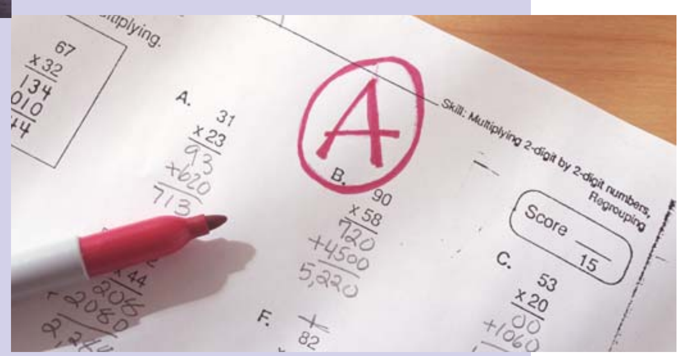
Classroom-Based Assessment Project

Changes in Mathematics Achievement and Instructional Ecology Resulting from Implementation of a Learning Information System



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MINNEAPOLIS PUBLIC SCHOOLS
SPECIAL SCHOOL DISTRICT NO 1

The College of Education & Human Development
UNIVERSITY OF MINNESOTA

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Changes in Mathematics Achievement and Instructional Ecology Resulting from Implementation of a Learning Information System

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Executive Summary

In this study we examined the effects a learning information system, Accelerated Math (AM)™, has on student math achievement and ecobehavioral variables known to be related to overall student achievement outcomes. These features included both teacher and student behaviors.

Overall, students who used the Accelerated Math program demonstrated greater gains in math achievement than district-wide or within-school control groups. These gains were realized in a difficult context: incorporation of a new procedure into an instructional routine in the middle of the year. And, there was well-documented variance in degree of implementation of the program. Some teachers implemented the program with much more commitment and fidelity than did others. Commensurate gains on the district administered assessments (NALT) were also observed. Use of Accelerated Math enhanced the skill development of students of all ability groups to some degree, but especially lower achieving students.

Findings indicate that instructional grouping was different when AM was added to the Everyday Math curriculum (EM). Students were coded as receiving more individualized instruction during the EM with AM condition. This meant that they either were working on an individual assignment or with the teacher, one-on-one. In contrast, during the EM alone condition, students were mostly involved in entire group instruction. Individualized instruction or instructional grouping increases the opportunity for teachers to tailor feedback to match student needs.

Further, the ecobehavioral analysis revealed that students were more likely to be engaging in academic responses during individual instruction and they were less likely to engage in academic responses during entire group instruction. Thus, the use of Accelerated Math appears to facilitate instructional arrangements that enable teachers to engage in best practices, which are related to positive student outcomes.

The results indicate that teachers chose a wide variety of tasks for instruction during the EM alone condition. These tasks included: worksheets, workbooks, teacher/student discussion, listen/lecture, and other media (calculators, protractors, and other manipulatives). The Everyday Math curriculum incorporates a broad range of activities to assist in the transmission of math concepts to students.

Accelerated Math provides a way for teachers to give students a boost of individualized practice on math concepts embedded within the curriculum. It is very time consuming, if not impossible, for teachers to provide individualized practice for students on math objectives within any math curriculum, without the kind of computer-managed information tracking provided by Accelerated Math. Including Accelerated Math into a preexisting math instruction program may function as a means of "accelerating" student learning of the full math curriculum.

The addition of Accelerated Math to the Everyday Math curriculum produced a strong positive effect on student behavior. Students spent less time engaged in management behaviors and more time engaged in academic responding, which is related to positive student achievement outcomes (Borg, 1980). Students at all levels of achievement (high, middle, and low) were all more actively engaged during the EM with AM condition than the EM alone condition. In addition, low achieving students during EM with AM, reached academic engagement levels similar to high achieving students in the EM alone condition.

It is clear from these data that the implementation of Accelerated Math with Everyday Math resulted in an increase in the amount of time spent on ecobehavioral activities that have been identified as contributing to positive academic outcomes. Further, students across all achievement levels who participated in the Accelerated Math program, demonstrated significant gains on both a district administered standardized test (NALT) and the STAR Math test, a proprietary Computer Adaptive Test.

Overview

Concerns about the math achievement of U.S. students are highlighted in the popular press, journal articles (Stedman, 1997), major conference presentations (Jones, et al., 1999; Gonzalez, Martin, & Mullis, 1999; Tananis, & van der Ploeg, 1999), and official U. S. Department of Education reports (1998). In the Third International Math and Science Study (TIMSS), eighth grade students in the United States scored below the international average in Math (41-country comparison), and eighth graders in 20 other countries scored higher in math than American eighth graders (Beaton, et al., 1996). To respond effectively to these findings, educators must find ways to increase student achievement in math.

There are empirically demonstrated principles of learning, which if effectively applied, will result in significant improvements in student outcomes (Carroll, 1963; Walberg, 1984; Pressley, 1998; Ysseldyke & Christenson, 1993). Also, there are specific instructional strategies and tactics that teachers can use to increase student success. Ysseldyke and Christenson (1987; 1993) identified some of the instructional factors that are related to improved student achievement outcomes (Table 1). These factors are divided into four categories: Planning, Managing, Teaching (Delivering) and Monitoring/Evaluation Procedures. Ysseldyke and Christenson (1987) note that a combination of these instructional features must be present in the natural classroom environment to maximize student outcomes. Goodard (1979) pointed out that single instructional variables rarely account to more than 5% of the variance in student outcomes (cited in Ysseldyke & Christenson, 1987).

Furthermore, there is extensive research that indicates that the ways in which students spend their time in school are related to achievement outcomes (Graden, 1984). Greenwood and his colleagues consistently have argued that students' academic responses and the extent to which they profit from instruction are dependent on how they spend their time in school and that this in turn is dependent on specific classroom ecological factors. Hall et al. (1980) report that students typically spend the school day in one of three types of behaviors, (a) management behavior (53%) (e.g., getting materials, listening, waiting for instructions), (b) active academic responding (25%) (e.g., reading aloud, asking academic questions), and (c) inappropriate behavior (18%) (e.g. disrupting class, looking around). It commonly is argued that higher achievement results when students receive task relevant practice and active academic responding, commensurate with decreases in management behavior and inappropriate behavior. Stallings (1980) has demonstrated that on-task behaviors (e.g., reading aloud and talking about academic topics) correlate positively with achievement. In a study by Greenwood et al. (1981) total academic responses correlated significantly with student achievement (r=.52).

Fisher et al. defined academic engaged time more precisely in 1980. In this definition, the difficulty level of the material is considered as well as student response. The authors introduced

Table 1. Instructional Factors Related to Improved Student Achievement Outcomes

Planning Procedures • Sufficient time allocated to academic activities • Quality teacher-diagnosis of student skill level • Prescription of tasks that are matched to skill level • Realistic, high expectations and academic standards • Appropriate instructional decision-making (grouping, materials, ongoing diagnoses) • Sufficient content coverage • Instruction designed to include presentation, practice, application and review • Kind of curriculum (spiral vs. sequential) **Management Procedures** • Efficient classroom management procedures • Well-established and efficient instructional organization and routines • Productive use of instructional time • Positive, supportive classroom interactions **Monitoring and Evaluation Procedures** • Active monitoring of seatwork activities • High success rates (on daily and unit tests) • Frequent, direct measurement of pupil progress • Progress through the curriculum depends on mastery criteria • Curriculum alignment (the relationship between what is to be taught [goals], what is taught [instruction], and what is tested [assessment])	**Teaching Procedures** • Instructional sequence includes demonstration, prompting, and provision of opportunity for practice • Expectations (goals, objectives, academic standards) are communicated clearly • Lesson Presentation – Related Factors – Extensive substantive teacher-pupil interaction, teacher questioning, signaling and re-explaining – Teacher-directed instruction (proceeding in small steps, careful structuring of learning experiences, etc.) – Clear demonstration procedures and systematic use of error correction procedures – High rate of accurate student response – Amount of guided practice prior to independent practice – Explicitness of task directions • Practice – Related Factors – Amount and kind of independent practice – Appropriate seatwork activities – Systematic application of principles of learning to instruction – High rates of academic engaged time (academic learning time, opportunity to learn) – Brisk, fast pacing of curriculum and lesson – Degree of student accountability – Systematic, explicit feedback and corrective procedures

Ysseldyke & Christenson (1987).

the idea of Academic Learning Time (ALT), which is defined as “the amount of time a student spends engaged in an academic task, which he or she can perform with high success” (p. 8). Studies using the concept of ALT reported a significant relationship between engaged time and achievement and further, that ALT is a significant predictor of achievement (Borg, 1980).

Other information suggests that students in schools across the United States spend relatively little time academically engaged in school (Hall, 1980). Thus, educational interventions that can alter the classroom ecology to enhance ALT hold the most promise to accelerate the academic skills of all students.

However, educators have experienced difficulty identifying specific interventions that will result in significant increases in these variables collectively. Researchers have had difficulty identifying interventions that will produce significant increases in academic engaged time, freeing up teachers from the tedium of having to identify appropriate instructional levels and match instruction to the level of skill development of the learner. Moreover, there are major difficulties in freeing teachers up from grading papers and providing corrective feedback, enabling them to spend more time assisting learners who are having specific difficulties or fostering the enhancement of gifted and talented students.

Accelerated Math™

A recently developed and released educational software product, Accelerated Math™, created by Advantage Learning Systems, Inc., (1998a), looks to have the potential of making it easier for teachers to incorporate best practices into their instruction. Accelerated Math is not a curriculum, but rather an instructional system that can enhance any curriculum (ALS, 1998b). Accelerated Math is part of Math Renaissance, an educational model developed by The Institute for Academic Excellence, a training institute for ALS. The four primary components of this Math Renaissance model are: Time on Appropriate Practice (TAP), the Learning Information System (LIS), a Math Motivation System (MMS), and most importantly the teacher who, Motivates, Instructs, Monitors, and Intervenes (MIMI) with students so they can be successful. The Accelerated Math software program fits into the LIS component of the model. To assist teachers with the MIMI element of the model, the LIS plays a fundamental role, allowing teachers to manage multiple instructional tasks like appropriate match of instruction to individual students' skill levels, direct and frequent monitoring of student performance and progress, and provision of corrective and motivational feedback. Accelerated Math as an LIS increases the rate at which teachers can easily receive meaningful information about student work and thus are able to make more frequent and consistent instructional decisions.

There are five major components of the Accelerated Math program that support the achievement outcome factors listed in Table 1 most directly. These components are: (1) Accelerated Math grade level libraries, (2) individualized practice assignments, (3) TOPS (Teacher's Opportunity to Praise Student) reports, (4) Status of the Class reports, and (5) Diagnostic reports. More detail on these five factors is provided in the paragraphs that follow.

Accelerated Math Grade Level Libraries. The program offers twelve standard libraries of math objectives, ranging from grade three through calculus. Each library has over 100 objectives, which cover a year's worth of mathematics topics. The objectives of each library cover the content included in widely used curriculum guidelines and textbooks and National Council for Teachers of Mathematics (NCTM) standards. Each student works in a library that is matched to his/her individual achievement level as determined by a computerized adaptive test (STAR Math™). This allows students to work within their instructional level.

Individualized Practice Assignments. The software program creates and prints out individualized practice assignments for each student. The student works on the practice problems at his/her seat and then scans the answers back into the computer for scoring. The computer automatically scores the student's responses, generates a new individualized practice assignment (based on how well the student performed on the previous assignment) and a teacher report (TOPS) (The TOPS report will be explained below). For those objectives that the student has demonstrated satisfactory knowledge, the program automatically moves on to a new set of objectives. In addition, once a student has been successful with objectives on practice assignments, the program alerts the teacher that the student is ready to test on those objectives to demonstrate mastery. Mastered objectives and mastery of tested objectives (based on test performance) are spiraled into future practice sets to help maintain mastery. The individual practice assignments facilitate the presence of two of the achievement outcome factors, appropriate "amount and kind of practice" targeting specific objectives and "appropriate difficulty" related to ALT, which is directly related to increased student performance.

TOPS reports. Teachers and students receive task specific feedback through computer-generated reports. The most common is the TOPS (Teacher's Opportunity to Praise Student) report. The TOPS report is automatically printed after each assignment that is scanned and provides a format for constructive, precise feedback regarding student performance. This report begins with a positive comment on how well the student performed on the task. It also details which questions were answered correctly and which were answered incorrectly. The TOPS report gives teachers the opportunity to affirm correct responding and offer corrective feedback to students who answer incorrectly. It facilitates (a) positive, supportive classroom interactions; (b) frequent, direct measurement of student progress, (c) extensive, substantive teacher-pupil interaction, teacher questioning, signaling and re-explaining, and (d) systematic and explicit feedback and corrective procedures, all factors identified by Ysseldyke and Christenson (1993) as critical to academic success, listed in Table 1.

Status of the Class Reports. Frequent monitoring of student progress is possible at an individual and class level with the Status of the Class report. This report identifies those students who are ready for or need additional instruction on specific objectives. It also lets the teacher know students who are ready for a test on certain objectives. With information from this report, the teacher can plan one-on-one or small group instruction with the students who need it, and also have students work on tests when they are ready. This report also identifies for the teacher students who have not turned in work recently. This means teachers get the information they need to check in with these students, individually, and get them back on track. Essentially, teachers can tailor instruction and concentration of instruction at an individual level. The Status of the Class report facilitates the achievement outcome factor of "appropriate instructional decision making" and it also helps to ensure that students experience "high success rates on tests," as tests may not be created until the student has demonstrated a certain level of success during practice.

Diagnostic Reports. The Diagnostic report provides information to the teacher about student progress toward accomplishment of objectives. It indicates how many objectives have been mastered through success on tests, the total number of problems the student has attempted, and the average percent correct on practices, tests and review items. This report allows the teacher to track overall student progress and can be printed at any time. Teachers can use the direct information they obtain frequently to group students, ensure high rates of academic success, and adapt instruction to accommodate the needs of diverse learners. Teachers get good frequent information, and can readily identify both their outstanding performers (for enrichment) and their at-risk students (for remediation or compensatory instruction).

In summary, AM is a task-level learning information system that helps teachers monitor and ensure student achievement across various math objectives. Moreover, Accelerated Math encourages and monitors practice of foundational skills while providing immediate feedback on performance to both the student and the teacher (TOPS report). The program uses Objective Tracker™ technology and a powerful Algorithm Problem Generator™ to ensure that each student works at his or her own pace with a continuous supply of problems and assignments that are new, relevant, appropriate, and unique to each individual. Accelerated Math also handles all scoring and record keeping chores, minimizing teacher paperwork time.

Purpose and Research Questions

The purpose of this study was to evaluate the effects of using Accelerated Math on classroom ecology and student achievement. Specifically, we examined the effects of using AM in tandem with the standard math instruction on student behavior, teacher behavior, grouping structures, teacher position relative to students, the kinds of tasks used, and student math achievement. Second, we wanted to know the extent to which effects were different for students who are high, middle, and low achievers. We carried out the study in as naturalistic an environment as possible. The standard math curriculum remained in place. Further, we did not re-assign students to instructional groups, but went with their natural classroom assignments.

The following research questions were addressed:

1. To what extent are there differences in mathematics achievement gains for students who use accelerated math in comparison to those who do not?

2. To what extent are there differences in mathematics achievement gains for high, middle,

and low-achieving students who use accelerated math in comparison to those who do not?

3. To what extent are there differences in instructional ecology for high, middle and low achieving students under two conditions: Everyday Math alone versus Everyday Math with Accelerated Math?

Method

Participants

Four elementary schools in a large urban school district in the Midwest participated in the project from February to June of 1999. Overall, nine classrooms were selected to participate in the implementation of AM based on the classroom teachers' willingness to participate in the study. At school #1, four classrooms participated, at school #2, three classrooms participated, and one classroom was involved at school #3 and school #4. The total number of students in the experimental group was 205. These classrooms used AM as well as their Everyday Math curriculum. Second, in addition to the large experimental group, a subgroup of 26 students was selected from eight of the classrooms using the AM program, for intensive observation. This subgroup of students was selected to represent three separate math skill levels (high, middle and low). Third, a control group, including a total of 184 students, was also selected from three of the schools. These students in the control group did not use Accelerated Math during the school year and they were representative of the students who participated. For a detailed description of demographic characteristics for all groups, refer to Table 2.

We also gathered the math test scores on the district large-scale assessment for all students in the district.

Observed Students

Because we were interested in differential effects of AM on the performance and progress of students at differing skill/ability levels, three students (one high, one middle, and one low achiever) were selected from eight classes for additional observation. This enabled us to observe intensively 26 students. Assignment of achievement level was based on performance on the STAR Math test administered in December 1998. High achievers were defined as students in the class whose percentile rank on the STAR Math test was at or above 80. The range of percentile rank used to identify middle achievers was from the 40^{th} to 60^{th} percentile. The low achievers were defined as those students who scored below the 20^{th} percentile.

Table 2. Demographic Characteristics of Participants

	EM only (control)	EM with AM (experimental group)	EM with AM (observed students)		
			High	Middle	Low
Total	184	205	9	8	9
Gender					
Male	99	100	6	4	5
Female	85	105	3	4	4
Grade					
4	71	71	5	4	4
5	38	111	4	4	5
6	45	5	0	0	0
7	16	10	0	0	0
8	14	8	0	0	0
Ethnicity					
Native American	9	10	0	0	2
African American	54	78	2	4	4
Asian American	17	52	4	1	1
Latin American	36	28	0	0	1
European American	68	37	3	3	1
Free/Reduced Lunch					
Full Price	54	43	2	1	0
Free	103	140	6	4	8
Reduced	27	22	1	3	1
Special Service					
ELL*	34	54	4	0	0
Special Education	30	33	0	0	1

* ELL - English Language Learner

The data collector identified which students met the criteria of each skill level, for each of the eight classrooms in which students were observed. The teacher was then asked to pick one student, within each skill level, who had a good attendance record. There were four classrooms that did not have any students who scored at or above the 80th percentile. In these classes all three students were chosen based on their ranking on the test compared to other students in the class. During the course of the study two students were selected as substitutes for two other students who had prolonged absences. The two substitutes were chosen using the same criteria as the others, matching the original students on achievement level and gender.

The Curriculum

The Minneapolis Public Schools, in the elementary grades, use Everyday Math (EM) as the primary math curriculum. Within the curriculum there are goals and objectives that all students need to learn, as well as an elaborate set of standards articulating grade level Minneapolis Teacher Instruction Support Services (TIS) expectations. As with most curricula, teachers must use their own set of instructional strategies to convey the information in the curriculum to students.

Achievement Measures

District Testing

Every year, all 2nd through 7th grade students in the Minneapolis Public School district are tested on the math portion of the Northwest Achievement Levels Test (NALT) (Northwest Evaluation Association.) The NALT: Mathematics Test is a series of eleven achievement tests that measure student performance in basic skill areas of mathematics. The tests were developed using the Northwest Evaluation Association item bank. Using the item bank allows for the creation of tests that are aligned with the district's curriculum standards and grade level expectations. Each student takes a paper and pencil, group administered, mathematics test that is appropriate for their skill level. The appropriate level test is determined for each student by previous performance on the NALT or a locator test. Some of the areas included in the tests are, number sense, measurement, relations, functions, randomness and data investigation. Results are reported in RIT scores (scale scores). From the RIT scores, statistics describing within district comparisons of student performance can be calculated.

STAR Math Testing

Students in this study were also evaluated using the STAR Math exam (Advantage Learning Systems, 1998c), a computer-adaptive test of math skills. STAR Math is designed for use with grades 3 through 12 and measures skills in numeric concepts, computation, and math application. The test takes approximately 15 minutes and requires students to respond to 24 questions.

The STAR Math test is used for two purposes. First, it is used to place each student at the appropriate level in the AM program; second, as a post-test to determine student growth. The adaptive branching technology used with this system continuously adjusts each test to the abilities of each individual. Students who answer correctly are presented a more difficult item, while those who answer incorrectly are given an easier item. In this way, the test narrows in on the instructional level of the student. The test provides grade equivalents, percentile ranks, scaled scores, and NCEs, based on a national norms.

Observation Measure

Observations were conducted to measure the effects of using AM on the classroom ecology and to account for various independent variables on student achievement. In the past, the process of gathering data on classroom behavior has not been systematic. Data frequently have been in the form of informal observations, self-report, and checklists based on teacher recollection (Ysseldyke & Christenson, 1987). In this study we used a computerized observation system, created by the Juniper Gardens Children's Project (Greenwood, Carta, Kamps, & Delquadri, 1995), Ecobehavioral Assessment System Software (EBASS), to collect data on student and teacher behavior. EBASS offers a more precise way of observing classroom behaviors, and gave us a precise description of the instructional ecology across the eight classrooms.

The EBASS system consists of three different observational codes. We used the Code for Instructional Structure and Student Academic Response (CISSAR), which is appropriate when the observed student is enrolled in one educational setting, primarily a general education setting. Within CISSAR there are 53 variables divided into six major categories. (1) *Activity* (reading, math, spelling, etc.), (2) *Task* (worksheet, workbook, listen/lecture, etc.), (3) *Instructional Structure* (entire group, small group, or individual), (4) *Teacher Position* (front, back, among students, etc.), (5) *Teacher Behavior* (teaching, no response, other talk, etc.), and (6) *Student Response* (writing, reading aloud, talking inappropriately, etc.). All 53 variables are listed and briefly defined in Table 3.

With the EBASS program, classroom observations are recorded directly onto a laptop computer. The program uses a momentary time sampling technique. Audible prompts are used to alert an observer to record events that are occurring in the classroom at pre-set time intervals depending on the coding system used. Every 10 seconds, the program prompts the observer to record variable information in one of the six categories. The program cycles through all six categories through several of the variables. The collection of data on teacher behavior and position gives information about teacher-pupil interaction. For example, one may conclude that teachers who circulate among students are better able to provide one-on-one instruction and interaction than teachers who are in front lecturing to the class. Collection of precise data on instructional grouping and assigned task gives insight into the type of instructional planning done by the teacher. Student behavior is measured directly by the variables in the student response category. These variables can also be combined into composite scores of academic engaged time, task management and competing responses.

Table 3. EBASS: CISSAR Code Definitions

Activity

Reading – when the student, or majority of the students are engaged in a reading activity
Math – when the majority of students are doing math work
Spelling – when the majority of students are copying spelling words from the blackboard
Handwriting – when the activity is focused on learning to write print or cursive
Language – when the activity is focused on speech and language meaning
Science – when the lesson is related to any scientific topic
Social Studies – when the lesson is related to cultures, ways of life, jobs and roles in society
Arts/Crafts – when the lesson involves drawing, painting, cutting, pasting or coloring.
Free time – when the students begin an activity after the teacher has said that free time or study time is available
Business Management – when the activity is focused on the schedule, lunch money, class rules, procedures, etc.
Transition – when the activity is changing (for example from reading to lining-up to go to music class)
Can't Tell – when the above descriptions do not apply

Task

Readers –the student is using a reading primer or reading book
Workbooks – workbooks are often paperback, and require the students to write responses in the book
Worksheets –the teacher presents prepared sheets on which the students are expected to read and then write their responses
Paper/Pencil –the student is using manuscript paper or non-printed sheet paper
Listen/Lecture –the requirement of the student is to look and listen to the teacher's instruction or presentation
Other Media –the student is viewing a film, using a tape recorder, overhead projector, computer, word cards, etc.
Teacher/Student Discussion –the student is talking or discussing with the teacher individually
Fetch/Put – students are required to change or get additional materials during and/or after an activity

Structure

Entire Group –the student is in the same seating arrangement and has the same assignment as all other students
Small Group –the student is positioned next to at least one other student, but away from the other students in class
Individual – (1) when the student is working alone, or with the teacher, (2) when the student is physically away from other students and is working on a different task from the other students, or (3) when the student is among the other students, but the assigned activity is different from all the other students

Teacher Position

In front –the teacher is in front of the majority of the students
At desk –the teacher is working from the desk, seated at or on the desk
Among students - the teacher is standing or seated among the majority of the students
Side –the teacher is to the side of the class and not among the students
Back –the teacher is in the back of the classroom
Out –the teacher has left the classroom

Teacher Behavior

No response –the teacher makes no observable response directed toward the student or the class. This can include grading papers, looking in a closet, working with the computer, being out of the room, etc.

Table 3. EBASS: CISSAR Code Definitions (continued)

Teaching –the teacher is actively instructing or giving a lesson to the students or inactively listening to a student respond.
Other Talk – the teacher is talking about class business, management of activities, rules, the schedule, etc.
Approval – the teacher expresses praise for the students' classwork, conduct or performance
Disapproval – the teacher expresses dislike or dissatisfaction with student's work or conduct.

Student Response

Academic – active engagement with academic subject matter
Read Aloud – the student is looking at printed material like a book or blackboard, and saying aloud what is written
Read Silent – the student is looking at reading material for at least 2 seconds, with eye movement indicative of scanning words or numbers. (Rapid flipping of pages is coded as attending, not reading silently)
Talk Academic – the student is verbalizing about an academic subject, material, instructions, or other appropriate topic
Answer Academic Question – the student writes, verbalizes or gestures to provide an answer to the teacher's academic question
Ask Academic Question – the student verbally asks the teacher a question related to an assignment or instruction

Task Management – behaviors supporting academic responding
Attending to Task – the student is looking at the teacher teaching or another peer who is asking or answering a question. It also includes when the student is looking for a place in a text, putting materials away, erasing, sharpening pencils, and putting their head on their desk when given permission to do so.
Raise Hand –the student is observed with a hand raised
Look for Materials – the student is looking for materials either at or away from their desk
Moves – when the student is observed moving to a new area in the classroom
Play appropriate – the student is engaged in play behaviors approved by the teacher, such as during free time.

Competing (Inappropriate) Responses – undesired, inappropriate behaviors that interfere with academic learning
Disrupt – behavior that is aggressive (hitting, kicking, etc.,) or loud noises (yelling, banging materials, etc.)
Play Inappropriate – the student is manipulating small toys, rubber bands, passing notes, etc, any behavior not directly approved by the teacher
Task Inappropriate – the student is engaged in an academic task that is not the related to the present task approved by the teacher
Talk Inappropriate – the student is talking to a peer or the teacher about anything not related to the material at hand
Location Inappropriate – the student is out of their seat, away from instruction site, and does not have permission to move
Look Around – the student is looking away from the academic task at hand
Self-Stimulation – the student is rapidly rocking back and forth, thumb sucking, or nail biting, etc. for more than 2-3 seconds and it is the major feature of their activity.

Several reports can be generated from the data collected. The Percentage of Occurrence Report gives information about the frequency of occurrence of each of the 53 variables. The Profile Comparison Report allows analysis of similarity/dissimilarity scores between two subjects, settings or types of files. An Ecobehavioral Analysis Report provides conditional probabilities. That is, given a set of conditions (e.g., Activity—Math, Task—Worksheets, Teacher Behavior—Teaching), what is the likely student behavior. All three of these analyses were used to examine student behavior, teacher behavior, grouping structures, teacher position relative to students and type of task.

Procedure - Achievement Measures

All students in the experimental group and control tested on the NALT along with other students in the district under the standard procedures employed by the district each year. Results are reported as the change from spring 1998 to 1999 as measured by Normal Curve Equivalents (NCEs).

In addition, all students (experimental and control) participated in pre-testing on STAR Math in December 1998. All students completed a post-test on STAR Math at the end of the school year (May/June 1999). Students were tested in computer labs under the supervision of their teacher or lab assistants. Results are reported as the change from pre-to post-testing as measured by NCEs.

Procedure - Observation Measure

Condition 1: EM alone

Each student was observed across two points in time during two conditions, traditional instruction using Everyday Math (Condition 1: EM alone) and Everyday Math with Accelerated Math (Condition 2: EM with AM) (Table 4). Students were observed during condition 1 (EM alone) prior to and immediately following the implementation of Accelerated Math in the their classrooms. The initial observations of condition 1 (EM alone) were conducted in January and February, before the classes started using the AM program. Observations were conducted again during condition 1 (EM alone) in May, at the end of the school year, after the classes had stopped using AM as part of their math instruction.

Condition 2: EM with AM

Once teachers began implementing the AM program in addition to EM instruction (Condition 2: EM with AM), observations were scheduled and conducted between February and May. The

Table 4. Observation Timeline for Condition 1 (Everyday Math Alone) and Condition 2 (Everyday Math with Accelerated Math)

	Jan	Feb	Mar	April	May	June
EM alone (C - 1)	C-1: time 1 ——				C-1: time 2 ——	
EM w/AM (C - 2)		C-2: time 1 ——————		C-2: time 2 ——		

C - 1 = Condition 1 (Everyday Math alone)
C - 2 = Condition 2 (Everyday Math with Accelerated Math)
Time 1 = Timing of the first round of observations
Time 2 = Timing of the second round of observations

first round of observations of condition 2 (EM with AM) spanned three months, February through April. The second round of observations for condition 2 (EM with AM) was initiated in April and completed by the second week of May.

Each time observation data were collected, each student was observed for a total of about one-hour, across multiple days. However, at the end of the school year, due to scheduling logistics, an hour of observation may have been collected all in one sitting.

Analyses

We completed four kinds of analyses of achievement data. First we compared math achievement gains for all 4th and 5th grade students in the treatment condition (Everyday Math with Accelerated Math) to gains in math achievement for all 4th and 5th grade students in the district. Second, we compared gains in math achievement for students in the treatment condition to gains for a within-school control group. Third, we compared gains for high, middle, and low achieving students in the treatment group to those for high, middle, and low achieving students within the district. We did so by examining gains for students in our treatment group whose pre-test scores were in the top 20%, the median and the low 20% to the average score of the top 20%, median and low 20% of students in the entire district. The fourth achievement analysis was one in which we compared gains for students in our treatment group whose pre-test scores were in the top 20%, median and low 20% to the average score of the top 20%, median and low 20% of students in the same schools. We call these kinds of analyses 20/20 analyses and they are based on procedures recommended by Reynolds & Heistad (1997).

Several analyses of the observation data were conducted to examine changes in instructional ecology. These data were aggregated across the three schools for high, middle and low achieving students. Data analysis involved examining three types of EBASS report outputs, including Percentage of Occurrence, Profile Comparison, and Ecobehavioral Analysis. In addition, repeated measures multivariate analyses of variance were conducted to examine changes in student behavior by skill level and treatment condition.

Results

Achievement Gains

Gains in mathematics achievement were always studied by looking at changes in Normal Curve Equivalents (NCEs) on either the Northwest Achievement Levels Test (NALT) or the STAR Math test. Students who are developing their skills at the expected rate show no change in NCE scores across time. When there are increases in NCE scores this indicates better than expected performance, and decreases indicate slower than expected performance. An NCE gain of more than 3 points typically is considered statistically significant.

We were interested in gains in mathematics achievement for students who received the treatment (EM with AM) in comparison to those who received standard math instruction using Everyday Math alone. The average math achievement gain on the NALT for all students, grades 4 and 5 (N=6, 548), in the district over a one-year period of time (spring 98 – spring 99) was 2.66 NCEs. Students in grades 4 and 5, who participated in the three month Accelerated Math intervention (N=163) gained 6.65 NCEs in the same period of time. Gains in math achievement for the AM participant group were significantly higher than gains for all other 4th and 5th grade students in the district ($p < .00$).

We compared gains in mathematics achievement using STAR Math as the criterion measure. STAR Math was administered to all students in the four schools in which our treatment classes were located. It was given in December 1998 and again in May/June, 1999. Gains for the treatment group (N=187) were 5.8 NCEs, while the 139 students in the control group gained 1.7 NCEs. Students who received Accelerated Math treatment significantly out gained those who received Everyday Math only. Data on the NALT and STAR comparisons are shown in Figure 1.

We were also interested in the extent to which gains/losses in math achievement were different for students of differing skill levels. So, first we compared the NCE gains for the top 20%, median, and low 20% of the 15,502 continuously enrolled students in the district to the top 20%, median, and low 20% of the 187 students in our sample. NCE scores and gains for the district and for our experimental group are shown in Table 5.

Figure 1. Differences in Gains on NALT and STAR Math Accelerated Math Participants vs. Control Group

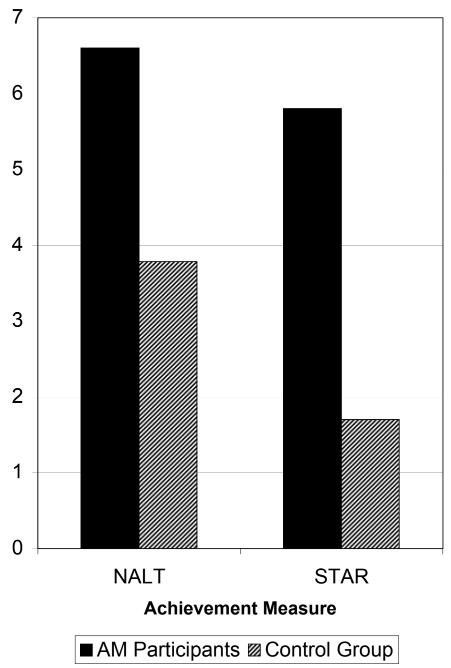


Table 5. Normal Curve Equivalent Scores on the NALT for the Entire District and for Accelerated Math (AM) Participants

	District (N=15,502)			AM Participants (N=187)		
	NALT 1998 (Pre NCE)	NALT 1999 (Post NCE)	*Gain*	NALT 1998 (Pre NCE)	NALT 1999 (Post NCE)	*Gain*
Top 1/5	70.9	70.9	*0.0*	64.2	67.7	*3.5*
Median	46.3	48.9	*2.6*	43.6	52.4	*8.8*
Bottom 1/5	28.2	31.5	*3.3*	26.3	34.4	*8.1*

An additional 20/20 analysis was run to examine performance across skill levels for the entire group of students who participated in Accelerated Math programming compared to the within-school control group. On STAR Math, students in the top 1/5, Median, and bottom 1/5 all showed significant NCE gains, 11.5, 6.0, and 4.1 respectively (Figure 2). The control group showed a slight (not statistically significant) decline at the top and low end of the distribution and a significant gain of 3.2 NCE units at the median of the distribution (Figure 3). On the NALT significant gains were again observed at all three levels of student performance for students participating in AM classrooms (Top 1/5 = 3.5, median = 8.8, bottom 1/5 = 8.1) (Figure 4). For the control group there was not a significant change for students at the top level (1.4), and significant gains observed at the median (6.2) and low level (4.4) (Figure 5).

Figure 2. Accelerated Math Participants: 20/20 Analysis of STAR Math Test Performance

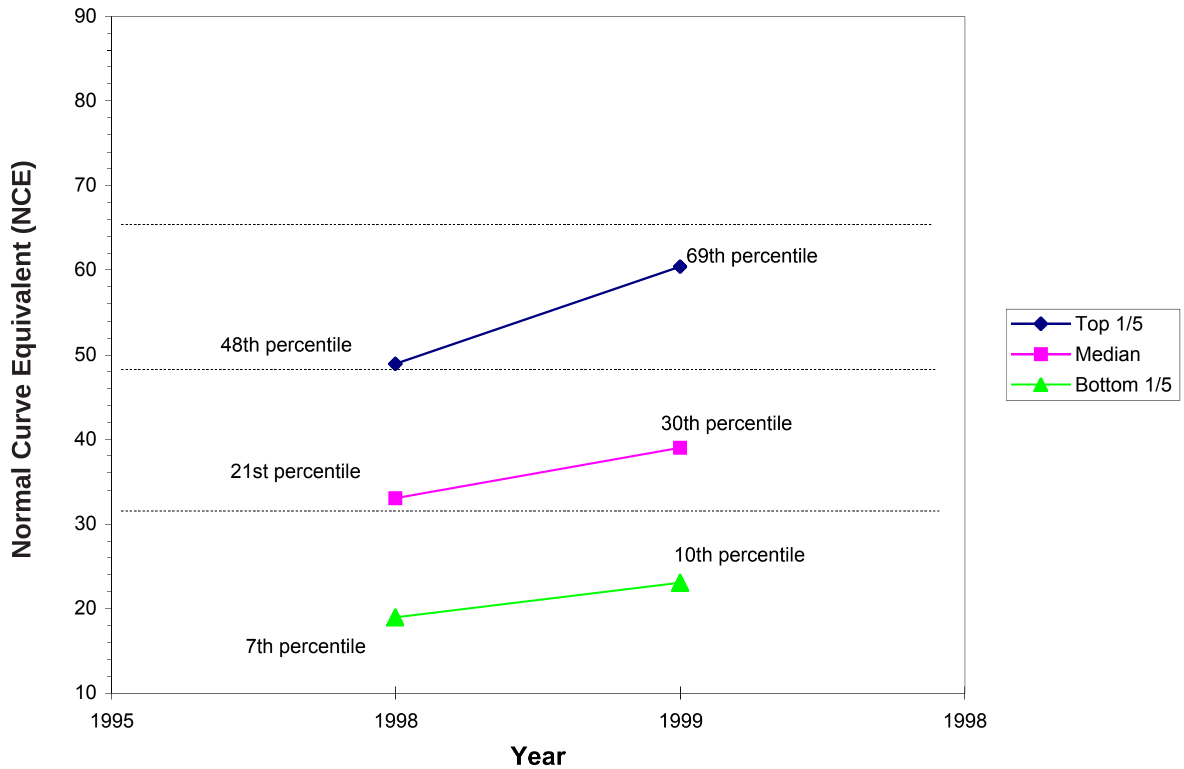


Figure 3. Control Group: 20/20 Analysis of STAR Math Test Performance

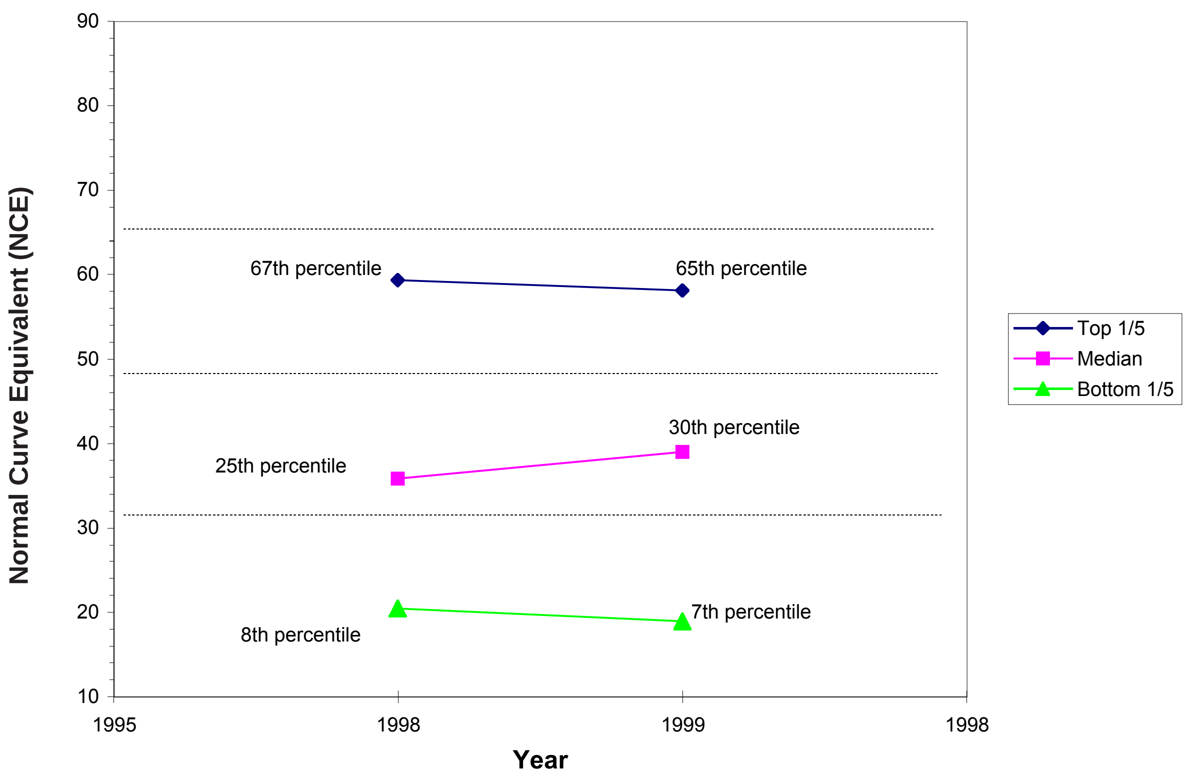


Figure 4. Accelerated Math Participants: 20/20 Analysis of NALT Performance

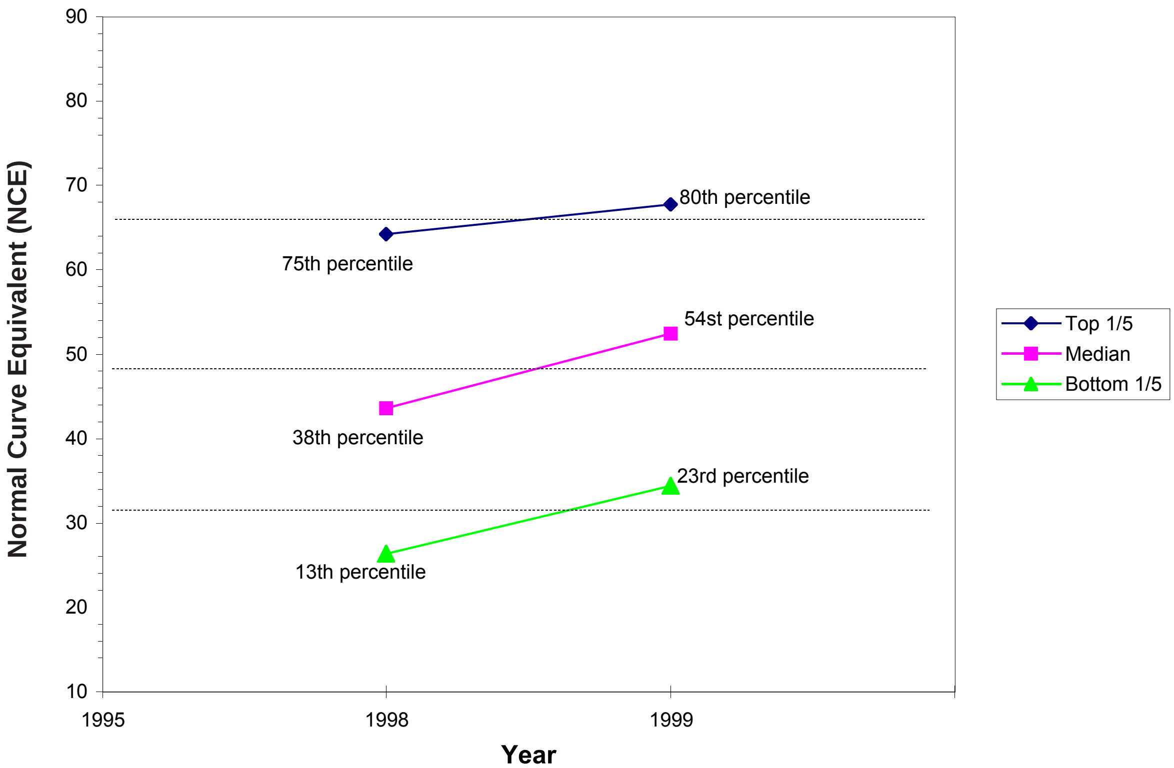
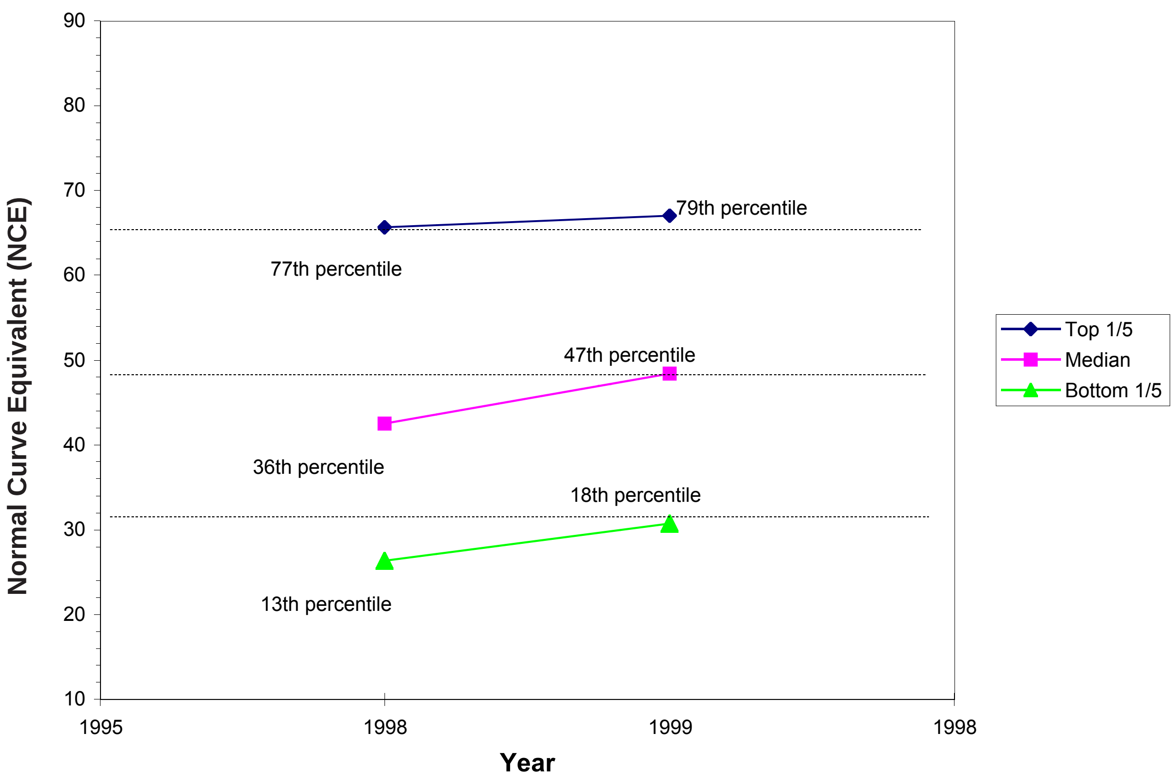


Figure 5. Control Group: 20/20 Analysis of NALT Performance



EBASS Observations

In total, 3,613 minutes of observation data were collected. During condition 1 (EM alone), 1,797 minutes (10,782 – 10 second intervals) were collected, 1,152 of those minutes (6,912 intervals) were collected at condition 1 - time 1 and 645 minutes (3,870 intervals) were collected at condition 1 - time 2. Observations during condition 2 (EM with AM) totaled 1,816 minutes (10,896 intervals). Condition 2 - time 1 included 939 minutes (5,634 intervals) and condition 2 - time 2 included 877 minutes (5,262 intervals).

Three separate analyses were conducted using the EBASS analysis program embedded in the software. In addition to the 19 variables for student response, three composite variables were created to represent student response. The seven academic responses (Writing, Play Academic, Read Aloud, Read Silent, Talk Academic, Answer Academic Question and Ask Academic Question) were added together to form a Total Academic Response score. The five task management variables (Attention, Raise Hand, Look for Materials, Moves and Play Appropriate) were combined to create a Total Task Management Score. The seven inappropriate classroom behaviors (Disrupt, Play Inappropriate, Task Inappropriate, Talk Inappropriate, Location Inappropriate, Look Around and Self-Stimulation) were added together to form a Total Competing Behavior Response score. Difference scores at or above 10 percentage points were considered significant for all analyses.

In the first analysis, we examined changes in all variables across the two points in time for condition 1 (EM alone). Results are shown in Table 6. During condition 1 there was no significant difference from time 1 to time 2 in activity, teacher position, structure, or student behavior. The only two significant changes were in Task, where there was a significant increase in teacher/student discussion, and in teacher behavior, where there was a significant decrease in teaching (e.g. actively giving a lesson, listening to a students respond, etc.). In Table 7 changes were observed over time during condition 2 (EM with AM). During condition 2, the variables were relatively stable across time-1 and time-2. However, at time 2 there was an increase in small group instruction combined with a relatively similar amount of entire group and individual instruction (40%). Further, teacher position demonstrates varied practice with no one style above 40% or maximizing teacher focus.

Due to the fact that most of the variables measured did not change more than 10% from time-1 to time-2, data were aggregated for each teaching condition. This allowed a second analysis comparing all the files collected during condition 1 (EM alone) with all the observation files collected during condition 2 (EM with AM). The results indicate that in general, during condition 1, there was a wide range of tasks used, but primarily use of worksheets, workbooks, other media, and listen/lecture. However, during condition 2 the activity was almost exclusively worksheets.

Table 6. Observations of Condition 1 (Everyday Math Alone) at 2 Different Points in Time, Listed in Percent of Occurrence

	T-1	T-2	DIFF
Activity			
Reading	0.3	1.6	1.2
Math	96.3	97.5	1.3
Spelling	0.7	0.5	-0.2
Handwriting	0.2	0.3	0.1
Language	0.0	0.0	0.0
Science	0.0	0.0	0.0
Social Studies	0.0	0.0	0.0
Arts/Crafts	0.1	0.0	-0.1
Free time	0.5	0.0	0.5
Business Mgmt	0.0	0.0	0.0
Transition	1.6	0.0	-1.6
Can't Tell	0.0	0.0	0.0
Missing	0.3	0.2	-0.1
Task			
Readers	0.4	0.2	-0.3
Workbooks	33.0	30.1	-2.9
Worksheets	26.0	20.2	-5.9
Paper & Pencil	5.3	5.9	0.6
Listen/Lecture	12.9	3.9	-9.1
Other Media	16.8	24.2	7.3
Teacher/Stud. Discus	1.9	13.0	11.1
Fetch/Put	2.8	1.7	-1.1
Missing	0.8	0.9	0.1

	T-1	T-2	DIFF
Structure			
Entire Group	80.6	81.2	0.6
Small Group	15.5	14.3	-1.3
Individual	2.2	2.8	0.6
Missing	1.6	1.7	0.1
Teacher Position			
In Front	48.7	50.7	2.1
At Desk	2.1	2.8	0.7
Among students	34.1	35.3	1.2
Side	2.3	1.7	-0.6
Back	7.7	5.2	-2.5
Out	1.4	2.5	1.2
Missing	3.6	2.5	-2.0
Teacher Behavior			
No Response	13.8	20.9	7.1
Teaching	72.2	59.1	-13.0
Other talk	7.0	14.2	7.2
Approval	0.9	0.7	-0.1
Disapproval	2.3	2.2	-0.2
Missing	3.8	2.9	-0.9

	T-1	T-2	DIFF
Student Response			
Writing	13.5	17.4	3.9
Play Academic	8.0	6.0	-2.0
Read Aloud	0.1	0.1	-0.1
Read Silent	2.7	2.7	-0.1
Talk Academic	3.5	3.9	0.4
Answer Ac. Question	1.2	1.1	-0.1
Ask Acad. Question	0.6	0.4	-0.2
T Academic Response*	***29.6***	***31.6***	***2.0***
Attention	42.6	34.7	-7.9
Raise hand	1.8	1.6	-0.3
Look for Materials	2.2	1.2	-1.0
Moves	2.9	5.4	2.5
Play appropriate	0.2	0.1	-0.1
T Task Management*	***49.7***	***43.0***	***-6.7***
Disrupt	0.2	0.4	0.2
Play Inappropriate	1.3	1.2	-0.1
Task Inappropriate	2.0	3.1	1.1
Talk Inappropriate	2.5	3.7	1.1
Location Inappropriate	1.5	0.7	-0.8
Look around	7.0	7.0	0.0
Self-Stimulation	0.7	1.5	0.9
T Compete Behavior*	***15.2***	***17.6***	***2.4***
Missing			

T Academic Response = total of active academic engagement variables
T Task Management = total of behaviors supportive of academic responding
T Complete Behaviors = total of undesired, inappropriate behaviors that interfere with academic learning

Table 7. Observations of Condition 2 (Everyday Math with Accelerated Math) at 2 Different Points in Time, Listed in Percent of Occurrence

	T-1	T-2	DIFF
Activity			
Reading	0.9	1.5	0.6
Math	96.8	97.7	0.9
Spelling	0.3	0.2	-0.1
Handwriting	0.2	0.3	0.1
Language	0.0	0.0	0.0
Science	0.0	0.0	0.0
Social Studies	1.5	0.0	-1.5
Arts/Crafts	0.1	0.1	0.0
Free time	0.0	0.0	0.0
Business Mgmt	0.0	0.0	0.0
Transition	0.1	0.1	0.0
Can't Tell	0.0	0.0	0.0
Missing	0.1	0.0	-0.1
Task			
Readers	0.0	0.1	0.1
Workbooks	0.2	0.2	0.0
Worksheets	94.8	98.4	3.6
Paper & Pencil	1.7	0.0	-1.7
Listen/Lecture	0.7	0.0	-0.7
Other Media	0.3	0.0	-0.3
Teacher/Stud. Discus	0.0	0.8	0.8
Fetch/Put	1.4	0.1	-1.3
Missing	0.9	0.3	-0.5

	T-1	T-2	DIFF
Structure			
Entire Group	37.7	47.3	9.6
Small Group	1.8	11.1	9.2
Individual	59.1	40.8	-18.3
Missing	1.4	0.8	-0.6
Teacher Position			
In Front	9.2	16.9	7.7
At Desk	14.7	7.3	-7.5
Among students	28.9	37.0	8.1
Side	7.7	9.1	1.3
Back	33.9	24.4	-9.5
Out	2.2	3.2	1.0
Missing	3.4	2.2	-1.2
Teacher Behavior			
No Response	22.8	33.4	10.6
Teaching	45.7	31.3	-14.4
Other talk	22.9	29.8	6.9
Approval	1.2	0.7	-0.5
Disapproval	3.5	1.9	1.6
Missing	3.9	2.9	1.1

	T-1	T-2	DIFF
Student Response			
Writing	24.7	25.4	0.7
Play Academic	0.7	1.1	0.4
Read Aloud	0.4	0.2	-0.1
Read Silent	9.6	12.0	2.4
Talk Academic	3.6	2.3	-1.3
Answer Ac. Question	1.3	1.4	0.2
Ask Acad. Question	0.9	0.9	0.1
T Academic Response*	***41.2***	***43.3***	***2.1***
Attention	27.1	24.5	-2.6
Raise hand	0.2	0.7	0.5
Look for Materials	1.9	1.8	-0.1
Moves	7.2	5.3	-1.9
Play appropriate	0.1	0.1	0.0
T Task Management!*	***36.5***	***32.4***	***4.1***
Disrupt	0.8	0.1	-0.6
Play Inappropriate	1.0	1.1	0.1
Task Inappropriate	1.8	2.9	1.1
Talk Inappropriate	3.7	3.1	-0.6
Location Inappropriate	0.4	0.7	0.2
Look around	6.8	8.3	1.5
Self-Stimulation	0.3	1.3	1.1
T Compete Behavior*	***14.8***	***17.5***	***2.7***
Missing	7.5	6.7	-0.8

T Academic Response = total of active academic engagement variables
T Task Management = total of behaviors supportive of academic responding
T Complete Behaviors = total of undesired, inappropriate behaviors that interfere with academic learning

The results also show that during condition 2, there was more individual instruction, and less entire group instruction. In contrast, during condition 1, instructional structure was almost always "entire group" (80%). During condition 2, the structure was more balanced between entire group and individual instruction (entire group = 47.3%, small group = 11.1%, individual = 40.8%).

In terms of student behavior, during condition 1 students spent more time writing, an academic response, and less time "attending to task," a passive behavior. (Attending to task includes listening to the teacher, waiting for a turn, etc.) Finally in regard to composite measures of student behavior, students spent less time engaged in task management behaviors in condition 2 (EM with AM = 34.6%) than in condition 1 (EM alone = 47.2%). They also spent more time academically engaged during condition 2 (EM with AM) than they did during condition 1 (EM alone) (Condition 1 = 30.3 percent, Condition 2 = 42.2 percent), an increase of 12%.

Two separate, repeated multivariate analyses of variance were completed to examine the extent to which there were changes in student behaviors over time for students as a function of achievement level (high, middle, and low) and treatment (Everyday Math alone v Everyday Math with Accelerated Math). We examined the extent to which there were significant increases in academic behaviors when AM was added to EM, and the extent to which this was a function of ability/skill group. Findings are shown in Table 9 and Figure 6. In this first analysis, no interaction was found. There was however, a significant effect for treatment: all students were more academically engaged in condition 2 (EM with AM). There was also a significant effect for skill level: higher achieving students were more academically engaged in both conditions than lower achieving students. In the second analysis we examined the extent to which there were changes in incidence and frequency of competing behaviors (like inappropriate behavior). No significant differences were observed. Results are shown in Table 10.

The final analysis examined conditional probabilities between student academic engaged time, and teacher behavior, as measured by the instructional grouping, teacher position and teacher behavior categories. This relationship was examined for both conditions. In both instructional conditions, "entire group instruction" was negatively related to academic responding. This is important, since in condition 1 (EM only) students were instructed in entire groups 80% of the time. The addition of AM appears to affect the ecology in such a way that teachers are able to engage in best practices. Also, in both conditions, there was a negative relationship between academic responding and the teacher positioned in front of the class. Small-group instruction was positively related to academic responding, as seen in condition 1 data. In addition, individual instruction was positively related to academic responding in condition 2. In both instructional conditions, a positive relationship was demonstrated between academic responding and teachers being positioned among their students. Finally, academic responding tended to be suppressed when teachers engaged in "other talk" (general discussions) for both conditions.

Table 8. Condition 1 (EM Alone) Compared to Condition 2 (Everyday Math with Accelerated Math).

	C-1	C-2	DIFF
Activity			
Reading	0.8	1.2	0.4
Math	96.7	97.2	0.5
Spelling	0.6	0.3	-0.3
Handwriting	0.2	0.3	0.1
Language	0.0	0.0	0.0
Science	0.0	0.0	0.0
Social Studies	0.0	0.8	0.8
Arts/Crafts	0.1	0.1	0.0
Free time	0.3	0.0	-0.3
Business Mgmt	0.0	0.0	0.0
Transition	1.1	0.1	-0.9
Can't Tell	0.0	0.0	0.0
Missing	0.2	0.1	-0.1
Task			
Readers	0.3	0.1	-0.3
Workbooks	31.9	0.2	-31.7
Worksheets	23.9	96.5	72.6
Paper & Pencil	5.5	0.9	-4.6
Listen/Lecture	9.7	0.4	-9.3
Other Media	19.5	0.2	-19.3
Teacher/Stud. Discus	5.9	0.4	-5.5
Fetch/Put	2.4	0.8	-1.6
Missing	0.8	0.6	-0.2

	C-1	C-2	DIFF
Structure			
Entire Group	80.9	42.3	-38.5
Small Group	15.1	6.3	-8.8
Individual	2.4	50.3	47.9
Missing	1.7	1.1	-0.6
Teacher Position			
In Front	49.4	12.9	-36.5
At Desk	2.4	11.1	8.8
Among students	34.6	32.8	-1.8
Side	2.1	8.4	6.3
Back	6.8	29.3	22.4
Out	1.8	2.7	0.9
Missing	2.9	2.8	-0.1
Teacher Behavior			
No Response	16.3	28.0	11.6
Teaching	67.5	38.7	-28.8
Other talk	9.6	26.2	16.6
Approval	0.8	1.0	0.1
Disapproval	2.3	2.7	0.4
Missing	3.5	3.4	-0.1

T Academic Response = total of active academic engagement variables
T Task Management = total of behaviors supportive of academic responding
T Complete Behaviors = total of undesired, inappropriate behaviors that interfere with academic learning

	C-1	C-2	DIFF
Student Response			
Writing	14.9	25.1	10.2
Play Academic	7.3	0.9	-6.4
Read Aloud	0.1	0.3	0.2
Read Silent	2.7	10.7	8.0
Talk Academic	3.6	3.0	-0.7
Answer Ac. Question	1.2	1.3	0.2
Ask Acad. Question	0.5	0.9	0.3
*T Academic Response**	***30.3***	***42.2***	***11.9***
Attention	39.7	25.9	-13.9
Raise hand	1.7	0.4	-1.3
Look for Materials	1.8	1.9	0.1
Moves	3.8	6.3	2.5
Play appropriate	0.2	0.1	-0.1
*T Task Management**	***47.2***	***34.6***	***-12.6***
Disrupt	0.2	0.5	0.2
Play Inappropriate	1.2	1.0	-0.2
Task Inappropriate	2.4	2.3	-0.1
Talk Inappropriate	3.0	3.5	0.5
Location Inappropriate	1.3	0.5	-0.7
Look around	7.0	7.5	0.5
Self-Stimulation	1.0	0.8	-0.2
*T Compete Behavior**	***16.1***	***16.1***	***0.0***
Missing	6.3	7.1	0.9

Table 9. Average Percent of Time Engaged in Academic Responding

Achievement Level	Treatment	
	EM alone	EM with AM
High	35.3	46.6
Middle	30.6	42.3
Low	25.3	36.2

* High, middle and low achieving students were defined based on performance on a Computerized Adaptive Test. High achievers scored a percentile rank ≥75, middle achievers earned a percentile rank between 40 and 60, and low achievers earned a percentile rank < 25.

Figure 6. Average Percent of Time Engaged in Academic Responding

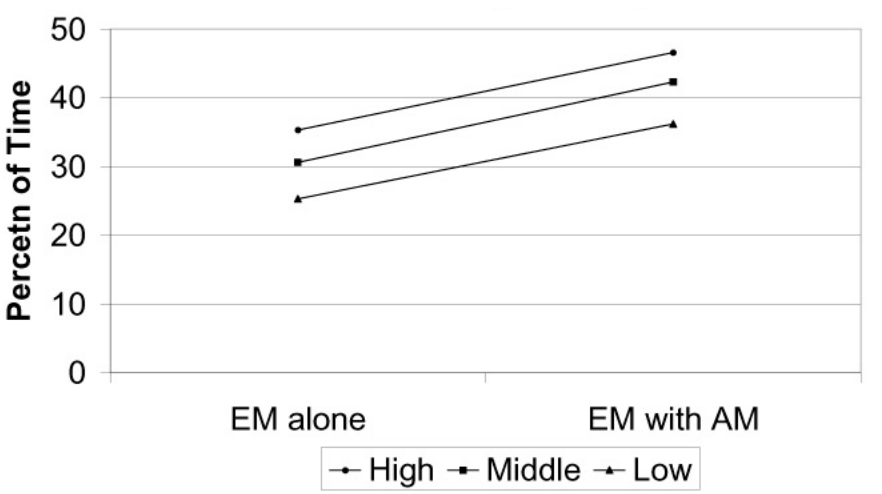


Table 10. Average Percent of Time Engaged in Competing Behaviors

Achievement Level	Treatment EM alone	EM with AM
High	13.7	13.2
Middle	16.3	22.1
Low	18.2	14.9

* High, middle and low achieving students were defined based on performance on a Computerized Adaptive Test. High achievers scored a percentile rank ≥75, middle achievers earned a percentile rank between 40 and 60, and low achievers earned a percentile rank < 25.

Discussion

In this study we examined the effects a learning information system, Accelerated Math (AM), has on student math achievement and ecobehavioral variables known to be related to overall student achievement outcomes. These features included both teacher and student behaviors.

Student Achievement

Overall, students who used the Accelerated Math program demonstrated greater gains in math achievement than district-wide or within-school control groups. These gains were realized in a difficult context: incorporation of a new procedure into an instructional routine in the middle of the year. And, there was well-documented variance in degree of implementation of the program. Some teachers implemented the program with much more commitment and fidelity than did others. This is the subject of a separate investigation now being completed.

Significant differences in gains between groups on the STAR Math test may be partially related to the nature of the STAR Math test and the Accelerated Math program. Both are computer-generated and created by the same company. There may be a closer overlap between these two instruments in the language used and type of problems presented. Familiarity with the Accelerated Math program may enhance performance on the STAR Math test above and beyond what would be expected from skill development alone. However, commensurate gains on the district administered assessments (NALT) were also observed.

As seen in the 20/20 analysis, students in the experimental group, across all skill levels, demonstrated significant gains on the NALT test. In contrast only students in the middle and lower skill groups of the controls showed significant gains on the NALT.

Use of Accelerated Math enhanced the skill development of students of all ability groups to some degree, but especially lower achieving students.

Observations

Instructional Structure

Findings indicate that instructional grouping was different when AM was added to the Everyday Math curriculum (EM). Students were coded as receiving more individualized instruction during the EM with AM condition. This meant that they either were working on an individual assignment or with the teacher, one-on-one. In contrast, during the EM alone condition, students were mostly involved in entire group instruction. Individualized instruction or instructional grouping increases the opportunity for teachers to tailor feedback to match student needs. Future studies will need to be conducted to verify that under these conditions, student-teacher interactions were taking advantage of these opportunities.

Second, findings indicate that there was more individual grouping in the EM with AM condition versus more entire group instruction during the EM alone condition. Further, the ecobehavioral analysis revealed that students were more likely to be engaging in academic responses during individual instruction and they were less likely to engage in academic responses during entire group instruction. Thus, the use of Accelerated Math appears to facilitate instructional arrangements that enable teachers to engage in best practices, which are related to positive student outcomes.

Teacher Position and Teacher Behavior

The EBASS variable categories Teacher Position and Teacher Behavior were used to examine whether using AM with Everyday Math actually facilitates teacher/pupil interaction. The hypothesis posited was that teacher position in the room and teacher behavior would either increase or decrease the probability of teacher-student interactions. For example, if the teacher is in front, teaching the class, it is less likely that they are providing individualized interaction with all students than if they are among the students and teaching (MIMI).

During condition 2, teachers spent more of their time in the back of the room and less in front than during condition 1. Neither of these positions would appear to be more conducive to teacher/pupil interactions. They are also both negatively related to student academic engagement. Accelerated Math did not increase the amount of time teachers spent among students. In both conditions, teachers spent about 35% of the time among the class. In this study use of AM did not change teacher position. They simply do not spend much time among students. Further, during condition 2, teachers' behavior and position were more balanced than in condition 1, where they spent about 50% of the time teaching in front of the entire group. Unfortunately, the CISSAR code selected was not sensitive enough to determine the actual instructional activities of the teacher and whether or not pupil interaction was taking place. Future studies may wish to draw upon the rich data available using the MS-CISSAR code of the EBASS software to enhance observational data.

Task

The results indicate that teachers chose a wide variety of tasks for instruction during the EM alone condition. These tasks included: worksheets, workbooks, teacher/student discussion, listen/lecture, and other media (calculators, protractors and other manipulatives). The Everyday Math curriculum incorporates a broad range of activities to assist in the transmission of math concepts to students.

During the EM with AM condition, the task observed was almost exclusively worksheets (98.4%). Although AM worksheets are individualized and provide appropriate practice at each individual's ability level, they are only one part of an instructional program necessary for educating students on all the math standards articulated by the NCTM. The primary focus of Accelerated Math on worksheets is a reminder that the AM program is best used to augment a full math curriculum, which generally includes a broader range of activities.

Accelerated Math provides a way for teachers to give students a boost of individualized practice on math concepts embedded within the curriculum. It is very time consuming, if not impossible, for teachers to provide individualized practice for students on math objectives within any math curriculum, without the kind of computer-managed information tracking provided by Accelerated Math. Including Accelerated Math into a preexisting math instruction program may function as a means of "accelerating" student learning of the full math curriculum.

Student Behavior

The addition of Accelerated Math to the Everyday Math curriculum produced a strong positive effect on student behavior. Students spent less time engaged in management behaviors and more time engaged in academic responding, which is related to positive student achievement outcomes (Borg, 1980). Students at all levels of achievement (high, middle, and low) were all more actively engaged during the EM with AM condition than the EM alone condition. In addition, low achieving students during EM with AM, reached academic engagement levels similar to high achieving students in the EM alone condition (Table 9).

Conclusion

It is clear from these data that the implementation of Accelerated Math with Everyday Math resulted in an increase in the amount of time spent on ecobehavioral activities that have been identified as contributing to positive academic outcomes. Further, students across all achievement levels who participated in the Accelerated Math program, demonstrated significant gains on both a district administered standardized test (NALT) and the STAR Math test, a proprietary Computer Adaptive Test.

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