RETAKING A HIGH STAKES MATHEMATICS TEST: EXAMINATION OF SCHOOL INTERVENTIONS AND ENVIRONMENTS

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ABSTRACT

Many states allow those high school students who have failed a high stakes tests to retake the exam. At stake can be the student's eligibility to receive a diploma and the accountability status of the school. This study examined how high schools supported students who retook the mathematics portion of a high stakes exam. Ten schools that had relatively high success were compared to ten schools with relatively low success. The two groups of schools employed a similar array of intervention strategies, and no general differences were discerned among approaches such as schedule changes, choice of mathematics program, or tutoring. A strong difference was detected between the two groups in how they decided on their intervention strategy and the degree to which authority was shared. Other differences included the number of data sources used for decision making and the support of external resources.

No Child Left Behind (NCLB) legislation has generated numerous effects, not the least of which has been the establishment of accountability assessments nationwide. The substance of these high stakes tests vary based on states' content standards, and the stakes themselves can vary. In most states, school accountability is based largely on the federal designation of Adequate Yearly Progress (AYP). Other states (e.g., Arizona, Colorado, and Texas) manage dual accountability systems with AYP operating alongside the state's own accountability program (Galehouse, 2003). In either case, if schools continually fail to meet the requirements of their state's

accountability guidelines, a school can be subject to abrupt intervention from the state's department of education. This intervention might take on a relatively mild form such as requiring a school to submit an improvement plan or might be quite drastic, such as replacement of school administrators or removing the responsibility of the school's governance from the district school board.

At the high school level, many states have also established high stakes for students. In several states (e.g., Arizona, California, Massachusetts) high school students who are unable to pass their state's accountability tests in multiple subjects are not awarded high school diplomas. Because NCLB requires that assessments in mathematics and reading or language arts were to be established in grades 3-8 by the 2005-06 academic year, to date most high stakes tests remain devoted to these content areas. Arguably, the pressure to pass these assessments is greatest in high schools where faculty members are apprehensive about the possibility of state intervention and students are very concerned about their own promotion. No matter what one's position is on the value of high-stakes accountability, these tests have become a rallying point for students, teachers, and administrators.

Despite images of state and federal institutions eager to intervene in school affairs or to deny high school students their diplomas, state accountability programs often offer generous accommodations for both schools and students. When schools fail to meet acceptable achievement, state and federal authorities do not immediately steamroll in. Schools are generally provided a long-term opportunity (typically two years) to develop and satisfactorily implement an improvement plan. Similarly, when high school students fail to attain a passing score on a high stakes test (i.e., one where their high school diploma is in jeopardy), they are normally provided successive opportunities to pass.

How high schools respond to help students prepare for these retake tests has not been well documented. Furthermore, effective approaches to helping students meet standards under these conditions is also not clear. The focus of this study was to examine the differences between groups of schools demonstrating relatively high and low retake performance in mathematics. By examining schools with relatively high and low gains on the mathematics retest, the hope was to detect and report differences between intervention methods. This information can then be used to guide schools concerned with mounting a mathematics intervention for low-performing students.

BACKGROUND

Before attempting to discover differences between low and high performing schools, it is first crucial to determine where to look for these differences. Broadly, school-based causes for improvement in mathematics are found at the school-level or the program-level. The distinction here is that school-level intervention refers to those activities which require complete support of administrators and typically also the support of teachers from other disciplines. Altering academic schedules or reducing class sizes are examples of school-level interventions. Program-level interventions are changes that are specific to the mathematics program. Adopting new curriculum and shifting toward student-centered pedagogy are examples of program-level interventions.

A body of school-level research outlines the elements of successful schools (Doubleteen, Levin & Oosterbeek, 2002; Marzano, 1998; Marzano, 2003; Miller, 2003; Northwest Regional Education Laboratory (NWREL), 1995; Waters, Marzano & McNulty, 2003). Likewise researchers have conducted program-level research to delineate the key factors of successful mathematics programs (Masini & Taylor, 2000; National Research Council, 2005; Romberg, 2002; Tanner, Jones & Treadaway, 1999). Unfortunately though, school-level research and program-level research are all too often unconnected entities. For example, school-level researchers may highlight the importance of after-school tutoring without describing whether mathematics students learn better through guided inquiry or direct instruction. Similarly, program-level researchers may well investigate the effectiveness of introducing pre-algebra concepts to middle grade students without considering the effect of the school's leadership on student outcomes.

The question of how to best prepare students for mathematics retake tests is driven from two fields of study, 1) school effectiveness, and 2) effective mathematics programs. Intuitively, school-level success and program-level success are dependent upon one another, but the degree to which this dependency exists is not clear. Are schools that do well on retakes achieving this high level of performance because they have reformed school policies and have changed the structure of the school, or are the successes rooted in the classroom where instruction is being delivered differently?

SCHOOL LEVEL

Although some publications (e.g., Cole-Henderson, 2000; United Stated Department of Education, 2004) state that particular characteristics are

common among schools performing above expectation, there is little concrete guidance to help schools decide how best to attain those characteristics. Brighouse (2003) was critical of what he termed the "soft evidence" (p. 230) used by policymakers to effect school reform. Brighouse points out that replicating success, especially among disadvantaged schools is not straightforward. Additionally, it is notable that the research literature found on school effectiveness does not typically make clinical comparisons to other schools. That is to say, the reports are largely descriptions of schools that have surfaced to the top of the data heap (Cole-Henderson, 2000; Miller, 2000; United States Department of Education, 2004). After identifying schools that achieve above expectations, the schools may, for example, be described as having strong leadership; however, there is a failing to investigate if schools with poor student performance might have leaders with similar qualities.

PROGRAM LEVEL

At the program-level, much of what research has demonstrated to be effective in learning mathematics was brought to light in the seminal publications of the National Research Council (1999 and 2005). Effective mathematics programs seem to involve students by engaging prior understandings, building a deep foundation of factual and organized knowledge, and stimulating metacognitive strategies. The report Adding It Up (National Research Council, 2001) used these broad strategies to identify five intertwining strands that constitute mathematical proficiency: 1) conceptual understanding, 2) procedural fluency, 3) strategic competence, 4) adaptive reasoning, and 5) productive disposition. Unfortunately, it is no small task to actually detect these strategies occurring in classrooms, let alone school-wide. The work of Carpenter et al. (2004) also contributes to a program-level focus on mathematics. Their research identified cognitive elements necessary for meaningful learning to occur such as applying knowledge and explaining generalizations.

SETTING

According to Arizona guidelines, students are provided opportunities to retake any portion of the Arizona Instrument to Measure Standards (AIMS) they have failed. The opportunities to retake the exam occur twice during their junior year and twice during their senior year. Thereafter, an individual may apply beyond their high school years to retake any portion of AIMS that they have not passed. The senior class of 2006 (i.e., sophomore class of 2004) was the first class subject to Arizona's AIMS graduation

requirement. During April 2004 more than 60,000 Arizona high school sophomores completed the AIMS. Of these students, approximately 60 percent failed to meet standard in mathematics.

The following academic year, students had their first opportunity to retake AIMS. 33,172 students retook the mathematics portion of AIMS as juniors in October 2004 at the same school where they had failed it the prior academic year. Schools were pressed to quickly adopt and implement interventions due to the concern across the state for this first group of students (i.e., the class of 2006) in jeopardy of not earning their diplomas. The unpredicted large number of students failing to meet standard, particularly in mathematics resulted in resources and manpower being reshuffled in many districts to support students as the 2004-2005 academic year began.

In October 2004 Arizona high school juniors, who had failed to meet standard on the mathematics portion of AIMS as sophomores, retook this test. Among the students who had failed the mathematics section the previous year 33,172 were re-taking the test at the same school. For this study, only these students who were retaking the mathematics test at the same school where they had failed it the previous year were considered. Across the state 18.6 percent of these students moved to a Meets or Exceeds Standard level on this first retake attempt.

The mathematics AIMS retake data revealed a great range of success among high schools. Considering only schools that had at least 30 students retake the mathematics portion of AIMS, the percent of students successfully meeting standard on their second attempt ranged from a low of 0% to a high of 54%. Not surprisingly, the schools with greater proportions of students achieving standard on the retake were those schools where the mean score among the failed sophomores from the previous year was close to standard. In other words, schools with many students within a few points of meeting standard in April 2004 moved the greatest number of students into the Meets Standard category in October 2004.

METHOD

SCHOOL SELECTION

During October 2004, 221 Arizona high schools had at least 30 students retake the mathematics portion of AIMS, at the same school where they had failed during their initial attempt the previous spring. As mentioned, those schools with higher mean scores on the initial April exam saw a greater percentage of students meet standard on their second attempt. As a reasonable achievement indicator, students' mean raw score percentage

gains were analyzed. Individual differences between students' initial attempt (April) and second attempt (October) test scores were calculated, and school means were determined. Average changes in raw scores for the schools ranged from -10.3% to 23.8%.

These schools were rank ordered based on mean percent increase. Because the research interest was to learn if there were discernible differences between schools where students made the greatest gain and schools where students made the least gain, it was determined to survey only the top twelve and lowest twelve schools in this analysis. Further, it was decided to only survey regular facility schools. This eliminated those schools with exceptional enrollment policies such as correctional facilities, charter schools targeting failing students and magnet schools. Charter schools with open enrollment policies were still considered. This filter led to four of the top 16 schools and 35 of the lowest 47 schools being eliminated for survey purposes. Clearly a disproportionate amount of non-regular facility schools populated the lower end of achievers and this may warrant further investigation. Therefore, the top twelve regular facility high schools (referred to hereafter as the top schools) were chosen for comparison to the lowest twelve achieving regular facility high schools (referred to hereafter as the comparison schools). Table 1 summarizes the achievement information for these 24 schools. In this table, the top schools are numbered 1 through 12 and the comparison schools are numbered 13 through 24.

SURVEY

A 12-item survey (Appendix) composed largely of open-ended questions was developed to reveal the interventions that these top schools and comparison schools used to help students prepare for the AIMS mathematics retake. The questions were crafted to allow respondents to describe program-level or school-level or both types of interventions.

School principals were sent an email by the Arizona Department of Education (ADE) regarding the survey. This email requested principals and other school personnel to complete the survey online. This request did not indicate the relative gains that the school had made on the retake assessment. Because the ADE had never reported any type of retake calculation for schools, there were no data available for school personnel to use to calculate if their retake proficiency was comparatively high or low. The request from ADE simply stated that the school had been selected to participate in a study of various mathematics intervention strategies. One to two follow-up phone calls were made to each school that did not

Table 1. Top Schools and Comparison Schools, Mathematics Achievement

School	Amt. of retakers	April 2004		October 2004		Raw score % increase
		Mean scale	Mean raw	Mean scale	Mean raw	
1	35	467.74	28.66	485.74	35.49	23.8%
2	78	471.06	29.90	487.18	36.08	20.7%
3	146	476.92	32.30	494.99	38.79	20.1%
4	123	484.49	35.31	504.39	42.16	19.4%
5	166	478.72	32.99	496.41	39.40	19.4%
6	52	472.81	30.56	488.62	36.33	18.9%
7	72	477.22	32.35	493.01	38.31	18.4%
8	153	480.94	33.87	498.29	40.08	18.3%
9	32	478.50	32.91	494.31	38.91	18.2%
10*	208	476.09	31.96	491.96	37.78	18.2%
11*	393	470.34	29.65	484.51	35.04	18.2%
12	160	476.52	32.08	491.73	37.83	17.9%
Mean, top schools	134.8	475.95	31.88	492.60	38.01	19.3%
13	241	474.41	31.27	479.39	33.05	5.7%
14*	51	468.63	28.84	472.73	30.47	5.6%
15	64	466.84	28.13	470.92	29.66	5.4%
16	241	478.12	32.77	483.02	34.51	5.3%
17	38	467.84	28.74	469.92	29.42	2.4%
18	90	475.08	31.47	476.62	32.06	1.9%
19*	33	469.19	29.17	470.49	29.70	1.8%
20	84	470.67	29.79	471.70	30.12	1.1%
21	62	476.10	31.95	476.34	32.00	0.2%
22	58	464.52	27.19	463.60	26.97	-0.8%
23	121	475.60	31.79	474.93	31.43	-1.1%
24	81	469.31	29.32	468.12	28.74	-2.0%
Mean, comparison schools	97.0	471.36	30.04	473.15	30.68	2.1%

*School did not respond to survey request

initially respond, and they were requested to complete the online survey. It is important to note that the request to principals did not ask that only the principals complete the survey. Rather, the request was for "all those involved in your school's mathematics intervention to complete the survey" The body of the survey was designed to resolve three specific questions related to these schools' mathematics intervention:

1. What, if any, was your intervention(s)? (description)
2. Why was the intervention(s) chosen? (justification)
3. How was this decision made? (decision power)

Following a three week window, 10 of the 12 top schools had completed the survey and likewise 10 of the 12 comparison schools had completed the survey.

RESULTS

The qualitative survey responses were collected and analyzed for comparison. Responses for most questions were categorized based on prevalent responses. For example, question number 4 asked for the basis on which an intervention strategy was selected. For this question, respondents provided answers that included personal experiences, research, beliefs, and availability of resources. These then became the categories of consideration for this item.

Because the directions requested as many people as possible who had been involved with the intervention to complete the survey, the number responding per school varied. This presented an evaluation dilemma. At some schools, as many as seven people responded to the survey, but at several schools only the principal responded. Although the response rate varied, because the request was clear and it was felt that the response rate itself might be indicative of school culture, all responses from any particular school were considered the "voice" of the school. Additionally, it was found that multiple respondents from the same school had fairly consistent answers and were judged to be providing a coherent account.

SIMILARITIES

Although the two school groups examined had disparate student results, many of the responses between the groups were surprisingly similar. The first similarity was that neither the top schools nor the comparison schools

developed their intervention decisions from any one type of leadership group. Within both groups, respondents cited a variety of sources for the decisions. The decision-making groups most commonly included mathematics teachers only and mathematics teachers plus school administrators. Other variations of decision makers included district personnel and whole school staffs.

Regarding why a school chose a specific strategy (i.e., their evidence of effectiveness), the top schools were comparison schools and equally mixed. Both groups mentioned availability of resources, personal experiences, personal beliefs, and hearsay about the intervention's effectiveness. Only one of the top schools stated that the decision was at least partly based on research evidence.

Another similarity was the frequent response that tutoring before- and after-school was widely available to students who had failed the AIMS test. Respondents from both sets of schools indicated that teachers were available before and after school specifically to assist students in preparation for the retake. Furthermore, just as the availability of tutoring was common in both groups, so was avoidance of these tutoring opportunities. Both sets of schools reported dismal attendance at these non-mandatory tutoring opportunities.

The top schools and comparison schools also implemented similar schedule changes to assist their eleventh-grade students who would be retaking the AIMS mathematics test. The schedule changes ranged from none at all to small changes (e.g., occasionally pulling students out of regular class for tutorial programs) to large changes (e.g., altering students' regular classroom schedule and enrolling them in specific courses). Table 2 indicates magnitude and quantity of schedule changes made by the two sets of school.

Interestingly, there was no distinguishable pattern setting the comparison schools apart from the top schools when examining the types of interventions implemented. Schools in both sets indicated that they used the exact same commercial programs (e.g., Buckle Down). Many of the

Table 2. Schedule Change Magnitude and Quantity

	No changes	Small changes	Big changes	Not reported
Top schools	3	2	4	1
Comparison schools	2	3	3	2

strategies used by both sets of schools appear to have been equivalent. These strategies included pullout programs, dedicated time in math class specifically for AIMS review, tutoring, and courses focused primarily on AIMS review. Other similarities between the two groups were that both groups reported testing students on AIMS objectives with periodic tests and quizzes throughout the academic year and both groups generally reported similar ways to recognize student achievement (e.g., newsletter, pizza parties, student assembly).

DIFFERENCES

DECISIONS ARISING FROM PROCESS. How schools arrived at their intervention decisions provided one of the starkest contrasts between the groups. Responses were coded as either process-based decisions or delivered decisions. Responses coded as process-based indicated that the decision developed from progressive stages that typically included several stakeholders. Responses coded as delivered decisions indicated that the decision was provided directly by one source such as the district office, the math chair or a committee. Among the top schools, nine out of the ten reported that their intervention decision was process-based. In contrast, only three of the comparison schools provided process-based responses. These excerpts from the top schools reflect the inclusion of several faculty members in the process and the importance of the process itself when deliberating on the intervention decision.

> " . . . there was a dept. conference after senior members reviewed the results. We decided that geometry students were too removed from Algebra, so we implemented Algebra refresher [programs] . . . "

> "The Campus Improvement Team met and analyzed data with dept. reps. The plan was presented by the CIT and dept. members to the teachers for acceptance, collaboration, implementation . . ."

> ". . . Strategy sessions with the principal and the math department analyzing scores and trying to discern what we were missing. Two weaknesses were identified. . . . "

As a group, the comparison schools were distinctively different in how they selected their intervention. Among these schools, seven of the ten referred only to the decision emanating from a committee or an administrator or that the decision emerged from general intuition.

Regarding how the comparison schools arrived at their intervention decision, these excerpts highlight a lack of a systematic approach or at least a lack of an awareness of any such approach. The remarks below are complete responses to the process question and are not truncated excerpts.

"An AIMS steering committee was established early last year."

"Committee of math and non-math teachers."

"We feel students that have geometry and above have a better chance of passing the test."

"Panel of teachers."

QUANTITY OF DATA SOURCES. There was a marked difference between the two groups in the number of data sources they used to determine their intervention strategy. While all schools reported using the AIMS results, other data sources such as attendance records, district test results, and national normalized scores were also reported. The quantity of student sources used to arrive at decisions was tallied and compared for the two groups. On average, the top schools used 3.4 data sources, but the comparison schools used only 1.6 data sources.

TIME DEDICATED TO TARGETED TRAINING. Though all of the schools reported having regularly scheduled teacher meetings to discuss student concerns, there was a difference in the specificity of these meetings between the two groups. The comparison group more commonly reported that these meetings were general and provided time for teachers and administrators to discuss issues and for information to be relayed. Six of the top schools indicated that they spent time engaged with a training that was dedicated to a specific intervention strategy. Only one of the comparison schools made a similar claim.

ADVOCACY OF EXTERNAL RESOURCES. On a final question, respondents were asked "What else, specific to other supportive elements that helped with math intervention is important for us to know?" Eight out of ten of the schools in the top group mentioned positive support or resources coming from a source external to the math teachers. These external supports included the district office, state funds, community education funds, feeder schools, and the principal. Only two of the comparison schools made such statements. The economic statuses of the school

communities were not examined, and it possible that some of these external resources that are attributable to the community are correlated to economic capacity. This item did not provide enough information to discern whether the school was provided these resources without request or if the school had investigated possible resources and made specific application for the assistance.

NUMBER OF RESPONDENTS. Although all schools received identical requests to complete the survey, and each school received the same number of follow-up phone calls, there was a conspicuous difference in the number of respondents to the survey. Again, the survey request did not indicate whether the school was determined to be a relatively low or high performing school. For both the top and comparison groups 12 schools were solicited to complete the survey and in each group 10 actually did. However, the rate of response within each school for the two groups was quite different. While the top schools averaged 4.4 respondents per school, the comparison schools averaged only 1.6. All of the top schools had multiple respondents completing the survey, but in five of the ten comparison schools only the principal responded. This was parallel to the number of departments the respondents represented (e.g., mathematics, administration, counseling, other content area). The top schools drew responses on average from 2.2 departments, but the comparison schools only had 1.4 departments represented on average in the survey.

CONCLUSION

By relying on self-reported accounts, I was unable to detect fine differences between program implementations or student engagement levels in the classrooms. The lens here was broad and sought to spot apparent differences between those schools where students had relatively high retake success and those schools where they did not. The research design was an exploratory study and did not allow detailed analysis of classroom materials or in-depth observations. Nevertheless, the results do provide evidence of distinguishable differences between the two groups of schools. As outlined, the intent was to detect if any dissimilarities in program or school level actions. The results provide evidence that the differences between these two groups are at the school level, and, more specifically, that the differences reside within the culture of decision making and shared responsibility.

Both school groups reported a similar mixed bag of interventions and schedule accommodations. Other similarities such as assessing students

throughout the year and formally recognizing student achievement were also found. Where these schools differed was not in the interventions chosen but rather in how the interventions were chosen, in dedication to the intervention, and in a seeming shared ownership among faculty. Differences noted between the two groups; decision-making process and the quantity of data sources used, both provide evidence that decision-making was more a shared event within the top schools. The distinguishing characteristic that decisions stemmed from a progression of steps is further supported by the evidence that the top schools were accessing a greater number of data sources when determining their intervention strategy. Successive decisional steps likely necessitate more extensive data needs.

Although the schools from each of the groups selected nearly identical strategies, it would seem that the practice of involving staff in a process of decisions leading logically to the selection of an intervention is itself valuable. Not only would this most likely lead to choosing a suitable strategy, but it would also yield a shared understanding as to why that a particular strategy was chosen over alternatives. By engaging in this type of shared decision making, the top schools appear to have staffs who are generally more involved in the mathematics intervention. This seems evidenced by the higher response rate among the top schools. Not only did the top schools provide a greater number of responses, but responses from top schools were more likely to include not just the principal or a small number of math teachers, but also teachers from other content areas and even counselors. It would seem that the top schools have more people on board. This may be the crux to this difference. If administrators and faculty throughout the school understand and endorse a particular intervention, then it is not difficult to imagine that getting students on board would be a simpler task.

The results of this study also support the idea that the top schools dedicated greater resources to their intervention. The dedication of human resource by the top schools is evidenced by the time designated for teachers to learn about a specific intervention. If the child does not specifically receive instruction on how to play a new musical instrument, then after the initial zeal wears off, that instrument is often subject to mistreatment or neglect. Specific lessons can actually lead to greater confidence and motivate one to continue playing. This analogy may hold true with faculties adopting interventions. Without explicit guidance and time to reflect on how best to integrate the new adoption, the new intervention may be put aside, after a few sour notes.

Additionally, top schools reported a far greater number of external resources (e.g., district personnel) that they considered important to the implementation of their intervention. This produces an interesting research question: Were these schools fortunate enough to have these resources simply provided, or were these schools, which have an apparent culture of active participation, more likely to reach out to these resources and make better use of them?

The limits of this study did not allow for complete comparisons among staffs and school environments. For example, experience levels and education levels may be a contributing factor to these differences. At best these, however, would be contributing factors to the results detected. This study was designed to detect differences between high schools where students did relatively well and relatively poorly on a statewide math retake assessment. Encouragingly, the results do provide evidence that there are distinguishable differences. What remains challenging is that the differences were not tangibles easily transferable from one institution to another. The differences were of the type most often identified with the ethos of a school. These differences were beyond a stated school philosophy, they represent a spirit of shared responsibility among the administrators and faculty. These two groups of schools actually seemed similar in their eclectic selection of intervention programs, schedule changes, and tutoring offerings. If student achievement on a retake test was the desired end result, then the interventions selected were the means. Here it would seem that it's not the means to the end that distinguished accomplishment. Rather it's the shared involvement, allocation of ownership, and commitments of resources surrounding the means that best predict success.

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APPENDIX: RETAKE SURVEY

1. Please describe the strategies your school implemented to help this year's juniors, who did not "meet standard" on the AIMS math assessment last year as sophomores, prepare for the AIMS retake this year?

2. How did your school decide on the above?

3. Who were involved in deciding this and to what extent?

4. Why were these strategies/processes chosen? (e.g., evidence of effectiveness)

5. What data, if any, were available to help with this process?

6. Are there opportunities for students to receive help (toward achieving standard on the AIMS maretake) beyond regular class instruction (i.e., beyond the class day)? If yes, what are those opportunities and to what extent do students take advantage of these opportunities?

7. What schedule changes, if any, were made for students who would be retaking AIMS?

8. Do teachers receive any training/preparation specific to these intervention(s) strategies? If so, describe the training/preparation.

9. How is students' progress toward meeting standard in math communicated to various groups (e.g., students, parents) and how frequently is this done?

10. How do you recognize (celebrate) student success on the AIMS and the AIMS retake?

11. What else, specific to other supportive elements (e.g., district support, discipline policy) that helped with math intervention is important for us to know?

12. Is there anything else we should know?