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An Innovative Math Program, Agile Mind: Effective?

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Abstract

In the current study, the researchers investigated the effects of an innovative math program, *Agile Mind*, on the Texas Assessment of Knowledge and Skills math test scores for students enrolled in the 9th, 10th, and 11th grades in Texas public schools. Nine school districts utilising the Agile Mind program were included in the study, with a comparable set of six school districts serving as a control group. Over a three-year time period, TAKS math scores improved for both sets of school districts, particularly for 11th grade students. No statistically significant differences, however, were present between the Agile Mind participating school districts and the non-participating school districts on the TAKS math test. Thus, Agile Mind did not appear to be effective in enhancing the math scores of 9th, 10th, and 11th grade students on the TAKS among the participating school districts. However, an important consideration is whether or not enough time was spent utilising the Agile Mind program to make a significant impact. Findings and implications are discussed.

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To graduate from high school, students in the State of Texas are required to pass the Texas Assessment of Knowledge and Skills (TAKS, Texas Education Agency, 2007). In 1994, the Texas Education Association (TEA) named the Dana Center as the subcontractor to coordinate development of the math and science standard for every school child in the state (Griffith, 2002). The standards they helped develop, known as the mathematics and science Texas Essential Knowledge and Skills (TEKS) were adopted by the Texas State Legislature in 1997. Since that time, the Dana Center has developed numerous resources to support teachers in teaching the TEKS. Agile Mind is one such resource.

The Texas Education Agency reported that current Algebra I End of Course (EOC) exam scores are the best predictors on how students will do on the TAKS. Algebra I EOC data for nine public school districts in the Coastal Bend Region of Texas indicated an overall passing rate in 2004 between 34% and 65% (Alliance for the Improvement of Math Skills PreK-16, 2004). Without marked improvement, large percentages of students in the region will not be able to graduate from high school. The stakes associated with TAKS could not be higher—not passing results in not graduating. This issue is a major area of concern for educators in the South Texas region.

All students entering public institutions of higher learning are required to take the Texas Academic Skills Program test (TASP, Texas Higher Education Assessment, 2007) as a measure of students' ability to perform well in college-level classes. Similar to the Algebra EOC exam scores, TASP mathematics scores for local districts indicate gaps in achievement by ethnicity, race, income, and disability. Low TASP scores prevent students from enrolling in college level math and science classes and create a barrier to technical fields of study. Based upon their TASP scores, approximately 60% of all area high school graduates entering Del Mar College (2004) and Texas A&M University-Kingsville (2004) are not ready for college-level mathematics courses. Fourteen percent are considerably below college level, 25% are somewhat below level, and 22% are slightly below level (Texas Higher Education Coordinating Board, n.d.).

The Coastal Bend Region of Texas has unemployment rates well above the state and national averages. The population is predominantly young, poor, and Hispanic, and has a great need for education and skills. Major efforts are under way to change South Texas from an under-served region into an educated and economically stable region. In order to do this, it is necessary to build an infrastructure that creates a skilled and knowledgeable work force (Dana Center, 2004).

To address the math deficiency in South Texas, new techniques and innovations have been implemented in schools. Many of these innovations have attempted to integrate technology with mathematics. Mathematics is a highly technical field that has yet to be integrated thoroughly and properly with technology. The Alliance for the Improvement of Math Skills in the South Texas region is attempting to integrate technology, mathematics, and new teaching methods into local school districts. The Alliance for the Improvement of Mathematics Skills PreK-16 (AIMS) is a grant-funded partnership in South Texas consisting of Del Mar Community College, Texas A&M University-Kingsville (TAMUK), and nine independent school districts. The purpose of the Alliance was to create programs that support efforts of Texas students, especially ethnic minority and rural students, to achieve at the highest academic levels and to pursue advanced degrees in mathematics fields. The Alliance intended to develop the next generation of mathematicians and scientists that will reflect the diversity of the American society.

Traditional school mathematics instruction constitutes a domain of discourse with its own culture and its own brand of mathematics (Richards, 1991). This tradition includes the familiar routine of checking the answers to the previous day's homework, working some of these homework problems on the chalkboard, introducing new material, working some examples to illustrate the application of the new material and assigning seat work (Gregg, 1995). The traditional method of mathematics instruction is not preparing students to pass their high school exit exams, nor higher education entrance exams.

In 1983, *A Nation at Risk* was published (NCEE, 1983). This awakened the general public to the crisis at hand. The National Commission for Excellence in Education (NCEE) reported that "if an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might we have viewed it as an act of war" (NCEE, 1983, p. 5). Mathematics education in the U.S. has been under constant reform since the 1930s, and continues to be an area of controversy (Fey, 1999). The pendulum has swung back and forth between basic skills and innovative techniques, yet a viable balance has not been found. With the implementation of high stakes testing and the No Child Left Behind Act, serious

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issues have surfaced regarding mathematics education (Alliance for the Improvement of Math Skills PreK-16, 2004).

Today, educators are attempting to provide the best mathematical instruction which often includes implementing new strategies. One such innovation is linked to the Alliance for the Improvement of Mathematics Skills PreK-16 (AIMS). The school districts involved in the AIMS grant are Aqua Dulce, Calallen, Four Bluff, Gregory-Portland, Kingsville, Robstown, Sinton, Taft, and Tuloso-Midway. The goal of the AIMS project was to close the gaps in math achievement in the preparation of PreK-12 students for college-level math courses. In this project, the focus was on preparing all students for success by the time they graduated from high school through vertical alignment, professional development, challenging curriculum, use of information technology, and research on strategies and interventions. A five-year time frame was projected in which the goal of AIMS was to have been met (Alliance for the Improvement of Math Skills PreK-16).

The purpose of the study

The purpose of the current study was to investigate the effects of a specialized mathematics program, Agile Mind, on students from nine school districts in South Texas. Student achievement levels were examined when technological activities were coupled with or withheld from traditional instruction. Closing the gaps in math achievement that prepared PreK-12 students for college level math courses was the program's goal. If the innovation was successful, students should be better prepared for college-level math when they graduate from high school.

Research questions

1. Is there a statistically significant difference in math achievement scores on the TAKS between 2003, 2004 and 2005 for campuses that were involved in the innovation?
2. Is there a statistically significant difference in math achievement scores on the TAKS between campuses involved in the innovation and those campuses that were not involved in the innovation?
3. Is there a significant difference in math achievement scores between campuses that spend varying amounts of time on the intervention?
4. Is there a statistically significant difference in the effect of the innovation across grade levels?

Methods and procedures

Participants

These researchers investigated the effects of a locally developed specialised mathematical program on math achievement of high school students in South Texas school districts. The experimental group was composed of nine school districts being served by the AIMS grant housed at Del Mar College in Corpus Christi, Texas. The AIMS grant worked with nine independent school districts: Agua Dulce, Calallen, Flour Bluff, Gregory-Portland, Kingsville, Robstown, Sinton, Taft, and Tuloso-Midway. Participating schools had student populations that were 61% minority and 50% economically disadvantaged, and ranged in size from 5,000 to less than 350 students. Hispanic students comprised 57% of the total student population for all districts. Included in this study were test scores of over 5,500 students in the 9th, 10th and 11th grades for three consecutive years.

The control group consisted of six non-participating school districts in South Texas demographically comparable to the school districts involved in the AIMS grant: Alice, Aransas Pass, Beeville, George West, Ingleside, and Pettus. These districts were similar to the AIMS grant districts in size, economic status, and location. Many districts in the AIMS grant were identified as having the same peers. It was therefore possible to use six uninvolved districts to gain an adequate comparison between those using and not using the innovation. Comparisons were based on the total number of students and taxable value per total refined average daily attendance (RADA) within a specified standard deviation range, using 2000–2001 data. The student population and economic data are commonly used to define peer groups for Texas districts.

Instrumentation and procedures

Data collected included TAKS math scores from Spring 2003, Spring 2004, and Spring 2005 test administrations, as well as time spent using the innovation for each grade level in the experimental group. All TAKS scores were compared at the panel recommendation level. The transition plan for the TAKS test uses the standard error of measurement (SEM) to phase in the panel's recommended standards over time. Passing standards were fully implemented in 2005. "Members of the Class of 2006 will be required to meet the one SEM in order to meet the graduation requirements" (TEA, 2004). Although the State of Texas holds students to different accountability levels depending on grade level, these researchers used the same accountability level to compare scores so that measurements of growth were not skewed. In other words, raw scores were utilised rather than scale scores.

Intervention program

Agile Mind, an education company formed in 2001 to enhance both equity and high achievement in challenging academic courses, was developed in collaboration with the Dana Center (2004) which provides numerous research-based resources to support high achievement for a broad range of students. The Agile Mind program is built on the work of Treisman (Dana Center, 2004), in which he investigated the factors that support minority student high achievement in calculus. Many programs have been developed based on his research, including the Advanced Placement Program Mathematics Vertical Teams Toolkit and Advanced Placement Capacity Assessment Tool (Dana Center, 2004). These programs, along with Agile Mind, have set the standard of excellence for supporting successful advanced placement (AP) programs at high schools around the state of Texas (Agile Mind, n.d.).

Agile Mind was developed through research of high-performing, high-poverty schools and districts, including schools with exemplary high-enrollment AP calculus programs for traditionally under-served students. The innovation incorporates the K-12 mathematics standards for the State of Texas. Information was gathered from over 50 school districts that were improving their instructional programs and strengthening student achievement in mathematics. Teachers also helped to refine the Agile Mind program by providing feedback on the instructional design of the program (Agile Mind, n.d.).

Agile Mind is an online program designed to aid Algebra and Geometry students in meeting the rigorous demands of the TEKS. The Internet-delivered curriculum content is designed to provide students with advanced mathematics courses to continuously improve achievement. It was created to enhance existing curricula. All students have access 24 hours a day to high caliber curricular support, assessment, and test preparation, presented in a way that invites them, keeps them motivated, and ensures their success. Students master the most difficult concepts, prepare for the TAKS test, receive continuous feedback, and have access to teacher and student support (Agile Mind, n.d.).

Agile Mind utilises strategies that help students excel in the examination-driven advanced courses that are crucial for admission to America's leading colleges and universities. It also provides users with seminars, mentoring, and high-quality support material to manage usage. The program contains technologies that enable teachers and students to know very specifically how learning is proceeding, with data aggregated after each usage. The program was developed from evidence-based research, aligned with national and state requirements for professional development and technical assistance delivered by educators recognised nationally for their results in advancing equity and high achievement in mathematics (Agile Mind, n.d.).

Results

The TAKS data in 2003, 2004, and 2005 for all districts were gathered via data request from TEA for grades 9, 10, and 11. Table 1 presents the means and standard deviations of TAKS scores for 9th graders participating in the innovation for all three years. The mean score of 9th graders steadily improved each year, with the amount of improvement being nearly equal from year to year.

Table 1: Descriptive statistics for 9th, 10th, and 11th grade TAKS results for campuses involved in the innovation

Variable	*M*	*SD*
9th Grade Campuses 2003	40.44	14.17
9th Grade Campuses 2004	46.22	13.02
9th Grade Campuses 2005	53.22	17.06
10th Grade Campuses 2003	43.33	18.62
10th Grade Campuses 2004	48.78	17.86
10th Grade Campuses 2005	61.78	10.49
11th Grade Campuses 2003	39.33	5.48
11th Grade Campuses 2004	61.78	5.56
11th Grade Campuses 2005	72.33	4.26

Table 1 also presents the means and standard deviations of TAKS scores for participating 10th graders in all three years. The mean score of 10th graders grew larger each year; however, the improvement was much larger from 2004 to 2005 than it was from 2003 to 2004. Also depicted in Table 1 are the means and standard deviations of TAKS scores for participating 11th graders for the three years of the study. The mean score of 11th graders increased each year of test administration. The increase from the first year to the second year is double the increase from the second year to the third year.

Research question one

Is there a statistically significant difference in math achievement scores on the TAKS between 2003, 2004 and 2005 for campuses that were involved in the innovation?

A one-way within-subjects analysis of variance (ANOVA) was conducted with the factor being the year of test administration and the dependent variable being the TAKS scores. The results for the ANOVA indicated a statistically significant time effect, Wilks' $\Lambda = .346$, $F(2, 25) = 23.61$, $p < .01$, multivariate $\eta^2 = .65$. A statistically significant difference was present in math achievement scores on the TAKS between 2003, 2004, and 2005 for campuses involved in the innovation. Follow-up polynomial contrasts indicated a statistically significant linear effect with means increasing over time, $F(1, 26) = 60.89$, $p < .01$, partial $\eta^2 = .70$. Higher-order polynomial contrasts were statistically nonsignificant. Readers should note that the increase in means between the first two years and the last two years was nearly equal, 11.22 and 9.18 respectively. Accordingly, these results may be interpreted to mean that students' math performance grew at an equal rate each year. Overall, the study districts showed marked improvement in 9^{th}, 10^{th}, and 11^{th} grade TAKS scores between 2003, 2004, and 2005.

As part of the analysis, six independent school districts were identified as peer districts. These districts did not participate in the Agile Mind program or the AIMS grant. Similar to the intervention school districts, 2003, 2004, and 2005 TAKS data were gathered for these comparison school districts in grades 9, 10, and 11. Table 2 presents the means and standard deviations of TAKS scores for non-participating 9th graders for the three study years. Similar to the participating 9th grade campuses, the mean score of 9th graders steadily improved each year. The degree of improvement was consistent from year to year.

Also presented in Table 2 are the means and standard deviations of TAKS scores for non-participating 10th graders in all three years. The mean score of 10th graders grew larger each year, with the amount of improvement being equivalent from year to year. Finally, Table 2 depicts the means and standard deviations of TAKS scores for non-participating 11th graders in all three years. The mean score of 11th graders increased considerably from the first year to the second year and roughly the same from the second year to the third year.

Table 2: Descriptive statistics for 9th, 10th, and 11th grade TAKS results for campuses not involved in the innovation

Variable	*M*	*SD*
9^{th} Grade Campuses 2003	38.71	13.71
9^{th} Grade Campuses 2004	44.71	10.13
9^{th} Grade Campuses 2005	49.86	7.43
10^{th} Grade Campuses 2003	37.86	10.82
10^{th} Grade Campuses 2004	46.00	10.38
10^{th} Grade Campuses 2005	56.43	9.33
11^{th} Grade Campuses 2003	31.14	5.70
11^{th} Grade Campuses 2004	50.86	5.34
11^{th} Grade Campuses 2005	70.86	2.82

Concerning the between-group comparison of change in TAKS scores from 2003 to 2005 for the three grade levels in both participating and non-participating school districts, Table 3 presents these data. Of particular interest is the fact that the non-participating districts exhibited greater improvement in test scores for their 11th grade students. No meaningful differences were present in the 9th grade and 10th grade change scores between the participating and non-participating school districts.

Table 3: Change in TAKS scores from 2003 to 2005 for all grade levels in both non-participating and participating districts

Variable	*Participating*	*Non-Participating*
9th Grade	12.78	11.15
10th Grade	18.45	18.57
11th Grade	33.00	39.72

Research question two

Is there a statistically significant difference in math achievement scores on the TAKS between campuses involved in the innovation and similar schools that were not involved in the innovation?

A one-way ANOVA was conducted to evaluate the differences in TAKS scores between campuses involved in the innovation and schools not involved in the innovation. The factor, participation, included two levels: involved and not involved. The dependent variable was the average TAKS score. The ANOVA did not yield a statistically significant result, $F(1, 46) = 1.76$, $p = .19$. The strength of relationship between participation and average TAKS score, as assessed by η^2, was small, with the participation factor accounting for only 4% of the variance of the dependent variable. Therefore, there were no statistically significant differences in math achievement scores on the TAKS between campuses involved in the innovation and similar schools that were not involved in the innovation.

Listed in Table 4 are the nine participating districts involved in the AIMS grant and the level at which each participating district used the Agile Mind program relative to the other districts involved. Four districts were identified as low users (less than one hour per student per year). Three districts were identified as medium users (between one and two hours of usage per student per year). Two districts were identified as high level users (more than two hours of usage per student per year). Overall, the usage rates were quite low.

Table 4: Descriptive statistics for time spent on the agile mind innovation

Variable	*Level*
Agua Dulce	High
Calallen	Low
Flour Bluff	Low
Gregory-Portland	Medium
Kingsville	Low
Robstown	Low
Sinton	High
Taft	Medium
Tuloso-Midway	Medium

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Research question three

Is there a statistically significant difference in math achievement scores between campuses spending varying amounts of time on the intervention?

A one-way ANOVA was conducted to evaluate the difference in TAKS scores between campuses spending varying amounts of time on the innovation. The independent variable, time spent on the innovation, included three levels: low, medium, and high. The dependent variable was the average TAKS score for the years 2003, 2004, and 2005. The ANOVA was not statistically significant, $F(2, 24) = .33$, $p = .72$. The strength of relationship between the time spent on the innovation and the average TAKS score, as assessed by η^2, was small, with the participation factor accounting for 3% of the variance in TAKS scores. While the intent of the current analysis was to determine whether differences existed due to varying amounts of time spent on the intervention, the relative lack of use of the program made the analysis difficult to conduct. There were minimal differences in time of use, and the level of use was low (less than a few hours per student per year) for all districts involved.

Research question four

Is there a statistically significant difference in the effect of the innovation across grade levels?

A one-way ANOVA was conducted to evaluate whether statistically significant differences exist in TAKS scores among the grade levels examined in the study. The independent variable, grade level, included three levels: 9th, 10th, and 11th grades. The dependent variable was the average TAKS score for the years 2003, 2004, and 2005. Again, the ANOVA failed to yield a statistically significant finding, $F(2, 24) = 1.50$, $p = .24$. The strength of relationship between the grade level and the average TAKS score, as assessed by η^2, was moderate, with the participation factor accounting for 11% of the variance of the dependent variable. However, the differences in the effect of Agile Mind across the three grade levels were not enough to be considered statistically significant.

Discussion

These researchers examined the effects of a specialised mathematics program, Agile Mind, implemented in high schools in several South Texas school districts. An examination of the findings indicated that the mathematics TAKS scores rose in each grade level in the districts examined, regardless of whether the district participated in the Agile Mind project. In an examination of the TAKS scores for participating districts, statistically significant increases were yielded in TAKS scores across the 2003, 2004, and 2005 school years. Noted in the results was that all three grade levels of students had increased math test scores. Correspondingly, the results of the non-participating group increased each year as well.

This finding is consistent with many districts across the state, and appears to have little to do with the Agile Mind program specifically (TEA, 2007). One of the forces behind the TAKS score improvement may be time. With each passing year since the implementation of TAKS, districts gain information (such as prior results and release tests) with which they are better able to prepare their students to improve test results in subsequent years.

The third component of the analysis dealt with the time schools spent utilising the intervention, and whether differences in the amount of time spent on Agile Mind had an impact on mathematics achievement. Interestingly, the difference in TAKS achievement according to the amount of time spent on the innovation was not statistically significant. However, one should be cautioned by this finding. The differences between the usage groups were small, but the lack of difference appeared to be due to the overall lack of utilisation. The program did not appear to be utilised to the extent intended by the school districts working within the AIMS grant, and therefore TAKS results were not improved beyond the scores of the comparison districts not involved in the innovation. The lack of usage of the implementation made the researchers interested in further analysis. Why wasn't the program utilised? How was the program administratively encouraged? Was implementation consistent and well-maintained?

The lack of utilisation of Agile Mind could possibly be attributed to many factors. With limited instructional time, teachers may be spending the majority of class time on paper and pencil activities meant to prepare students specifically for the test. Another potential problem may be lack of buy-in at the campus or district level. While implementation was perhaps encouraged, it may be that teachers must be both comfortable with the technology and convinced of the program's worth to actually encourage use. Further, in-depth research at the individual campus level is necessary to examine the potential explanations behind the underutilisation of the Agile Mind program.

To fully examine the effect Agile Mind has on the mathematics achievement of students, it is imperative that districts employ the innovation in a more rigorous fashion than was employed by the districts examined in this study. This study, unfortunately, did not provide a clear demonstration of the impact that the Agile Mind program may well have on mathematical performance. The findings are inconclusive in that regard. It does, however, indicate that the districts involved in the AIMS grant were not utilising the provided mathematics instructional enhancement. Further study is necessary to uncover the problems behind the implementation of the program. More than one district reported zero hours of student use. Only when the strategy is entirely implemented will it be possible to test the effectiveness of the Agile Mind innovation.

The original purpose of Agile Mind, advancing equity and high achievement in mathematics, is a noble one (Dana Center, 2004). Supporting high achievement for a broad range of students is an effort worthy of undertaking. Major efforts continue on the pathway to transform South Texas from an under-served region into an educated and economically stable region. With continued research efforts and field-based work, the future mathematicians and scientists of the country will reflect the diversity of American society.

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