59.1
Total Sample	40	66.1	14.7	64.0

($t = 0.920$, $p = 0.361$, $df = 67$)

In this context, punishment refers to an attempt to discontinue an undesired behavior. The undesired behavior would be a student's history of achieving at the basic or below basic level on the PSSA in eighth grade or on subsequent standardized

[1] N = 16, PSSA outcomes from USCHS are included in Cognitive Tutor and UCSMP Appendix F.

instruments in high school. A reward refers to an effort to continue proficient or advanced outcomes. The 2006 PSSA results for math were lower, but not significantly lower, for these schools than for those schools lacking positive or negative rewards and/or punishments. There is a lack of evidence that these consequences are effective.

Summary

This study sought to quantify the correlation between scheduling, grouping, grading, secondary mathematics curriculum and 11th grade math outcomes on the PSSA in "outperforming school districts." Math department chairs in 40 of 60 high schools in the "outperforming school districts" participated in the study. Data were analyzed using SPSS. Separate samples t-tests and ANCOVA were used to measure the correlation between the dichotomous predictors and the percentage of students in each participating high school that met the proficient threshold on the mathematics portion of the PSSA in 2006. Per-pupil instructional spending was used as a co-variate in each ANCOVA.

It was learned that thirteen of sixteen possible combinations of the predictors are utilized in the "outperforming school districts." The only combinations not in use were: block schedule/heterogeneous grouping/non-weighted grades/non-USDE cited curricula, block schedule/homogeneous grouping/non-weighted grades/non-USDE cited curricula, and traditional schedule/homogeneous grouping/non-weighted grades/USDE cited curricula.

The only predictor variable that significantly correlated with 11th grade PSAA math outcomes in 2006 was scheduling. The mean score for "outperforming school districts" that utilize block scheduling (74.3) was significantly higher that the mean score for "outperforming school districts" that continue to adhere to a traditional schedule (62.6). The ANCOVA calculated that 84% of the difference in mean scores was attributable to the type of schedule in the participating high school.

None of the other three predictors, in combination with scheduling, correlated with higher PSSA math outcomes. Five secondary mathematics curricula were cited by the USDE as being "exemplary" or "promising." No statistical difference was detected among PSSA outcomes for high schools utilizing Cognitive Tutor, College Preparatory Mathematics (CPM), Core-Plus Mathematics Project (CPMP), Interactive Mathematics Project (IMP) or the University of Chicago School Mathematics Project (UCSMP).

CHAPTER 5

DISCUSSION

Purpose Statement

The purpose of this study was to examine and quantify the correlation between scheduling, grouping, grading, and mathematics curriculum and mathematics achievement in Pennsylvania secondary schools as measured by the Pennsylvania System of School Assessment (PSSA). Data were solicited from math department facilitators in 60 high schools in 55 Pennsylvania districts identified by Standard and Poor's as being "outperforming school districts." Responses were received and recorded from 40 (66.7%) high school math department chairpersons.

Research Questions

Discussion for Question One: *What combinations of scheduling (block or traditional), grouping (heterogeneous or homogeneous), grading (non-weighted or weighted) and secondary mathematics curricula (USDE cited or not) exist in Pennsylvania public high schools in school districts that Standard and Poor's cited as "outperforming school districts"?*

Seventy percent (28 of 40) of math department chairpersons report that their school utilizes a traditional schedule with classes that meet for less than one hour every day of the school year. State-wide data is not available; however, it is logical that this sample is representative of the scheduling policies throughout the commonwealth. It has been less than twenty years since John Carroll (1994) began promoting his "Copernican Plan." School board members need evidence and personal conviction to radically alter the length of classes in their high school. People generally resist change. Parents are often suspicious of educational policies that were not in effect when they themselves were students. School district policy-makers must be prepared to educate stakeholders about block scheduling to avoid the appearance of top-down imposition of a controversial policy. In one “outperforming school district” included in this study, constituents rallied against a 4 X 4 block when it was introduced during the middle of the last decade. A vocal minority forged a compromise with the school board and the high school schedule was amended to a non-research supported hybrid. Students meet every day in classes that vary in length from 50 minutes to 90 minutes. This district provided a case study in how not to introduce block scheduling or any significant educational policy change. Communication with stakeholders about any new school district policy is critical to acquiring the support needed to sustain the initiative.

Twenty-five respondents (62.5%) acknowledged that their school groups learners homogeneously in high school math classes. As with scheduling and all of the other predictors, there is a lack of state-wide data about the predominance of this grouping policy. Homogeneity was supported by diverse interests as being appropriate for all learners when the current generation of parents was being schooled. Tracking was thought to customize the pace for different groups of learners. High achievers would not lose interest, and slower processors of information would not be left behind. Jeannie Oakes (1985) attacked tracking and Linchevski and Kutscher (1998) quantified the shortcomings of ability-level grouping. The achievement of students close to grouping cutoffs was found to be largely dependent on the students being arbitrarily included in the higher or lower ability group. Not only do parents have to be convinced of the failings of the manner in which classes were grouped when they were in school, families of high achievers have to be sold on the greater good of heterogeneous grouping. Moving toward heterogeneous grouping may be even more challenging for policy makers than advocating block scheduling. Parents of high achievers are often involved and vocal about policies that affect their children. The concern needs to be what is best for all children. To reiterate the NCTM position, “students who encounter enriched curricula in heterogeneous classes will …learn new ways of thinking from their peers” (National Council of Teachers of Mathematics, 2000).

Eighty-five percent (34 of 40) of math department chairs in the sample for this study report the utilization of weighted grades in their high school. Theoretically, the policy of not weighting grades may be seen to compliment progressive policies regarding the other predictors. Pragmatically, acquiescing to parents who wish to see inflated grade point averages may help to disable opposition to policies in more meaningful areas.

Fifteen of 40 respondents (37.5%) acknowledged using one of the five USDE cited curricula. It is ironic that the actual discrepancy is the smallest with grouping and curriculum when the philosophical divide may be the greatest in regard to these predictors. The spiral learning and delaying of mastery is certainly foreign to the manner in which the current generation of parents was taught. The opposition to the USDE cited *standards*-based mathematics curricula has a powerful, if unwitting, ally in college and university professors. Most higher learning institutions still rely on non-calculator placement tests. These types of assessments focus on symbol manipulation that is contrary to the preparation received by students in schools using one of the USDE cited programs. Parents may justly assume that their own children will have to process and decipher the mixed-messages of following a technology-rich NCTM *standards*-based high school learning experience with the perceived rigor of a traditional college classroom environment.

Discussion for Question Two: *What policies regarding scheduling, grouping, grading, and secondary mathematics curricula in Pennsylvania public high schools in school districts that Standard and Poor's cited as "outperforming school districts" correlated with students achieving advanced or proficient designation on the 11th grade PSSA math sections in 2006?*

The study provided quantitative evidence of the positive correlation between block scheduling and superior PSSA results in "outperforming school districts." Simply put, students who have the opportunity to learn math during extended class meetings scored significantly higher than those that did not have the benefit of extended classes. Standard and Poor's found less than one in eight (60 of 501) Pennsylvania school districts met their criteria as being an "outperforming school district." Since three of the four predictors were not found to impact PSSA results (grouping, grading and secondary mathematics curricula), district personnel will be free to focus on scheduling. This was not an experimental design and causation is not implied. However, the data suggest the value of further study of scheduling. Perhaps John Carroll was not guilty of narcissism when he promoted his high school schedule as the "Copernican Plan." Administrators in districts with unsatisfactory standardized assessment outcomes should find the data herein as impetus to conduct their own quasi-experimental design to measure the impact of scheduling on PSSA results in other districts.

Discussion for Question Three: *What combinations of scheduling, grouping, grading, and secondary mathematics curricula in Pennsylvania public high schools in school districts that Standard and Poor's cited as "outperforming school districts" correlated with students achieving advanced or proficient designation on the 11th grade PSSA math sections in 2006?*

The study did not support the hypothesis that specific combinations of the predictor variables would correlate with higher percentages of students achieving advanced and proficient designation on the 11th grade mathematics PSSA in 2006.

Eighteen of the forty participants utilize a combination of a traditional bell schedule, homogeneous grouping, and weighted grades regardless of the secondary mathematics curriculum. Administrators in these school districts have taken a "if it ain't broke, don't fix it" approach. All of these districts qualify as "outperforming school districts;" however, that recognition results from a cumulative RaMP score for all of the students tested. High schools in "outperforming school districts" are not necessarily maximizing outcomes on the 11th grade mathematics portion of the PSSA.

School district administrators seeking to enhance the math PSSA performance of their 11th graders may consider phasing in block scheduling. As mentioned earlier, it should be anticipated that change would meet with resistance. The results of this study suggest that district personnel should anticipate a significantly positive impact on 11th grade math PSSA scores by introducing block scheduling. If, as expected, their own quasi-experimental design confirms the results of this study, administrators could time the introduction of block scheduling with the ratification of a new collective bargaining agreement with the teachers.

Discussion for Question Four: *Which specific mathematics curricula designated by USDE as "exemplary" or "promising" utilized in Pennsylvania public high schools in school districts that Standard and Poor's cited as "outperforming school districts" correlated with advanced or proficient student performance on the11th grade PSSA math sections in 2006?*

The study did not detect significant differences in PSSA outcomes among the four USDE cited secondary mathematics curricula. However, each of the four schools utilizing Core-Plus Mathematics Project or University of Chicago School Mathematics Project exceeded the mean score for the "outperforming school districts" using a non-USDE cited math curricula. It does not appear important which of the curricula is used in a district. Each of the USDE cited secondary programs are based upon the National Council of Teachers of Mathematics (NCTM) standards. It is logical and to be expected that these curricula would support learning as measured by an assessment begot by the PDE version NCTM standards. This study was unable to quantify the correlation between the PDE cited curricula and PSSA outcomes. For a district already using Cognitive Tutor, College Preparatory Mathematics, Core-Plus Mathematics Project, Interactive Mathematics Project or the University of Chicago School Mathematics Project, the evidence exists to affirm that decision. While the ANCOVA did not detect a statistically significant correlation between these five programs and 11th grade PSSA math results, the mean score for schools using each of the five USDE cited curricula exceeded the mean of the total sample.

The significance of the qualitative data is that positive and negative rewards and/or punishments are the result of unsatisfactory PSSA performance, not the cause of satisfactory PSSA performance. Policy makers looking to enhance PSSA outcomes introduce rewards and/or punishments while administrators in districts where PSSA achievement is at the highest levels of "outperforming school districts" decline to contaminate their recipe for success. There is no evidence herein to support the practice of offering rewards and/or punishments to students.

Summary

The idea for this study came from witnessing the alteration of policies regarding the four predictors in one school district during the 1990s. Does a change in scheduling, grouping, grading, and/or secondary mathematics curriculum affect student learning? The mixed results of this study do not identify one or even several combinations of the predictors that correlate with higher student achievement. Regardless, the study is effective in communicating the various ways that "outperforming school districts" deal with these policy issues. Additionally, a correlation between block scheduling and higher 11th grade math PSSA results has been quantified as statistically significant. Block scheduling is a more cost-effective allocation of personnel than a traditional schedule. The participation rate (66.7%) of high school math department chairpersons reveals a bottom-up interest in exploring effective educational policies, not just effective classroom practices. School district administrators should give serious consideration to conducting quasi-experimental research to determine if block scheduling could help to enhance PSSA outcomes while simultaneously helping to limit growth in instructional spending in their district.

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APPENDIX A

PENNSYLVANIA DEPARTMENT OF EDUCATION ACADEMIC STANARDS

Pennsylvania's public schools shall teach, challenge, and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:

2.1.11 Numbers, Number Systems and Number Relationships

A. Use operations (e.g., opposite, reciprocal, absolute value, raising to a power, finding roots, finding logarithms).

2.2.11 Computation and Estimation

A. Develop and use computation concepts, operations and procedures with real numbers in problem-solving situations.
B. Use estimation to solve problems for which an exact answer is not needed.
C. Construct quantities.
D. Describe and explain the amount of error that may exist in a computation using estimates.
E. Recognize the degree of precision needed in calculating a number depends on how the results will be used and the instrument used to generate the measure.
F. Demonstrate skills for using computer spreadsheets and scientific and graphing calculators.

2.3.11 Measurement and Estimation

A. Select and use appropriate units and tools to measure to the degree of accuracy required in particular measurement situations.

B. Measure and compare angles in degrees and radians.

C. Demonstrate the ability to produce measures with specified levels of precision.

2.4.11 Mathematical Reasoning and Connections

A. Use direct proofs, indirect proofs or proof by contradiction to validate conjectures.

B. Construct valid arguments from stated facts.

C. Determine the validity of an argument

D. Use truth tables to reveal the logic of mathematical statements.

E. Demonstrate mathematical solutions to problems (e.g., in the physical sciences).

2.5.11 Mathematical Problem Solving and Communication

A. Select and use appropriate mathematical concepts and techniques from different areas of mathematics and apply them to solving non-routine and multi-step problems.

B. Use symbols, mathematical terminology, standard notation, mathematical rules, graphing and other types of generalizations, ideas and results.

C. Present mathematical procedures and results clearly, systematically, succinctly and correctly.

D. Conclude a solution process with a summary of results and evaluate the degree to which the results obtained represent an acceptable response to the initial problem and why the reasoning is valid.

2.6.11 Statistics and Data Analysis

A. Design and conduct an experiment using random sampling. Describe the data as an example of a distribution using statistical measures of center and spread. Organize and represent the results with graphs. (Use standard deviation, variance and t-tests.)
B. Use appropriate technology to organize and analyze data taken from the local community.
C. Determine the regression equation of best fit (e.g., linear, quadratic, exponential).
D. Make predictions using interpolation, extrapolation, regression and estimation using technology to verify them.
E. Determine the validity of the sampling method described in a given study.
F. Determine the degree of dependence of two quantities specified by a two-way table.
G. Describe questions of experimental design, control groups, treatment groups, cluster sampling and reliability.
H. Use sampling techniques to draw inferences about large populations.
I. Describe the normal curve and use its properties to answer questions about sets of data that are assumed to be normally distributed.

2.7.11 Probability and Predictions

A. Compare odds and probability.
B. Apply probability and statistics to perform an experiment involving a sample and generalize its results to the entire population.

C. Draw and justify a conclusion regarding the validity of a probability or statistical argument.

D. Use experimental and theoretical probability distributions to make judgments about the likelihood of various outcomes in uncertain situations.

E. Solve problems involving independent simple and compound events.

2.8.11 Algebra and Functions

A. Analyze a given set of data for the existence of a pattern and represent the pattern algebraically and graphically.

B. Give example of patterns that occur in data from other disciplines.

C. Use patterns, sequences and series to solve routine and non-routine problems.

D. Formulate expressions, equations, inequalities, systems of equations, systems of inequalities and matrices to model routine and non-routine problem situations.

E. Use equations to represent curves (e.g., lines, circles, ellipses, parabolas, hyperbolas).

F. Identify whether systems of equations and inequalities are consistent or inconsistent.

G. Analyze and explain systems of equations, systems of inequalities and matrices.

H. Select and use an appropriate strategy to solve systems of equations and inequalities using graphing calculators, symbol manipulators, spreadsheets and other software.

I. Use matrices to organize and manipulate data, including matrix addition, subtraction, multiplication and scalar multiplication.

J. Demonstrate the connection between algebraic equations and inequalities and the geometry of relations in the coordinate plane.

K. Select, justify and apply an appropriate technique to graph a linear function in two variables, including slope-intercept, x- and y-intercepts, graphing by transformation and the use of a graphing calculator.

L. Write the equation of a line when given the graph of the line, two points on the line, or the slope of the line and a point on the line.

M. Given a set of data points, write an equation for a line of best fit.

N. Solve linear, quadratic and exponential equations both symbolically and graphically.

O. Determine the domain and range of a relation, given a graph or set of ordered pairs.

P. Analyze a relation to determine whether a direct or inverse variation exists and represent it algebraically and graphically.

Q. Represent functional relationships in tables, charts and graphs.

R. Create and interpret functional models.

S. Analyze properties and relationships of functions (e.g., linear polynomial, rational, trigonometric, exponential, logarithmic).

T. Analyze and categorize functions by their characteristics.

2.9 Geometry

A. Construct geometric figures using dynamic geometry tools (e.g., Geometer's Sketchpad, Cabri Geometre).

B. Prove that two triangles or two polygons are congruent or similar using algebraic, coordinate and deductive proofs.

C. Identify and prove the properties of quadrilaterals involving opposite sides and angles, consecutive sides and angles and diagonals using deductive proofs.

D. Identify corresponding parts in congruent triangles to solve problems.

E. Solve problems involving inscribed and circumscribed polygons.

F. Use the properties of angles, arcs, chords, tangents and secants to solve problems involving circles.

G. Solve problems using analytic geometry.

H. Construct a geometric figure and its image using various transformations.

I. Model situations geometrically to formulate and solve problems.

J. Analyze figures in terms of the kinds of symmetries they have.

2.10.11 Trigonometry

A. Use graphing calculators to display periodic and circular functions; describe properties of the graphs.

B. Identify, create and solve practical problems involving right triangles using the trigonometric functions and the Pythagorean Theorem.

2.11.11 Concepts of Calculus

A. Determine maximum and minimum values of a function over a specified interval.
B. Interpret maximum and minimum values in problem situations.
C. Graph and interpret rates of growth/decay.
D. Determine sums of finite sequences of numbers and infinite geometric series. Estimate areas under curves using sequences of areas.

APPENDIX B

U.S. DEPARTMENT OF EDUCATION EVALUATION CRITERIA

A. Quality of Program

Criterion 1. The program's learning goals are challenging, clear, and appropriate for the intended student population.

Indicator a. The program's learning goals are explicit and clearly stated.

Indicator b. The program's learning goals are consistent with research on teaching and learning or with identified successful practices.

Indicator c. The program's learning goals foster the development of skills, knowledge, and understandings.

Indicator d. The program's learning goals include important concepts within the subject area.

Indicator e. The program's learning goals can be met with appropriate hard work and persistence.

Criterion 2. The program's content is aligned with its learning goals, and is accurate and appropriate for the intended student population.

Indicator a. The program's content is aligned with its learning goals.

Indicator b. The program's content emphasizes depth of understanding, rather than breadth of coverage.

Indicator c. The program's content reflects the nature of the field and the thinking that mathematicians use.

Indicator d. The program's content makes connections within the subject area and between disciplines.

Indicator e. The program’s content is culturally and ethnically sensitive, free of bias, and reflects diverse participation and diverse student interests.

Criterion 3. The program’s instructional design is appropriate, engaging, and motivating for the intended student population.

Indicator a. The program’s instructional design provides students with a relevant rationale for learning this material.

Indicator b. The program’s instructional design attends to student’s prior knowledge and commonly held conceptions.

Indicator c. The program’s instructional design fosters the use and application of skills, knowledge, and understandings.

Indicator d. The program’s instructional design is engaging and promotes learning.

Indicator e. The program’s instructional design promotes student collaboration, discourse, and reflection.

Indicator f. The program’s instructional design promotes multiple and effective approaches to learning.

Indicator g. The program’s instructional design provides for diverse interests.

Criterion 4. The program’s system of assessment is appropriate and designed to inform student learning and to guide teachers’ instructional decisions.

Indicator a. The program’s system of assessment is an integral part of instruction.

Indicator b. The program’s system of assessment is consistent with the content, goals, and instructional design of the program.

Indicator c. The program’s system of assessment encourages multiple approaches and makes use of diverse forms and methods of assessment.

Indicator d. The program's system of assessment probes students' abilities to demonstrate depth, flexibility, and application of learning.

Indicator e. The program's system of assessment provides information on students' progress and learning needs.

B. Usefulness to Others

Criterion 5. The program can be successfully implemented, adopted, or adapted in multiple educational settings.

Indicator a. The program provides clear instructions and sufficient training materials to ensure use by those not in the original program.

Indicator b. The program is likely to be successfully transferred to other settings.

Indicator c. The program specifies the conditions and resources needed for implementation.

Indicator d. The program's costs (time and money) can be justified by the benefits.

C. Educational Significance

Criterion 6. The program's learning goals reflect the vision promoted in national standards in mathematics education.

Indicator a. The program's learning goals and subject matter are consistent with national standards.

Indicator b. The program's pedagogy and assessment are aligned with national standards.

Indicator c. The program promotes equity and equal access to knowledge, as reflected in national standards.

Criterion 7. The program addresses important individual and societal needs.

Indicator a. The program is of sufficient scope and importance to make a significant difference in student learning.

Indicator b. The program contributes to increases in teachers' knowledge of effective teaching and learning.

Indicator c. The program:

is designed to improve learning for a wide spectrum of students OR

serves to meet the special learning needs of under-served students OR

serves to meet the special learning needs of students whose interests and talents go beyond core mathematics education.

D. Evidence of Effectiveness and Success

Criterion 8. The program makes a measurable difference in student learning.

APPENDIX C

U.S. DEPARTMENT OF EDUCATION MATH AND SCIENCE EDUCATION EXPERT PANEL

Martin Apple, Council for Science Society Presidents, DC

Manuel Berriozabal, University of Texas, at San Antonio, TX

Joan Donahue, National Alliance of State Science and Mathematics Coalitions, DC

Janice Earle, National Science Foundation, DC

Mazie Jenkins, Lincoln School, Madison, WI

Genevieve Knight, Coppin State College, MD

Steven Leinwand, Connecticut State Department of Education, CT

Maria Lopez-Freeman, California Science Project, CA

James Minstrell, A.C.T. Systems for Education, WA

Jack Price, California State Polytechnic University, CA

James Rutherford, American Association for the Advancement of Science, DC

Steve Schneider, Ex Officio Panelist, WestEd, CA

William Spooner, Creative Business Solutions Group, NC

Jan Tuomi, National Research Council, DC

Gerry Wheeler, National Science Teachers Association, DC

APPENDIX D

PENNSYLVANIA DEPARTMENT OF EDUCATION REPORTING CATEGORIES, ASSESSMENT ANCHORS AND ELIGIBLE CONTENT FOR (11^{th} GRADE) MATHEMATICS

M11.A Numbers and Operations

M11.A.1 Demonstrate an understanding of numbers, ways of representing numbers, relationships among numbers, and number systems.

M11.A.1.1 Represent and/or use numbers in equivalent forms (e.g., integers, fractions, decimals, percents, square roots, exponents and scientific notation). Reference: 2.1.8.A, 2.1.8.B, 2.1.11.A

M11.A.1.1.1 Find the square root of an integer to the nearest tenth.

M11.A.1.1.2 Express numbers and/or simplify expressions using scientific notation (including numbers less than 1).

M.11.A.1.1.3 Simplify square roots (e.g. $\sqrt{24} = 2\sqrt{6}$).

M11.A.1.2 Apply number theory concepts to show relationships between real numbers in problem solving settings. Reference: 2.1.8.E

M11.A.1.2.1 Find the Greatest Common Factor (GCF) and/or Least Common Multiple (LCM) for sets of monomials.

M11.A.1.3 Estimate the value of an irrational number. Reference: 2.2.8.C

M11.A.1.3.1 Locate/identify irrational numbers at the appropriate location on a number line.

M11.A.1.3.2 Compare and/or order any real numbers (rational and irrational numbers may be mixed).

M11.A.2	Understand the meaning of operations, use operations and understand how they relate to each other.
M11.A.2.1	Apply ratio and/or proportion in problem-solving situations. Reference: 2.2.11.A, 2.8.11.P
M11.A.2.1.1	Solve problems using operations with rational numbers including rates and percents (single and multi-step and multiple procedure operations)(e.g., distance, work and mixture problems, etc.).
M11.A.2.1.2	Solve problems using direct and inverse proportions.
M11.A.2.1.3	Identify and/or use proportional relationships in problem solving settings.
M11.A.2.2	Use exponents, roots and/or absolute value to solve problems. Reference: 2.1.11.A
M11.A.2.2.1	Simplify/evaluate expressions involving positive and negative exponents, roots and/or absolute value (may contain all types of real numbers – exponents should not exceed power of 10).
M11.A.2.2.2	Simplify expressions involving multiplying with exponents (e.g., $x^6 \bullet x^7 = x^{13}$), powers of powers (e.g., $\left(x^6\right)^7 = x^{42}$ and powers of products $(2x^2)^3 = 8x^6$ (positive exponents only).
M11A.3	Compute accurately and fluently and make reasonable estimates.
M11.A.3.1	Apply the order of operations in computation and in problem-solving situations. Reference: 2.2.8.A
M11.A.3.1.1	Simplify/evaluate expressions using the order of operations to solve problems (any rational numbers may be used).

M11.A.3.2 Use estimation strategies in problem-solving situations. Reference: 2.2.11.B, 2.2.11.D

M11.A.3.2.1 Use estimation to solve problems.

M11.B Measurement

M11.B.1 Demonstrate an understanding of measurable attributes of objects and figures, and the units, systems and processes of measurement.

Not assessed at grade 11.

M11.B.2 Apply appropriate techniques, tools, and formulas to determine measurements.

M11.B.2.1 Use and/or compare measures of angles. Reference: 2.3.11.A, 2.3.11.B

M11.B.2.1.1 Measure and/or compare angles in degrees $\left(\text{up to } 360^{\circ}\right)$ (protractor must be provided or drawn).

M11.B.2.2 Use and/or develop procedures to determine or describe measures of perimeter, circumference, area, surface area and/or volume. (May require conversions within the same system). Reference: 2.3.8.A, 2.3.8.D, 2.9.11.E

M11.B.2.2.1 Calculate surface area of prisms, cylinders, cones, pyramids and/or spheres. Formulas are provided on the reference sheet.

M11.B.2.2.2 Calculate volume of prisms, cylinders, cones, pyramids and/or spheres. Formulas are provided on the reference sheet.

M11.B.2.2.3 Estimate area, perimeter or circumference of an irregular figure.

M11.B.2.2.4 Find the measurement of a missing length given the perimeter, circumference, area or volume.

M11.B.2.3 Describe how a change in the dimension of a figure (2 or 3 dimensional) affects other measurements of that figure. Reference: 2.3.8.E

M11.B.2.3.1 Describe how a change in the linear dimension of a figure affects its perimeter, circumference, area or volume.

- How does changing the length of a radius of a circle affect the circumference of the circle?
- How does changing the length of the edge of a cube affect the volume of the cube?
- How does changing the length of the base of a triangle affect the area of the triangle?

M11.C Geometry

M11.C.1 Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.

M11.C.1.1 Identify and/or use parts of circles and segments associated with circles. Reference: 2.9.11.F

M11.C.1.1.1 Identify and/or use the properties of a radius, diameter, and/or tangent of a circle (given numbers should be whole).

M11.C.1.1.2 Identify and/or use the properties of arcs, semicircles, inscribed angles and/or central angles.

M11.C.1.2 Recognize and/or apply properties of triangles and quadrilaterals. Reference: 2.9.8.D, 2.9.11.C

M11.C.1.2.1 Identify and/or use properties of triangles (e.g., medians, altitudes, angle bisectors, side/angle relationships, Triangle Inequality Theorem).

M11.C.1.2.2 Identify and/or use properties of quadrilaterals (e.g., parallel sides, diagonals, bisectors, congruent sides/angles and supplementary angles).

M11.C.1.2.3 Identify and/or use properties of isosceles and equilateral triangles.

M11.C.1.3 Use properties of congruence, correspondence and similarity in problem-solving settings involving two- and three- dimensional figures. Reference: 2.9.11.B

M11.C.1.3.1 Identify and/or use properties of congruent and similar polygons or solids.

M11.C.1.4 Solve problems involving right triangles using the Pythagorean Theorem. Reference: 2.10.11.B

M11.C.1.4.1 Find the measure of a side of a right triangle using the Pythagorean Theorem (Pythagorean Theorem included on the reference sheet).

M11.C.2 Identify and/or apply concepts of transformations or symmetry.

Not assessed at grade 11.

M11.C.3 Locate points or describe relationships using the coordinate plane.

M11.C.3.1 Solve problems using analytic geometry. Reference: 2.9.11.G

M11.C.3.1.1 Calculate the distance and/or midpoint between 2 points on a number line or on a coordinate plane (formula provided on the reference sheet).

M11.C.3.1.2 Relate slope to perpendicularity and/or parallelism (limit to linear algebraic expressions; slope formula provided on the reference sheet).

M11.D Algebraic Concepts

M11D.1 Demonstrate understanding of patterns, relations, and functions.

M11.D.1.1 Analyze and/or use patterns or relations. Reference: 2.8.11.Q, 2.8.11.A

M11.D.1.1.1 Analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically.

M11.D.1.1.2 Determine if a relation is a function given a set of points or a graph.

M11.D.1.1.3 Identify the domain, range or inverse of a relation (may be presented as ordered pairs or a table).

M11.D.2 Represent and/or analyze mathematical situations using numbers, symbols, words, tables and/or graphs.

M11.D.2.1 Write, solve and/or graph linear equations and inequality using various methods. Reference: 2.8.8.F, 2.8.11.D, 2.8.11.H, 2.8.11.J, 2.8.11.N

M11.D.2.1.1 Solve compound inequalities and/or graph their solution sets on a number line (may include absolute value inequalities).

M11.D.2.1.2 Identify or graph functions, linear equations or linear inequalities on a coordinate plane.

M11.D.2.1.3 Write, solve and/or apply a linear equation. (including problem situations).

M11.D.2.1.4 Write and/or solve systems of equations using graphing, substitution and/or elimination (limit systems to 2 equations).

M11.D.2.1.5 Solve quadratic equations using factoring (integers only – not including completing the square or the Quadratic Formula).

M11.D.2.2 Simplifying expressions involving polynomials. Reference: 2.8.11.S

M11.D.2.2.1 Add, subtract and/or multiply polynomial expressions (express answers in simplest form – nothing larger than a binomial multiplied by a trinomial).

M11.D.2.2.2 Factor algebraic expressions including differences of squares and trinomials (trinomials limited to the form $ax^2 + bx + c$ a is not equal to 0).

M.11.D.2.2.3 Simplify algebraic fractions.

M11.D.3 Analyze change in various contexts.

M11.D.3.1 Describe and/or determine change. Reference: 2.8.8.J, 2.11.8.B

M11.D.3.1.1 Identify, describe and/or use constant or varying rates of change.

M11.D.3.1.2 Determine how a change in one variable relates to a change in a second variable $\left(\text{e.g., } y = 4/x \text{, if x doubles, what happens to y?}\right)$.

M11.D.3.2 Compute and/or use the slope of a line. Reference: 2.8.11.J, 2.8.11.L

M11.D.3.2.1 Apply the formula for the slope of a line to solve problems (formula given on the reference sheet).

M11.D.3.2.2 Given the graph of the line, 2 points on the line, or the slope and a point on a line, write or identify the linear equation in point-slope, standard and/or slope-intercept form.

M11.D.3.2.3 Compute the slope and/or y-intercept represented by a linear equation or graph.

M11.D.4 Describe or use models to represent quantitative relationships.

M11.D.4.1 Interpret and/or use linear, quadratic and/or exponential functions and their equations, graphs or tables. Reference: 2.8.11.K, 2.8.11.Q

M11.D.4.1.1 Match the graph of a given function to its table or equation.

M11.E Data Analysis and Probability

M11E.1 Formulate or answer questions that can be addressed with data and/or organize, display, interpret or analyze data.

M11.E.1.1 Appropriately display and/or use data in problem-solving settings. Reference: 2.6.11.A, 2.6.8.E

M11.E.1.1.1 Create and/or use appropriate graphical representations of data including box-and-whisker plots, stem-and-leaf plots, or scatter plots.

M11.E.1.1.2 Analyze data and/or answer questions based on displayed data (box-and-whisker plots, stem-and-leaf plots, or scatter plots).

M11.E.2 Select and/or use appropriate statistical methods to analyze data.

M11.E.2.1 Use measures of central tendency to describe a set of data. Reference: 2.6.8.A, 2.6.11.A

M11.E.2.1.1 Calculate or select the appropriate measure of central tendency (mean, mode or median) of a set of data given or represented on a table, line plot, or stem-and-leaf plot.

M11.E.2.1.2 Calculate and/or interpret the range, quartiles and interquartile range of data.

M11.E.2.1.3 Describe how outliers affect measures of central tendency.

M11.E.3 Understand and/or apply basic concepts of probability or outcomes.

M11.E.3.1 Apply probability and/or odds to practical situations. Reference: 2.7.11.A, 2.7.11.E

M11.E.3.1.1 Find probabilities for independent, dependent or compound events and represent as a fraction, decimal, or percent.

M11.E.3.1.2 Find, convert and/or compare the probability and/or odds of a simple event.

M11.E.3.2 Apply counting techniques in problem-solving settings. Reference: 2.7.8.A

M11.E.3.2.1 Determine the number of permutations and/or combinations or apply the fundamental counting principle (Formula provided on the reference sheet).

M11.E.4 Develop and/or evaluate inferences and predictions based on data or data displays.

M11.E.4.1 Make predictions using data displays and probability. Reference: 2.7.8.E, 2.6.11.D

M11.E.4.1.1 Estimate or calculate to make predictions based on a circle, line, bar graphs or given situation.

M11.E.4.1.2 Use probability to predict outcomes.

M11.E.4.2 Analyze and/or interpret data on a scatter plot and/or use a scatter plot to make predictions. Reference: 2.6.11.C, 2.6.11.D

M11.E.4.2.1 Draw, find and/or write an equation for a line of best fit for a scatter plot.

M11.E.4.2.2 Make predictions using the equations or graphs of best-fit lines of scatter plots.

APPENDIX E

INSTRUMENTATION

0. Please identify your school.

ALTOONA AREA HS

Please select the categorization that best describes the policy in your high school.

1. Schedule for Math Classes

S(0): Classes in our school meet for 60 minutes or less every school day for the entire school year.

S(1): Our school uses block scheduling. This refers to schools which utilize any aspect of extended class meetings (i.e., 4X4, 4X4 A/B, periodically scheduled extended classes).

S0

1(a). Has the policy in your high school, regarding scheduling, been in effect since 2003?

Yes

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2. Grouping of Math Classes

P(0): Our school seeks to have math classes comprised of students with similar ability (i.e., policy of "leveling", different texts utilized by different sections of the same course).

P(1): Our school seeks to have math classes comprised of students with a wide range of ability levels. This is characterized by randomly assigned sections of a course, each utilizing the same text.

P0

2(a). Has the policy in your high school, regarding grouping been, in effect since 2003?

Yes

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3. Grading

D(0): In our school, grades earned in courses designated as honors and/or advanced placement are enhanced to increase the effect of that grade on class rank.

D(1): Our school does not utilize weighted grades.

D0

3(a). Has the policy in your high school, regarding grading been, in effect since 2003?

Yes

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4. Mathematics Curriculum

Does your school utilize one of these mathematics programs: Cognitive Tutor, College Preparatory Mathematics (CPM), Core-Plus Mathematics Project (CPMP), Interactive Mathematics Project (IMP), or the University of Chicago School Mathematics Project (UCSMP)?

Yes

4(a). If you selected yes, please identify the specific secondary math program.

Cognitive Tutor

4(b). Has the mathematics curriculum in your high school been in place since 2003?

Yes

5. In your district, are there remedial requirements (i.e. required courses) specifically for students who score basic or below basic on the 8th and/or 11th grade PSSA math?

Yes

5(a). If yes, please describe the remediation.

6. In addition to or instead of remediation, what policies or practices have been introduced at your high school to improve performance on the PSSA?
(i.e. positive /negative punishments or positive/negative reinforcements)

7. Would it be possible to contact you at school to discuss, in detail, your responses to the final two questions?

Yes

Submit Answers

APPENDIX F

COMPARTMENTALIZATION OF PARTICIPANTS REGARDING PREDICTORS

High School	County	Scheduling	Grouping	Grading	Curriculum
BELLWOOD ANTIS HS	Blair		Heterogeneous		
BLACKLICK VALLEY JSH	Cambria			~Weighted	
CENTRAL BUCKS HS-EAST	Bucks	Block			Cognitive Tutor
CENTRAL BUCKS HS-SOUTH	Bucks	Block	Heterogeneous		Cognitive Tutor
CENTRAL CAMBRIA HS	Cambria		Heterogeneous		
COLLEGIATE ACAD HS	Erie	Block	Heterogeneous		
CONEMAUGH VALLEY JSH	Cambria		Heterogeneous	~Weighted	CPM
CONESTOGA SHS	Chester				
DUBOIS AREA SHS	Clearfield		Heterogeneous		
EAST SHS	Erie				
FAIRVIEW HS	Erie	Block	Heterogeneous		
FERNDALE AREA JSHS	Cambria				Cognitive Tutor
FOX CHAPEL AREA SHS	Allegheny	Block		~Weighted	Cognitive Tutor
FREEPORT AREA SHS	Armstrong				
G A R MEMORIAL JSHS	Luzerne		Heterogeneous	~Weighted	
GENERAL MCLANE HS	Erie	Block			Cognitive Tutor
GIRARD HS	Erie	Block			
GREENSBURG-SALEM HS	Westmoreland	Block	Heterogeneous	~Weighted	UCSMP
HAMPTON HS	Allegheny				Cognitive Tutor
HARRITON SHS	Montgomery				CPM
HOMER-CENTER JSHS	Indiana				
INDIANA AREA SHS	Indiana		Heterogeneous		UCSMP
JAMES M COUGHLIN JSH	Luzerne		Heterogeneous	~Weighted	
JAMESTOWN AREA JSHS	Mercer		Heterogeneous		
LOWER MERION HS	Montgomery				CPM
MT LEBANON SHS	Allegheny				
NEW BRIGHTON AREA HS	Beaver		Heterogeneous		Cognitive Tutor
NORTH EAST HS	Erie	Block			
NORTHERN CAMBRIA HS	Cambria				

High School	County	Scheduling	Grouping	Grading	Curriculum
NORTHGATE JSHS	Allegheny				Cognitive Tutor
PETERS TWP HS	Washington	Block	Heterogeneous		
PORTAGE AREA HS	Cambria				CPM
RADNOR SHS	Delaware	Block			
SOUTH FAYETTE TWP HS	Allegheny				
STATE COLLEGE AREA	Centre				CPMP
STRONG VINCENT HS	Erie				
TITUSVILLE HIGH SCHOOL	Venango				
TYRONE AREA HS	Blair				
UPPER SAINT CLAIR HS	Allegheny				Cognitive Tutor & UCSMP
WINDBER AREA HS	Somerset	Block	Heterogeneous		

APPENDIX G

2006 PSSA RESULTS FOR "OUTPERFORMING SCHOOL DISTRICTS" AND 2005-06 PER-PUPIL INSTRUCTIONAL SPENDING FOR PARTICIPANTS

County	District Name	School Name	2006 Math Advanced and Proficient	2005-06 Per-Pupil Instructional Spending
BLAIR	ALTOONA AREA SD	ALTOONA AREA HS	55.9	
ARMSTRONG	APOLLO-RIDGE SD	APOLLO-RIDGE HS	52.0	
BLAIR	BELLWOOD-ANTIS SD	BELLWOOD ANTIS HS	48.7	$5,553
CAMBRIA	BLACKLICK VALLEY SD	BLACKLICK VALLEY JSH	52.0	$6,669
BUCKS	CENTRAL BUCKS SD	CENTRAL BUCKS HS-EAST	84.4	$6,137
BUCKS	CENTRAL BUCKS SD	CENTRAL BUCKS HS-SOUTH	76.9	$6,137
BUCKS	CENTRAL BUCKS SD	CENTRAL BUCKS HS-WEST	74.7	
CAMBRIA	CENTRAL CAMBRIA SD	CENTRAL CAMBRIA HS	59.9	$5,851
CAMBRIA	CONEMAUGH VALLEY SD	CONEMAUGH VALLEY JSH	48.7	$5,995
CLEARFIELD	DUBOIS AREA SD	DUBOIS AREA SHS	47.6	$5,402
LAWRENCE	ELLWOOD CITY AREA SD	LINCOLN JSHS	53.5	
ERIE	ERIE CITY SD	CENTRAL HS	50.0	
ERIE	ERIE CITY SD	COLLEGIATE ACAD HS	90.5	$6,404
ERIE	ERIE CITY SD	EAST SHS	35.0	$6,404
ERIE	ERIE CITY SD	STRONG VINCENT HS	50.6	$6,404
ERIE	FAIRVIEW SD	FAIRVIEW HS	73.5	$5,589
CAMBRIA	FERNDALE AREA SD	FERNDALE AREA JSHS	62.3	$5,785
ALLEGHENY	FOX CHAPEL AREA SD	FOX CHAPEL AREA SHS	68.6	$8,247
FAYETTE	FRAZIER SD	FRAZIER HS	69.9	
ARMSTRONG	FREEPORT AREA SD	FREEPORT AREA SHS	61.6	$5,628
ERIE	GENERAL MCLANE SD	GENERAL MCLANE HS	74.3	$5,314
ERIE	GIRARD SD	GIRARD HS	50.0	$5,129
WESTMORELAND	GREENSBURG SALEM SD	GREENSBURG-SALEM HS	75.5	$5,917
MERCER	GROVE CITY AREA SD	GROVE CITY AREA HS	82.0	
ALLEGHENY	HAMPTON TOWNSHIP SD	HAMPTON HS	84.0	$6,472
ERIE	HARBOR CREEK SD	HARBOR CREEK JSHS	54.0	
CLEARFIELD	HARMONY AREA SD	HARMONY AREA HS	39.1	
INDIANA	HOMER-CENTER SD	HOMER-CENTER JSHS	53.9	$$7,342
INDIANA	INDIANA AREA SD	INDIANA AREA SHS	65.7	$7,768
MERCER	JAMESTOWN AREA SD	JAMESTOWN AREA JSHS	43.7	$5,675
MONTGOMERY	JENKINTOWN SD	JENKINTOWN HS	57.5	
MONTGOMERY	LOWER MERION SD	HARRITON SHS	80.9	$10,853
MONTGOMERY	LOWER MERION SD	LOWER MERION HS	76.3	$10,853
MONTGOMERY	LOWER MORELAND TOWNSHIP SD	LOWER MORELAND HS	73.9	
SCHUYLKILL	MAHANOY AREA SD	MAHANOY AREA HS	31.2	
LYCOMING	MONTGOMERY AREA SD	MONTGOMERY SHS	78.2	
ALLEGHENY	MT LEBANON SD	MT LEBANON SHS	86.2	$6,732
BEAVER	NEW BRIGHTON AREA SD	NEW BRIGHTON AREA HS	57.8	$5,376
ALLEGHENY	NORTH ALLEGHENY SD	NORTH ALLEGHENY SHS	82.6	
ERIE	NORTH EAST SD	NORTH EAST HS	55.3	$5,462

County	District Name	School Name	2006 Math Advanced and Proficient	2005-06 Per-Pupil Instructional Spending
CAMBRIA	NORTHERN CAMBRIA SD	NORTHERN CAMBRIA HS	54.2	$6,885
ALLEGHENY	NORTHGATE SD	NORTHGATE JSHS	52.6	$6,828
WASHINGTON	PETERS TOWNSHIP SD	PETERS TWP HS	76.9	$5,047
CAMBRIA	PORTAGE AREA SD	PORTAGE AREA HS	59.1	$6,395
DELAWARE	RADNOR TOWNSHIP SD	RADNOR SHS	81.6	$9,603
ALLEGHENY	RIVERVIEW SD	RIVERVIEW HS	57.5	
SOMERSET	ROCKWOOD AREA SD	ROCKWOOD AREA JSHS	56.9	
LACKAWANNA	SCRANTON SD	SCRANTON HS	54.4	
LACKAWANNA	SCRANTON SD	WEST SCRANTON HS	43.7	
SCHUYLKILL	SHENANDOAH VALLEY SD	SHENANDOAH VALLEY JS	42.9	
ALLEGHENY	SOUTH FAYETTE TOWNSHIP SD	SOUTH FAYETTE TWP HS	74.3	$6,042
CENTRE	STATE COLLEGE AREA SD	STATE COLLEGE AREA H	77.0	$7,153
VENANGO	TITUSVILLE AREA SD	TITUSVILLE HIGH SCHOOL	52.3	$5,742
CHESTER	TREDYFFRIN-EASTTOWN SD	CONESTOGA SHS	84.2	$8,151
BLAIR	TYRONE AREA SD	TYRONE AREA HS	61.6	$5,142
CHESTER	UNIONVILLE-CHADDS FORD SD	UNIONVILLE HS	77.6	
ALLEGHENY	UPPER SAINT CLAIR SD	UPPER SAINT CLAIR HS	89.6	$7,071
WAYNE	WAYNE HIGHLANDS SD	HONESDALE HS	56.3	
LUZERNE	WILKES-BARRE AREA SD	ELMER L MEYERS JSHS	58.4	
LUZERNE	WILKES-BARRE AREA SD	G A R MEMORIAL JSHS	90.4	$6,804
LUZERNE	WILKES-BARRE AREA SD	JAMES M COUGHLIN JSH	60.2	$6,804
SOMERSET	WINDBER AREA SD	WINDBER AREA HS	67.7	$6,104
LUZERNE	WYOMING AREA SD	WYOMING AREA SEC CTR	64.5	

APPENDIX H

QUALITATIVE DATA

BELLWOOD ANTIS HS, Blair

Seniors placed in PSSA Math classes; 11th graders who didn't test proficient on the 4Sight test were taken out of study halls and placed in classes to use Study Island and receive PSSA math prep lessons.

Every 6-7 days, we have a PSSA review day; also, we do several open-ended problems per marking period to be placed into student portfolios.

BLACKLICK VALLEY JSH, Cambria

We do not have assigned courses, but we use PLATO as a remediation tool. In our lower 12th grade courses, we spend time preparing for the PSSA retest, since the majority of that group, will be retaking it.

We give out positive rewards to students who achieved at least one advanced on the PSSA.

CENTRAL BUCKS HS-EAST

Math Lab classes for students who scored below basic, basic, or marginally proficient in 8th grade. Math Lab 12 for students who were not proficient in 11th grade.

We have placed topics on the PSSA earlier in our courses of study to make sure students see them before the test. We try to make sure juniors in below average math classes are scheduled for math the first half of the school year.

CENTRAL BUCKS HS-SOUTH, Bucks

Students are identified from their 8th grade PSSA math score (close to proficient, basic, and below basic). These students are place in a program called Math Lab (10, 11, and/or 12 grades). Small class sizes are usually maintained. They practice working in the five major areas of the PSSA test (Algebra, Geometry, Data Analysis and Probability, Numbers and Operations, and Measurement.) Their work is graded and collected as part of their portfolio. This portfolio becomes part of their graduation evaluation if they do not reach the proficient level by the end of the senior retake PSSA test.

CENTRAL BUCKS HS-SOUTH, Bucks (continued)

All courses use a PSSA Review Packet. The problems in the packet are presented to the classes at the appropriate topic. These are integrated into the course and are identified to the class as a PSSA type question (we do the same for SAT problems).

CENTRAL CAMBRIA HS, Cambria

We have a PSSA Tutor that will go over the sections in which the students needs improvement and continue to still reinforce the material.

We tell the students that they need to take the test seriously due to the fact that they will not graduate unless they pass the PSSA.

COLLEGIATE ACAD HS, Erie

Special after school sessions (usually 6) are required of students performing at below-basic math........Other "optional" sessions are offered for students at a "basic" level.

I should note that only a handful of students perform at a basic/below basic level each year. We are a college prep school and select only the top students for admission into our program.

CONEMAUGH VALLEY JSH, Cambria

Students scoring basic and below basic must take a semester course that reviews all of the anchors tested on the PSSA.

If students score proficient or above they can opt out of a remediation course to do something else.

CONESTOGA SHS, Chester

We place students in a "math seminar" class for 1 marking period per year--2 x per week to review concepts and practice working on specific topics.

EAST SHS, Erie

They must attend tutoring classes in school.

They are assigned a tutoring class.

FAIRVIEW HS, Erie

Students scoring below basic on the 8th grade PSSA are automatically scheduled into Applied Algebra I which includes 20% remediation and those scoring below basic on the 11th grade PSSA are automatically scheduled into Applied Math Topics where 50% of the course is remediation - successful completion is required for high school graduation

FAIRVIEW HS, Erie (continued)

Remediation for two weeks prior to the PSSA exam for all students in Applied level algebra or geometry courses and incorporation of PSSA practice in all math courses in grades 9 - 11. Seniors are allowed to come to school approximately two and one-half hours late on the days the juniors are being tested for PSSA - as a reward for doing well the previous year.

FOX CHAPEL AREA SHS, Allegheny

This year, we have administered 4-site testing. Based on performances, we have pulled juniors identified as struggling thru the data from these tests to participate in tutoring sessions prior to the PSSA test.

FREEPORT AREA SHS, Armstrong

Weekly practice throughout the school year on targeted PSSA items.

G A R MEMORIAL JSHS, Luzerne

For 11th grade students, in their senior year they go to remediation twice a week for each subject that they failed and have to retake the test.

Students that have a D or below in their math class are required to go to remediation.

GIRARD HS, Erie

Students who do not meet the proficient guidelines on their 11th grade PSSA are placed in a special 12th grade PSAA course if their schedule allows. Others receive tutoring after school.

GIRARD HS, Erie (continued)

All students must complete Academic Algebra I, Algebra II, and geometry prior to taking their 11th grade PSSA test. In order for this to happen, policies needed to change at the middle school level. The change at our high school began at our middle school. In order for students to be proficient on their 11th grade PSSA, they need to complete Algebra I, Algebra II and Geometry at the high school level. The only way to do this was to allow all students to enter high school with the skills needed to pass these courses. Now, in our school District all 5th, 6th, 7th and 8th grade students take 84 minutes of math daily for 180 days each year. All students are included in the regular classroom (no pull out math for special education students.) We hold high expectations for all learners. Additionally, all middle school curriculums complete the math textbook every year. All students in 8th grade take algebra or pre-algebra.

GREENSBURG-SALEM HS, Westmoreland

Grade eight students who do not test proficient are scheduled for a support math class in lieu of an elective in Grade 9. This call uses cognitive tutor materials to supplement UCSMP materials. This process continues as needed in Grades 10 & 11. Also some required after-school and Saturday session for Grade 12 students who do not test proficient on Grade 11 test.

Test levels - below basic, basic, proficient, advanced printed on transcripts. Pre-test optional after school review/prep sessions for juniors.

HAMPTON HS, Allegheny

Students who do not earn proficient or advanced on the PSSA test in 11th grade are scheduled for a "focused study hall" until they take the test again in their 12th grade year. We have 2 teachers who are certified teachers, but who are only paid at that substitute rate teaching these students. (There are not that many, and it is only for a limited time period.)

Once the seniors have taken the test again in their senior year, the teachers who were helping them at least 1 day per week during a "focused study hall" then offer similar help to 9th, 10th, and 11th grade students who are considered to be at risk of struggling with the PSSA test when they are juniors. (Participation in this is voluntary and only if time is available within their schedule. No help is offered other than during their study hall time period.)

Other than that, we do very little to prepare specifically for the testing. Our math department believes very strongly that if we do a good job at teaching math, the students will naturally be successful at the minimal requirements on the PSSA test.

HARRITON SHS, Montgomery

We have used Study Island which is a web based program where students can work on specific skills and be monitored closely by their teachers. The teachers can then gear additional instruction around areas of weakness. We also have a Help Center in place in the school where teachers are assigned to help all students who sign out from their study halls or go to, during their free periods. Some of the students who have scored Basic or Below Basic on the PSSA have been recommended to the Help Center.

HOMER-CENTER JSHS, Indiana

We have done a few different things. We had remediation during our morning homeroom a few years. (This is a half hour period because all of our students are given a free breakfast and it takes this amount of time to get everyone fed.) We have had semester remediation classes. We have tried to be very pro-active in the last few years and make sure we prepare our students in their regular math classes for the test.

I sort of answered that in 5. In addition to the free breakfast, we have done a lot to make the students feel positive about the test and feel very prepared for the test. We even in-serviced all of our teachers on math concepts on the test that they didn't know (like box-plots), so that they would feel comfortable in study hall or tutoring if a student was working on a math worksheet in one of those areas.

INDIANA AREA SHS

Students who do not perform adequately on PSSA in grade 11 are required to take the next "appropriate course" as seniors, even though we do not generally require a 4th year of high school math to graduate.

JAMES M COUGHLIN JSH, Luzerne

For 11th grade students, they meet two class periods a week reviewing from a sheet containing problems that represent each of the anchors used on the PSSA test.

Detention and/or suspension for not showing up for remediation classes, prevention from attending all graduation activities

JAMESTOWN AREA JSHS, Mercer

Some students need to take 9th grade Reading if basic or below in Reading or Writing. Soon, we may implement a course for those that need remediation in Mathematics as well.

JAMESTOWN AREA JSHS, Mercer (continued)

We have implemented Study Island into our coursework. I wouldn't say we use any sort or punishments or reinforcements.

LOWER MERION HS, Montgomery

Teachers of 11th graders are encouraged to provide some type of PSSA practice in their classes (examples - warm up, computer programs)

MT LEBANON SHS, Allegheny

We have a dedicated "Math Lab" teacher work with our most mathematically at-risk students in their junior year. These students have the ability to opt-out before they begin, but once they are scheduled, it is an assigned study hall. Aside from targeting PSSA test-taking practices, the math lab teacher focuses on skill development for these students. Predominantly, she utilizes Study Island to help individualize the instruction. We will look to expand this teacher's role to include underclassmen in future years.

NEW BRIGHTON AREA HS, Beaver

Those who fall below Proficient in 8th grade are placed in a Math Strategies class as well as their grade level course (Alg, Geo, etc.). In 9th and 10th grade, the Strategies class uses Carnegie Learning "Bridge to Algebra" text and software for remediation. In grade 11, we use Apangea Smarthelp tutoring program, as well as, PSSA prep materials. Those who score below Proficient in 11th grade are pulled in the first 6 weeks of school for an intensive review of Eligible Content skills.

We have a positive reward that we call Open Lunch for seniors. Our students who score Proficient or above on one of the Grade 11 PSSA assessments (Writing, Reading, or Math) get to leave campus during their lunch period one day per week. Two scores of Proficient or above allow students to leave 2 days per week. Students with all 3 may leave every day during their lunch period. This reward has been very successful in driving students to succeed. We also recognize PSSA achievement in an all school assembly at the end of the year. Students who still do not test Proficient or above on the Grade 12 re-test must take an alternative test such as the Terra Nova.

NORTHERN CAMBRIA HS, Cambria

We have 3 PSSA classes for juniors only to help them get ready for the test. The students were selected based on their 8th grade PSSA scores and a 10th grade district assessment.

Our math teachers are aware of the math standards and try to compliment our lessons with sample problems from a variety of resources geared toward the PSSA. Some of the extra materials are "Buckle Down", "Aim Higher", etc. We also use a program entitled, Plato at the high school and Study Island at the middle school.

NORTHGATE JSHS, Allegheny

We call it Math Lab and it consists of reinforcement of PSSA topics. We are just starting this and it will be in full swing next school year.

Just a comment on the above info...Students taking the Cognitive Tutor courses have not, for the most part, been successful at passing the PSSA test. Our lower level students are enrolled in Cognitive. I'm not sure why we keep this course around because the students are not passing the PSSA. Research shows that the students who take Cognitive should be passing the PSSA, but it isn't working here. The students who take Cognitive are very unmotivated. We keep hoping each year that more of these students will pass, but they don't. We aren't sure why it isn't working. The students who are passing the PSSA test are, for the most part, taking Integrated Math. These are our average and advanced students. We are using McDougal Littell. We do not use any positive or negative punishment or reinforcement. We have very dedicated teachers who work very hard. Most of our average and advanced students want to do well on the test. If

we could figure out a way to get the cognitive kids to pass, we would be elated and life would be good!

PETERS TWP HS, Washington

They are placed in a test prep class. Also, we offer Academic Literacy and Reading Workshop.

Sustained Silent Reading period once a week, an Algebra II course just for juniors, all departments created a writing initiative

PORTAGE AREA HS, Cambria

Mandatory PSSA remediation grade 12 class meets 5days/week

We also have 8th grade remediation two or three days /week in grade 9

RADNOR SHS, Delaware

Courses designed for lower level students. We now have four levels of math curriculum.

STATE COLLEGE AREA HS, Centre

We do our best to have good courses so we don't need to worry about PSSA add-ons. Our lower-level course will do roughly one week of PSSA review prior to the test.

SOUTH FAYETTE TWP HS, Allegheny

We require tutoring of the 12th graders that did not meet proficiency requirements. The tutoring is to build a portfolio to show proficiency.

We hold a very high standard within our current curriculum. We strongly recommend that students without at least a 75% repeat the course so that they have strong fundamentals. We have developed a strong curriculum and the teachers within the department collaborate very well.

STRONG VINCENT HS, Erie

Extended math class (1 1/2 Periods long)

Extra help before and after school, providing students with a PSSA review class. Pull students from gym, home economics, etc. part of year.

TITUSVILLE HIGH SCHOOL, Venango

After school remediation

TYRONE AREA HS, Blair

We base a course for juniors on scores from TerraNova-10. Those "Basic" students are identified and assigned remediation class.

Emphasis on open-ended items in all math classes; inclusion of MC type tests throughout the school year in all math classes.

UPPER SAINT CLAIR HS, Allegheny

Student is assigned PSSA remediation in the resource center. Next year we are planning to start a required 9th grade class for students scoring basic or below.

PS we use Cognitive tutor for lower level classes and UCSMP for other classes.

WINDBER AREA HS, Somerset

11th graders take a 9-weeks remediation class their senior year (instead of getting out 1 period early) if they are not proficient.

1. Review practices of the math teachers in each class that involves juniors -

2. Written PSSA-type questions required on ALL math tests to get students used to the written format.

3. Alignment of the curriculum (and re-aligning when changes occur)

APPENDIX I

USDE EXEMPLARY AND PROMISING INDICATORS

Exemplary Programs, in addition to satisfying Criteria 1 – 7, must provide *convincing* evidence of effectiveness in *multiple sites with multiple populations* regarding *two or more* of the indicators below. The items must include either both indicators from Part I or one indicator from Part I and one indicator from Part II. Providing evidence of two indicators from Part II is not sufficient.

Part I

Indicator a. The program has evidence of gains in student understanding of mathematics.

Indicator b. The program has evidence of gains in inquiry, reasoning, and problem solving skills.

Part II

Indicator c. The program has evidence of improvements in course enrollments, graduation rates, and post-secondary school attendance.

Indicator d. The program has evidence of improvements in attitudes toward learning.

Indicator e. The program has evidence of narrowing the gap in achievement or accomplishment between disaggregated groups.

Indicator f. The program has other evidence of effectiveness or success.

Promising Programs, in addition to satisfying Criteria 1 – 7, must provide *preliminary* evidence of effectiveness in one or more sites for at least one of the indicators below.

Indicator a. The program has evidence of gains in student understanding of mathematics.

Indicator b. The program has evidence of gains in inquiry, reasoning, and problem solving skills.

Indicator c. The program has evidence of improvements in course enrollments, graduation rates, and post-secondary school attendance.

Indicator d. The program has evidence of improvements in attitudes toward learning.

Indicator e. The program has evidence of narrowing the gap in achievement or accomplishment between disaggregated groups.

Indicator f. The program has other evidence of effectiveness or success.

APPENDIX J

TEMPLE UNIVERSITY®

Office for Human Subjects Protections
Institutional Review Board
Medical Intervention Committees A1 & A2
Social and Behavioral Committee B

3400 North Broad Street
Philadelphia, Pennsylvania 19140
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MEMORANDUM

To: **HARLEY, WILLIAM M**
CUR,INSTR, & TECH (1902)

From: Richard C. Throm
Director, Office for Human Subjects Protection
Institutional Review Board Coordinator

Date: 5/10/2006

Re: Exempt Request Status for IRB Protocol:
10189: A Study of the Relationship Between and Among Scheduling, Grouping, Grading, Curriculum and Mathematics Achievement in PA Public Schools

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The Temple University Institutional Review Board (IRB) acknowledges receipt of your memorandum regarding the above referenced protocol. Upon review of the information provided for review, it has been determined via Expedited Review that this qualifies for Exemption Status as it is examining existing data.

45 CFR 46 Protection of Human Subjects

Section 101 (b): Unless other wise required by Department of Agency heads research, activities in which the only involvement of human subjects will be one or more in of the following categories are exempt from this policy.

Subsection (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the Investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subject.

Nothing further is required from you at this time; however, if anything in your research design should change, you must notify the Institutional Review Board immediately.

If you should have any questions, please feel free to contact me at 215-707-8757.

Thank you for keeping the IRB informed of your clinical research.