Evaluation of the Singapore Math Pilot Program
Year 2 Report of Findings

Office of Shared Accountability

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Suzanne Merchlinsky
Evaluation Specialist

Natalie Wolanin
Analyst

Montgomery County Public Schools

OFFICE OF SHARED ACCOUNTABILITY

Dr. Wesley L Boykin, Director
850 Hungerford Drive
Rockville, Maryland 20850
(301) 279-3448

Dr. Jerry Weast
Superintendent of Schools

Dr. Frieda K. Lacey
Chief of Staff

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Context

Purpose of the Pilot

In spring 2000 Superintendent Jerry D. Weast announced his intent to pilot the Singapore Math program in several Montgomery County Public Schools (MCPS) elementary schools in an effort to improve and accelerate mathematics performance. The purpose of the pilot was to determine whether, and to what degree, implementation of the Singapore Math program in Grades 1–5 in selected schools could 1) alter how mathematics concepts were presented by teachers, and 2) elevate and accelerate the mathematics performance of MCPS elementary school students. This report presents the results of the evaluation of the second year of the Singapore Math pilot. Staff in the MCPS Office of Shared Accountability (OSA) conducted the evaluation of both years of the pilot. (For a more complete description of the pilot, evaluation design, and Year 1 findings, see Gross and Merchlinsky, 2002).

Evaluation Design

Pilot and Control Schools

The evaluation design incorporated three types of schools—the Singapore Math pilot schools and two types of control schools. The four Singapore Math schools received a full dosage of the intervention (i.e., curriculum and materials, teacher training, quarterly assessments, and no Instructional System in Mathematics (ISM) assessments). The four Control A schools received a partial dosage of the intervention, and Control B schools received no dosage.

Within the Singapore pilot schools, two of the schools implemented the curriculum and materials, attended training, and provided support to teachers more fully than the other two pilot schools. As in the first year's evaluation report, the data presented in this report are broken out by the extent of implementation by the Singapore pilot schools. That is, the schools with the most complete implementation are labeled as Schools 1 and 2. The pilot schools with lesser implementation are Schools 3 and 4.

Evaluation Activities

The first year of the evaluation employed a variety of data collection instruments and procedures and focused on implementation issues as well as student achievement outcomes. During the first evaluation year, OSA staff—

- observed in-service training sessions provided to teachers;
- interviewed teachers, principals, and central office staff;
- observed classroom instruction;
- conducted focus groups with parents and students;

- analyzed systemwide mathematics assessments and quarterly assessments developed for the pilot; and
- examined middle school course enrollment for sixth graders who had participated in Singapore Math as fifth graders.

During the second evaluation year, OSA staff focused their analysis on student outcome measures and did not address implementation issues. Therefore, this report contains an analysis of students' performance on Singapore Quarterly Assessments and TerraNova Comprehensive Tests of Basic Skills (CTBS), and students' middle school mathematics course enrollment and achievement.

Year 2 Outcomes

Accelerated Progress through the Mathematics Curriculum

Quarterly Assessment Results

The Singapore Math Quarterly Assessments were designed to place greater emphasis on depth of understanding and problem solving in context than the ISM. Table 1 shows the results of the second-year implementation of the quarterly assessments in Singapore Math pilot and Control A schools. The table shows, by grade level and quarter, the total number of items on the assessments and the mean number of items correct by students in each school category.

The results from Year 2 implementation of the quarterly assessments mirror the trends seen in Year 1 implementation. For every assessment, at every grade level, students in the Singapore Math pilot schools performed significantly higher than students in the Control A schools. Additionally, for every assessment in Grades 2, 4, and 5, and for three of the four assessments in Grade 3, students in Schools 1 and 2 significantly outperformed students in Schools 3 and 4. In Grade 1, students in Schools 1 and 2 significantly outperformed students in Schools 3 and 4 only in the first quarter. Conversely, Grade 1 students in Schools 3 and 4 significantly outperformed students in Schools 1 and 2 in the fourth quarter. In the other two quarters, the differences between Grade 1 student performance in Schools 1 and 2 and Schools 3 and 4 were not statistically significant.

The Year 2 data indicate that Singapore Math students showed greater mastery of the more advanced mathematics content than students in the Control A schools. Additionally, the extent of implementation of Singapore Math affected students' progress. That is, students in Schools 1 and 2, where Singapore Math was more completely implemented, consistently outperformed their peers in Schools 3 and 4, which received only partial implementation. This trend was noted in every grade except Grade 1.

Table 1

Mean Performance of Singapore Pilot and Control A Students on the Quarterly Assessments, 2001-02

Grade/Quarter	Total # Items	Schools 1 & 2	Schools 3 & 4	All Singapore	Control A
Grade 1					
Quarter 1	25	21.86 *	20.27	21.21**	17.60
Quarter 2	25	20.90	21.03	20.95**	15.73
Quarter 3	23	18.46	17.98	18.27**	14.34
Quarter 4	19	14.06	15.40*	14.59**	12.37
Grade 2					
Quarter 1	25	20.62*	17.49	19.38**	15.58
Quarter 2	22	14.85*	11.66	13.62**	9.86
Quarter 3	27	20.56*	16.71	19.16**	12.88
Quarter 4	28	21.14*	19.91	20.69**	17.14
Grade 3					
Quarter 1	22	15.27*	12.50	14.12**	12.07
Quarter 2	25	18.18*	13.21	16.29**	13.93
Quarter 3	25	16.64	15.37	16.13**	12.32
Quarter 4	26	19.56*	16.16	18.20**	15.49
Grade 4					
Quarter 1	31	22.88*	18.21	20.62**	15.16
Quarter 2	20	14.90*	11.03	13.24**	10.38
Quarter 3	30	20.99*	14.01	17.86**	14.06
Quarter 4	19	14.89*	12.26	13.70**	11.08
Grade 5					
Quarter 1	28	21.77*	20.14	21.13**	17.46
Quarter 2	27	18.34*	13.44	16.40**	11.32
Quarter 3	49	37.00*	22.26	30.53**	24.28
Quarter 4	25	17.03*	14.86	16.19**	9.48

*Difference between Schools 1 and 2 and Schools 3 and 4 is statistically significant at the .05 level.
** Difference between Singapore Math pilot and Control A is statistically significant at the .05 level.

Students' Mathematics Achievement

CTBS Performance

Table 2 presents the CTBS performance for students in Grades 2 and 4, in 2000, 2001, and 2002 in the Singapore Math pilot and control schools. In the 1999-2000 school year, students experienced the traditional MCPS mathematics curriculum. In 2000-01 and 2001-02, students in the Singapore Math pilot schools received the Singapore Math curriculum and instructional strategies. Singapore Math was more fully implemented in Schools 1 and 2 than in Schools 3 and 4.

During the second year of the Singapore Math pilot (2001-02), the data show that Grade 4 students in the Singapore pilot schools significantly outperformed their peers in Control A schools on the mathematics subtest. Second and fourth graders in the pilot schools also outperformed students in both Control A and Control B schools in the mathematics computation subtest. Additionally, second and fourth graders in Schools 1 and 2 significantly outperformed their peers in Schools 3 and 4 in both the mathematics and the mathematics computation subtests. The 2002 data also show improvement in fourth grade student achievement for students in Schools 1 and 2 compared with Schools 3 and 4. Grade 4 students in Schools 1 and 2 significantly outperformed students in Schools 3 and 4, which did not occur in 2001. These data support the earlier conclusion that student achievement shows the most improvement in the schools where Singapore Math is most completely implemented.

Table 2

CTBS Mean National Percentile Scores for Students in Grades 2 and 4, 2000, 2001, and 2002

Subtest/Grade/Year	Schools 1 and 2	Schools 3 and 4	All Singapore	Control A	Control B
Mathematics					
Grade 2					
2000	63	57	60	64	59
2001	71*	57	65**	58	64
2002	72* +	57	66	62	66
Grade 4					
2000	75*	69	72**	63	69
2001	71	69	70**	61	68
2002	75*	65	69**	64	72
Math Computation					
Grade 2					
2000	62	62	62	64	57
2001	80*	68	75***	60	67
2002	82*	67	76***	69	74
Grade 4					
2000	68	65	66	63	68
2001	76	71	74***	62	63
2002	77*	70	73***	67	71

*Difference between Schools 1 and 2 and Schools 3 and 4 is statistically significant at the .05 level.
**Difference between Singapore pilot and Control A schools is statistically significant at the .05 level.
***Differences between Singapore pilot and Control A and B schools are statistically significant at the .05 level.
+ Difference between Schools 1 and 2 and Control A schools is statistically significant at the .05 level.

Middle School Mathematics Course Enrollment

Table 3 shows the Grade 6 mathematics course enrollment in fall 2000, fall 2001, and fall 2002 for students who experienced Singapore Math in Grade 5 and students who attended Grade 5 in the Control A schools. At the outset of the Singapore pilot, there was concern about articulation between Grade 5 and middle school mathematics courses. However, the first years' data from the pilot study showed that exposure to Singapore Math is not detrimental to students' middle school mathematics course placement. The second year's data reinforce this finding and demonstrate continued progress for students in all four Singapore pilot schools.

A similar percentage of students from Schools 1 and 2 were placed in Math A in fall 2002 as in fall 2001—46 percent. However, the number placed in Math B increased slightly between the two years,—from 32 to 36 percent.

The number of Grade 6 students from Schools 3 and 4 enrolled in Math A decreased, while the number enrolled in higher level mathematics courses this year increased. Placement in Math A for students from Schools 3 and 4 decreased from 52 to 40 percent from 2001 to 2002. At the same time, the number of students enrolled in Math 6 (g/t) or Magnet Math 6 increased from 2 to 10 percent; placement in Math B increased from 22 to 25 percent; and placement in Math Investigations increased from 15 to 23 percent. Students from Control A schools maintained their placement trends from previous years, with the majority of Grade 6 students enrolling in Math A.

Table 3

Grade 6 Mathematics Course Enrollment,
Fall 2002, Fall 2001, and Fall 2000

Mathematics Course	Schools 1 and 2 %	Schools 3 and 4 %	Control A %
Math 6 (regular) or Math A			
Fall 2000	53	50	44
Fall 2001	46	52	65
Fall 2002	46	40	70
Math 6 (g/t) or Magnet Math 6			
Fall 2000	17	0	35
Fall 2001	0	2	0
Fall 2002	1	10	1
Math 7 or Math B			
Fall 2000	21	27	8
Fall 2001	32	22	26
Fall 2002	36	25	22
Math Investigations			
Fall 2000	8	20	11
Fall 2001	19	15	8
Fall 2002	17	23	7
Algebra			
Fall 2000	0	4	0
Fall 2001	0	8	0
Fall 2002	0	0	0

School year 2001–02 yielded a second year of middle school mathematics course enrollment data for Singapore pilot and control students in Grade 7. Table 4 shows the mathematics course enrollment for Grade 6 students in 2001 and Grade 7 students in 2002 for the Singapore pilot and control schools. There are no comparison data for Grade 7 students in 2001. However, the data presented in Table 4 show a continuation of higher-level course enrollment for students in the Singapore pilot schools. In Schools 1 and 2, 45 percent of students enrolled in Math 7 or Math B in Grade 7 (a rate similar to their Grade 6 enrollment in Math 6 or Math A). The remainder of Grade 7 students from Schools 1 and 2 enrolled in higher-level mathematics courses—25 percent in Math Investigations, 20 percent in Algebra, 10 percent in Math C, and 1 percent in Honors Geometry. In Schools 3 and 4, it appears that many students who had enrolled in Math A as sixth graders enrolled in higher-level mathematics courses in Grade 7. While approximately half (52 percent) enrolled in Math A in Grade 6, only about one third (34 percent) enrolled in Math B in Grade 7. About the same amount (31 percent) enrolled in Algebra in Grade 7. Additionally, 21 percent of Grade 7 students from Schools 3 and 4 enrolled in Math C; and 7 percent each enrolled in Math Investigations and Honors Geometry. No students from the Singapore Pilot schools enrolled in Functional Math Skills Improvement. From the control schools, more than half (59 percent) of Grade 7 students enrolled in Math B. They enrolled in higher-level mathematics courses at a generally lower rate than students from the Singapore pilot schools.

Table 4

Grade 6 Mathematics Course Enrollment, Fall 2001 and Grade 7 Mathematics Course Enrollment, Fall 2002

	Math 6 (regular) or Math A %	Math 6 (g/t) or Magnet Math 6 %	Math 7 or Math B %	Math Investi-gations %	Alge-bra %	Honors Geom. A %	Math C %	Func. Math Sk Imp %
Schools 1 & 2								
Grade 6, Fall 2001	46	0	32	19	0			
Grade 7, Fall 2002			45	25	20	1	10	
Schools 3 & 4								
Grade 6, Fall 2001	52	2	22	15	8			
Grade 7, Fall 2002	2		34	7	31	7	21	
Control Schools								
Grade 6, Fall 2001	65	0	26	8	0			
Grade 7, Fall 2002			59	15	13		10	3

Middle School Mathematics Achievement

Despite initial concerns, the data have shown that exposure to Singapore Math has not been detrimental to students' middle school mathematics course placement and has in fact increased their preparedness for higher-level mathematics courses. Once students are placed in their mathematics courses, it is important to monitor their success. Table 5 presents final course grades for Grade 6 students in Spring 2002, based on the extent of their exposure to Singapore Math.

Table 5

Grade 6 Mathematics Course Final Grades, Spring 2002

Mathematics Course	Schools 1 and 2		Schools 3 and 4		Control A	
	N	Mean*	N	Mean*	N	Mean*
Math 6 (regular) or Math A						
Spring 2002, Final Mark	70	3.0	90	2.6	161	2.5
Math 7 or Math B						
Spring 2002, Final Mark	54	3.3	39	3.4	64	3.4
Math Investigations						
Spring 2002, Final Mark	28	3.5	25	3.6	19	3.2

*A=4, B=3, C=2, D=1

The Singapore pilot students represented in Table 5 experienced Singapore Math for two years (Grade 4 and Grade 5) in elementary school prior to their middle school mathematics placement. In regular Math 6 or Math A, students in Schools 1 and 2 outperformed their peers in Schools 3 and 4 and the Control A schools. In Math 7 or Math B, Grade 6 students in Schools 3 and 4 performed at the same level as students in Control A schools, and slightly above Grade 6 students in Schools 1 and 2. In Math Investigations, Grade 6 students in Schools 3 and 4 slightly outperformed their peers in Schools 1 and 2 as well as the Control A schools. Schools 1 and 2 had a higher percentage of their Grade 6 students taking the higher-level mathematics courses (i.e., Math 7, Math B, or Math Investigations) than Schools 3 and 4 or the Control A schools. While their final course grades are somewhat lower than their peers in the other schools, they nonetheless performed successfully in the higher-level courses.

Conclusions

Analysis of the Year 2 student outcome data confirmed the trends noted in the Year 1 data. In Schools 1 and 2, where Singapore Math was more fully implemented, students typically outperformed their peers in Schools 3 and 4. However, in 2002 performance for students in Schools 3 and 4 generally improved over 2001. Additionally, students in all of the Singapore pilot schools typically outperformed students in the Control A schools.

- Students in Schools 1 and 2 significantly outperformed students in Schools 3 and 4 in most quarters and most grade levels on the Singapore Quarterly Assessments. Additionally, Singapore pilot students significantly outperformed students in the Control A schools in every quarter in all grade levels. Since the quarterly assessments measure concepts that are introduced earlier than the traditional ISM, the data show that Singapore Math students progressed through the curriculum at an accelerated pace compared with their peers in the control schools. This acceleration helps to prepare Singapore Math students for higher-level mathematics placements in middle school.

- Students in Schools 1 and 2 significantly outperformed students in Schools 3 and 4 and in the control schools on both the Mathematics and the mathematics computation subtests of the CTBS in both Grades 2 and 4.

- Singapore Math students achieved higher-level mathematics course placements in middle school than did students in the Control A schools. In 2002, students in Schools 3 and 4 continued to improve their placement in higher-level mathematics courses, while students in Schools 1 and 2 remained relatively steady in their placements.

- Schools 3 and 4 implemented Singapore Math less completely during the first year than did Schools 1 and 2, and this level of implementation was reflected in the first year's student performance data. The trend continued in the CTBS and quarterly assessment data. However, the second year of implementation shows improved outcomes for students in Schools 3 and 4 in middle school mathematics course placement and achievement. Although no implementation data (e.g., observations, focus groups, surveys) were collected in the second year, it appears from the outcome data that teachers in schools 3 and 4 may have become more comfortable and proficient in teaching the Singapore content and methodology.

Recommendations

Two years of data about the implementation and outcomes of Singapore Math have yielded insights that should be considered in implementing any new curriculum reform efforts in MCPS. Although the continuation of Singapore Math in the pilot schools is uncertain, the following recommendations are lessons learned from the pilot study which apply to implementation of the current elementary mathematics curriculum roll-out.

Recommendation 1: Principals should be formally included in the decision-making processes for reform efforts. One characteristic of the Singapore pilot schools with the greatest degree of implementation was the active involvement and support of the principal as an instructional leader. It may be beneficial to involve those principals whose schools have successfully implemented new reform efforts (such as Singapore Math) as advisors to MCPS curriculum staff or fellow principals regarding how their instructional leadership facilitated change in their schools.

Recommendation 2: End-of-unit assessments to support mathematics instruction and communication with parents need to be carefully developed to yield data that is useful both to inform instruction and to report student outcomes. Validity and reliability studies should be conducted, and rubrics should be developed to show teachers and parents what level of performance constitutes students' mastery of the objectives.

Recommendation 3: In implementing any new curriculum reform effort, MCPS needs to be mindful of the amount of time required to complete the implementation process itself, and the level of support teachers need to practice the new curriculum. Year 2 data from Singapore Math indicated some growth in Schools 3 and 4, which did not fully implement the curriculum during the first year. Variations in the length of time needed to come "up to speed" must be considered an important factor as evaluation activities are developed for future reform efforts, and as inferences are formulated regarding program success.