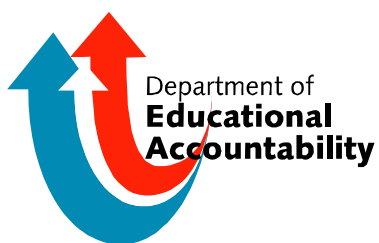


**Carnegie Learning
Cognitive Tutor Algebra 1
Implementation Report
2001-2002**

January 2003



**Fairfax County Public Schools
Office of Program Evaluation**

FAIRFAX COUNTY PUBLIC SCHOOLS

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CARNEGIE LEARNING COGNITIVE TUTOR ALGEBRA 1 IMPLEMENTATION REPORT 2001-2002

INTRODUCTION

The Carnegie Learning Cognitive Tutor Algebra 1 (CTA1) program was first implemented in four high schools in Fairfax County Public Schools in January 2002. The schools that were considered for and eventually volunteered to participate in the program have low Standards of Learning (SOL) Algebra 1 scores, a high percent of students on free and reduced lunch (F&RL), and a high percent of English for speakers of other languages (ESOL) students. During the 2001-2002 school year, the four participating schools were Annandale, Mount Vernon, and West Potomac High Schools, as well as Pimmit Hills Alternative High School. In three of the four schools, the targeted group consisted of students with failing or close to failing grades in Algebra 1 in the first two quarters of the 2001-2002 school year, whereas at the fourth school students demonstrated a range of achievement performance. Approximately 177 students were enrolled in the program between January and June 2002. The adoption of the program for low-performing students is consistent with the division target that, by the end of the eleventh grade, all students scheduled to graduate with a standard or advanced studies diploma will have passed the Algebra 1 and two English 11 SOL tests.

Unlike the traditional approach to teaching Algebra 1, the CTA1 curriculum requires students to dedicate 40 percent of classroom time in a computer lab solving mathematics problems and 60 percent of the classroom time learning mathematics concepts and practicing problem-solving skills in group activities and presentation. The cognitive tutor embedded in the computer software uses model tracing to provide “just-in-time” assistance that is sensitive to students’ individual approach to a problem. The cognitive tutor also traces students’ knowledge growth across a range of problem-solving activities. The knowledge tracing capacity of the software updates estimates on how well students know each problem-solving skill. These estimates are used to select problem-solving activities and adjust pacing to accommodate the needs of individual students. Both computer lab and class activities allow for ample student participation in the learning process. The teacher facilitates learning by offering assistance to students whenever needed and by ensuring the understanding of course content on the part of the students. The CTA1 curriculum is based on the research of Anderson’s cognitive theory of learning and skill acquisition (1983, 1993). The rationale behind this student-centered, hands-on instructional approach is that students learn best through active involvement in the learning process.

The Carnegie Learning Corporation provides a blueprint that describes the alignment between the CTA1 curriculum and the Virginia SOL (Carnegie Learning, 2002a) and the standards set by the National Council of Teachers of Mathematics (Carnegie Learning, 2002b). The CTA1 curricula have been adopted in more than 37 states and in 35 of the 100 large school districts in the United States (Carnegie Learning, 2002c). The Carnegie Learning publication indicates that the CTA1 students outperform their traditional mathematics Algebra 1 (TMA1) counterparts on standardized tests (Carnegie Learning, 1994, 1997) and that low-performing students benefit from the CTA1

program as is reflected in a study where 76 percent of the students who had failed a previous course passed a summer school course (Carnegie Learning, 2000).

The total cost of the CTA1 program for the four schools during the 2001-2002 school year was \$22,753 (based on the information from Instructional Services). The itemized cost is listed below: (1) \$14,355 for site license and computer software (\$2,142 for the smallest school, and \$4,071 for each of the remaining three). This cost allows for as many students in the CTA1 program as a school desires. (2) \$8,000 for teacher training and instructional materials. This cost permits the training of up to 25 teachers to use a Carnegie Learning product such as CTA1 or CT Geometry. (3) \$398 for textbooks (During the 2001-2002 school year, each school got the first 50 textbooks free and paid \$7.50 for each additional copy. Starting from the 2002-2003 school year, the textbook is \$10.50 per copy.). Since the textbook is consumable (paper cover), the textbook needs to be purchased every year.

Table 1 provides an estimated cost per student comparison of the CTA1 versus TMA1 programs for different enrollment capacity. The estimate takes into consideration the cost for site license, teacher training, and textbooks for a single start-up year. It can be seen that cost per student is similar for both programs when the enrollment capacity is around 100 and that the cost decreases more for the CTA1 program than for the TMA1 program as the enrollment capacity reaches 200. Given past success with the CTA1 program in other school districts (Carnegie Learning, 1994, 1997, 2000) and the initial reactions to the program in FCPS, it is likely that participating schools will continue to increase enrollment in the CTA1 program. Therefore, there is the potential for the CTA1 program to be a more cost-effective approach to teaching Algebra 1 than the TMA1 approach.

Table 1
Cost per Student Comparison of CTA1 and TMA1 Programs for a Single Start-Up Year

Program	Cost per Student Estimate for Different Enrollment Capacity				
	Item of Cost	50 ¹	100	200	300 ²
CTA1	Site License ³	\$81.42	\$40.71	\$20.36	\$13.57
	Teacher Training ⁴	\$47.68	\$27.68	\$17.68	\$14.35
	Textbook	\$10.50	\$10.50	\$10.50	\$10.50
	Total	\$139.96	\$78.89	\$48.54	\$38.42
TMA1	Site License	0	0	0	0
	Teacher Training ⁵	\$49.6	\$29.6	\$19.6	\$16.27
	Textbook	\$60.00	\$60.00	\$60.00	\$60.00
	Total	\$109.6	\$89.6	\$79.6	\$76.27

¹ The average number of students enrolled in the CTA1 program per school (regular size) during the 2001-2002 school year. We assume training one teacher for every 50 students.

² The maximum number of students that can be enrolled in the CTA1 program at a regular high school (based on the 2002 SOL Algebra 1 end-of-course test data).

³ Annual cost of site license and computer software is \$4,071 per school (regular size).

⁴ Cost of teacher training by Carnegie Learning trainers is \$8,000 (can be reduced significantly if FCPS teachers are used as trainers). Assuming only four schools participate in the program, the cost per school is \$2,000. The estimate here takes into consideration teacher stipend (\$384 per teacher for 4 days) during summer training.

⁵ Cost of teacher training in summer is \$2,000 per instructor. The estimate here takes into consideration teacher stipend (\$480 per teacher for 5 days).

In response to several participating schools' request to expand the CTA1 program, the Instructional Services Department (ISD) contacted the Office of Program Evaluation (OPE) in May 2002 for a study of the impact of the CTA1 program on student achievement and their attitudes about learning mathematics. Data were collected from student survey, teacher interviews, Algebra 1 course marks, and the SOL Algebra 1 end-of-course test to facilitate the evaluation of the program. The analysis results of the data are presented in this report. Given the short duration of involvement in the CTA1 program by students prior to data collection (half way through the 2001-2002 school year), the report mainly focuses on teacher preparation, program implementation, and program impact on teaching. Student attitudes and achievement data are also included to establish baseline information. Subsequent interim reports will provide more insight on the impact of the program on student achievement.

PURPOSE OF THE EVALUATION AND EVALUATION QUESTIONS

The two and one half years' evaluation of the CTA1 program (January 2002 - June 2004) was designed to determine the extent to which the prescribed CTA1 components were implemented and to identify the impact of the program on student mathematics achievement, student attitudes about learning mathematics, and teaching. Seven evaluation questions were constructed and grouped under four key areas: teacher preparation, program implementation, program impact on teaching, and program impact on student attitudes and achievement (Year 1 evaluation focuses on establishing baseline data). Consideration of teacher preparation and program implementation helps establish the link between program outcomes and program implementation and interpret the findings in a realistic context.

The evaluation covered in this interim report addresses the following questions:

- To what extent are teachers prepared to implement the CTA1 program?
- To what extent is the CTA1 program implemented and operational as prescribed?
- In what ways has the CTA1 program changed teachers' beliefs about teaching and learning Algebra 1 and Geometry? (This question will be addressed in the Year 2 interim report.)
- What impact does the CTA1 program have on teachers in terms of course preparation, pacing of course content, instructional strategies, course assessment, and special preparations for SOL tests?
- What are the attitudes of CTA1 students about learning Algebra 1?
- How do the grades of CTA1 students differ from those earned by similar students in the TMA1 classes?
- How do the SOL mathematics scores of CTA1 students compare with those of similar TMA1 students?

EVALUATION DESIGN AND DATA COLLECTION

An evaluation team was established to provide feedback for the design of the evaluation. The team consists of OPE and ISD staff, as well as two school-based staff members. Both quantitative and qualitative methods were used in the evaluation of the CTA1 program. Data were collected from multiple sources using teacher interviews, student survey, course grades, and SOL Algebra 1 end-of-course test scores. Given that three of the four schools implementing the CTA1 program selected students based on their unsatisfactory course marks (i.e., F, D, D+), student-level matching was used to identify a comparison group for the CTA1 students. Based on a consideration of previous course marks (1st and 2nd quarters in the 2001-2002 school year), eighth grade SOL mathematics score, and ninth grade Stanford 9 mathematics score, the students enrolled in the CTA1 program were matched with those enrolled in the TMA1 classes within the same school. Demographic factors such as percent of ESOL students, percent of students on F&RL, gender, and ethnicity were also taken into consideration to determine the comparability of the two groups before statistical tests were performed on the data.

Teacher interviews were conducted with all five teachers in the CTA1 program in May and June 2002. The interview was designed to collect information on teacher training, program implementation, student motivation and achievement, and the impact of the program on teaching. A student survey was administered to all the students enrolled in the CTA1 program at the end of the 2001-2002 school year. The survey was designed to measure the participants' perception of the advantages of the CTA1 program, their attitudes about learning mathematics, and their perceived mathematics achievement. Two sources of student achievement data were used in the evaluation: Algebra 1 course marks and the SOL Algebra 1 end-of-course test scores. Achievement data for both the CTA1 students and their TMA1 counterparts were obtained from the Office of Student Testing between May and August 2002.

YEAR 1 FINDINGS

Findings are presented for each of the six evaluation questions. The evaluation questions are grouped into four general categories of teacher preparation, program implementation, program impact on teaching, and baseline data on student attitudes and achievement.

Teacher Preparation

To what extent are teachers prepared to implement the CTA1 program?

The CTA1 teachers received a 3-day training provided by Carnegie Learning in January 2002 and had a 1-day follow-up session a month later. Three out of the five teachers interviewed reported that the training was "adequate" or "sufficient" because the trainer "showed different ways to use the program." One of these teachers also pointed out that her previous teaching experience with a similar curriculum helped her a lot and that "without that experience, the training will not be enough."

One of the major changes from the traditional instructional approaches is that the CTA1 program requires collaborative learning activities (see discussion for the next question). The

implementation of collaborative learning proved to be difficult for both novice and veteran teachers. For a novice teacher, the use of collaborative learning impacted every aspect of teaching because “It is geared towards cooperative learning... It was a very different way of preparing for it, the assessment, and everything that went along with it.” A veteran teacher also confessed that she was originally “out of [her] comfort zone doing not much teaching and letting the class go with groups.” For the new teacher, the challenge of the instructional approach was compounded with the limited preparation time since the teachers received the CTA1 training and instructional materials in January and started teaching the program in the first week of February.

When asked what additional support do they need to ensure the successful implementation of the program, most teachers mentioned the need for excellent technical support. Several teachers also expressed the desire to communicate with other CTA1 teachers as a convenient way to solve problems they encounter in the classroom.

Program Implementation

To what extent is the CTA1 program implemented and operational as prescribed?

The CTA1 instructional approach requires a dedicated use of 40 percent of classroom time in a computer lab and 60 percent of the classroom time going over mathematics concepts and skills, doing group work, and making student presentations. While in the lab, students work independently on the computer solving mathematics problems at their own pace and ability level. Another key feature of the CTA1 program is collaborative learning embedded in group work and student presentations. Rotating group members is recommended to maximize interaction and learning opportunities. Group work and student presentation should go hand in hand in that students present the results of their group work. Every student has to participate in the group work and presentation. If a student does not talk during a presentation, the teacher should check his or her understanding by asking questions related to the problem the group has worked on. It is recommended that collaborative learning activities should be used from the beginning of the school year. For both lab and classroom activities, the teacher is a resource person and a facilitator in the learning process.

All the teachers interviewed reported that they had implemented the lab component as required although some teachers reported loss of classroom time due to computer setup when laptop computers were used. The implementation of group work and student presentation, however, was less consistent. While one teacher expressed excitement about collaborative learning activities because “kids love the group work and they love doing presentations,” two other teachers’ responses indicated that the implementation of collaborative learning turned out to be challenging in their classrooms. One teacher reported that group work was a struggle and that only one student presentation was done because it was difficult to manage and discipline students. In another class, the teacher “backed off from doing group work to do pairs” and “dropped group presentation because four students stand here and only one will talk.” These findings suggest that collaborative learning activities were not yet fully implemented in some classrooms.

Program Impact on Teaching

What impact does the CTA1 program have on teachers in terms of course preparation, pacing of course content, instructional strategies, course assessment, and special preparations for SOL tests?

Several teachers reported that the CTA1 program came with sufficient instructional materials and “many exercises that are good.” A direct benefit of this is less preparation in the form of “copying and typing.” For some teachers, the collaborative learning component of the CTA1 program affected course preparation, pacing of course content, and instructional strategies either because including student presentation made it harder to estimate how long “it would take to cover a unit” or because the teachers came from a “direct teaching background” and found it difficult “to do group work.” As for the assessment, the teachers needed to pick and choose the right materials from the CTA1 teacher’s book to ensure that all topics were covered for the SOL test. Three of the five teachers interviewed reported that they had to make up their own tests and quizzes either because the assessment materials in the CTA1 book “are too easy” or because the word problems format frequently used in the CTA1 book did not align well with the multiple-choice format on the SOL Algebra 1 test. One teacher also used what was available from other teachers to prepare students for the SOL test.

In spite of the adjustments required by the new instructional approach, most teachers applauded the benefits of the CTA1 program for student learning. One teacher commented that collaborative learning “allows them [students] to have ownership” because it is student-centered and allows for student teaching whereas the teacher “comes in more like a facilitator.” Another teacher commended the CTA1 curriculum because “it teaches higher-cognitive learning and communication skills” through word problems.

Baseline Data on Student Attitudes and Achievement

What are the attitudes of CTA1 students about learning Algebra 1?

At the end of the 2001-2002 school year 177 students enrolled in the CTA1 program were surveyed regarding the advantages of the CTA1 approach, their attitudes about learning Algebra 1, their perceived mathematics achievement, and their class attendance and participation. All together 167 students responded to the survey, resulting in a response rate of 94 percent. Most of the respondents were in ninth grade (65.7 percent). By gender, 43.7 percent of the respondents were female and 56.3 percent were male. The percent of respondents by ethnicity was 20.4 percent Asian, 26.3 percent Black, 21 percent Hispanic, 21 percent White, and 11.3 percent multicultural.

Table 2
Student Opinions Regarding the Advantages of the CTA1 Program, Their Attitudes About Learning Mathematics, and Their Perceived Mathematics Achievement (n=167)

Items	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
<i>Advantages of the CTA1 Program</i>					
Computer gives many opportunities to practice solving problems.	44.9	42.5	7.2	3.6	1.8
Computer graphics helps solve mathematics problems.	28.3	44.6	15.7	8.4	3
Computer shows how to correct mistakes and move on.	42.9	37.4	5.5	9.2	4.9
Computer allows me to learn mathematics at my own pace.	35.8	41.8	11.5	6.7	4.2
Computer allows me to learn mathematics at my own ability level.	30.9	50.6	12.3	4.3	1.9
Group work helps me master concepts and skills.	31.5	33.3	23.5	8	3.7
<i>Attitudes About Learning Mathematics</i>					
I have more confidence that I can learn mathematics well.	29.1	42.4	17.6	4.8	6.1
I enjoy solving math problems in a group.	18.9	45.7	18.3	11	6.1
I enjoy coming to this class to learn mathematics.	29.5	29.5	22.9	9	9
I like spending time solving mathematics problems in the lab.	23.5	41	16.3	12	7.2
I am actively involved in classroom activities.	22.6	40.2	23.2	9.8	4.3
I want to learn more mathematics.	29.1	38.2	22.4	3.6	6.7
<i>Perceived Mathematics Achievement</i>					
I learned a lot about how to solve mathematics problems by working in a group.	23.2	36	23.8	11.6	5.5
I improved my understanding of course content through presentation.	19.4	31.5	31.5	10.9	6.7
I can help other students solve mathematics problems.	21.9	36.9	21.3	11.3	8.8
I usually have a good understanding of course content after each class.	22	52.4	13.4	6.7	5.5
I am making a better grade in mathematics than I did before.	35.2	27.3	23.6	7.9	6.1
I am doing well in this class.	34.3	27.1	23.5	7.8	7.2
I have a good understanding of the concepts and skills we are expected to learn.	26.4	50.3	14.7	5.5	3.1

The numbers reported represent percentages.

As can be seen in Table 2, the overwhelming majority of the students confirmed the anticipated advantages of the CTA1 program (64.8 percent - 87.4 percent for Strongly Agree and Agree combined). The majority of the respondents also expressed positive attitudes about learning mathematics (59 percent - 71.5 percent for Strongly Agree and Agree combined). Most noteworthy are the following figures: 64.5 percent, 62.8 percent, 67.3 percent, and 71.5 percent of the students agreed or strongly agreed that they “like spending time solving mathematics problems in the lab,” “are actively involved in classroom activities in this class,” “want to learn more mathematics,” and “have more confidence that [they] can learn mathematics well,” respectively. Approximately one half to three-fourths of the respondents also reported self-perceived mathematics achievement (50.9 percent - 76.7 percent for Strongly Agree and Agree combined). Specifically, about 75 percent of the respondents agreed or strongly agreed that they had a good understanding of the course content. In addition, 61.4 percent and 62.5 percent of the respondents agreed or strongly agreed that they were “doing well in this class” and “making a better grade in mathematics than before,” respectively.

Of concern is a noticeable proportion of the students (21.3 percent - 31.5 percent) expressed No Opinion for nine of the 19 items. Most of these items are in the categories of *Perceived Mathematics Achievement* and *Attitudes About Learning Mathematics*. The response pattern for these questions will be investigated further for the next interim report. Overall, the students' reaction to the CTA1 approach was positive and encouraging. The positive reaction of the students to the CTA1 program is also evidenced in their self-report class attendance and participation as summarized in Table 3.

Table 3
Student Attendance and Participation in the CTA1 Classes

<i>How would you describe your attendance in this class? (n=167)</i>		
Rarely Absent	Sometimes Absent	Frequently Absent
73%	21%	6%
<i>How would you describe your participation in this class?(n=165)</i>		
Participate Often	Participate Sometimes	Participate Rarely
56.4%	35.2%	8.5%

Three of the five teachers interviewed reported that students' motivation in learning Algebra 1 had greatly improved. This was evidenced in better class attendance and participation, constant involvement in the learning process, willingness to learn and help others, eagerness to make up the work they had missed, and working extra hours on mathematics after school. One teacher supported her claim that students' "motivation is way up" by saying that "when they are here, they give more of themselves to the process. They are not just observing. They are part of it."

How do the grades of CTA1 students differ from those earned by similar students in the TMA1 classes?

Table 4
Course Marks – Percentage of Passing Grades

CTA1 (n=112) ¹			TMA1 (n=112) ¹		
Pre Passing % ²	Post Passing % ³	Change in Passing %	Pre Passing % ²	Post Passing % ³	Change in Passing %
63.3	75.9	+12.6	61.3	65.2	+3.9

Letter grades above F are defined as passing grades.

¹One hundred and twelve out of 177 CTA1 students were included in the analysis because the remaining students did not have the required Stanford 9 math score or SOL Algebra 1 score.

²For 3 of the 4 schools, the pre passing % was based on the 2nd quarter course marks; for the other school, it was based on the 1st quarter course marks due to the unavailability of the 2nd quarter course marks.

³Post passing % was based on the 4th quarter course marks for all the schools.

Course marks for the CTA1 students and their TMA1 counterparts were obtained from the Office of Student Testing for this study. The change in percentage of passing grades (above F) before and after the implementation of the CTA1 program is reported in Table 4 for the participating schools as a means of measuring the impact of the program on student mathematics achievement. It is noteworthy that the CTA1 students as a group experienced a greater increase in percentage of passing grades than their TMA1 counterparts.

Teacher interview data also lent support to improved student achievement for the CTA1 program. After reporting student active participation in the learning process, one teacher commented that the majority of the students in her CTA1 classes experienced “half a letter grade up,” suggesting that better class participation is associated with improved course grades.

How do the SOL mathematics scores of CTA1 students compare with those of similar TMA1 students?

The SOL Algebra 1 end-of-course test scores are used in conjunction with grades in the current evaluation to establish baseline data regarding the impact of the CTA1 program on student mathematics achievement. The CTA1 students were matched with those enrolled in the TMA1 classes within the same school on previous course marks (1st and 2nd quarters in the 2001-2002 school year), eighth grade SOL mathematics score, and ninth grade Stanford 9 mathematics score. Demographic factors such as percent of ESOL students, percent of students on F&RL, gender, and ethnicity were also taken into consideration to determine the comparability of the two groups before statistical analyses. Analysis of Covariance (ANCOVA) was performed on the SOL Algebra 1 total test score and at the content strand level. Ninth grade Stanford 9 mathematics score was used as a covariate to address the initial differences between the two groups. The results of the statistical analyses are summarized in Table 5.

**Table 5
Mean SOL Algebra 1 Scale Scores**

Content Strands	Total Group		Subgroups			
			Black and Hispanic		White and Asian	
	CTA1 ¹	TMA1 ¹	CTA1 ²	TMA1 ³	CTA1 ⁴	TMA1 ⁵
Expressions and Operation	29.20	31.02**	28.57	30.72*	30.16	31.45
Relations and Functions	30.24	30.96	29.09	30.42	32.06	31.83
Equations and Inequalities	31.70	31.56	30.76	31.34	33.35	31.92
Statistics	31.25	30.12	29.99	28.88	33.25	32
Total	403.24	406.07	396.78	402.54	413.82	411.56

¹ n=109 (109 out of 177 CTA1 students were included in the analysis because the remaining students did not have Stanford 9 math score or SOL Algebra 1 score.).

² n=65; ³ n=66; ⁴ n=41; ⁵ n=43.

** Mean differences statistically significant at .01 level; * Mean differences statistically significant at .05 level.

It can be seen from Table 5 that no significant differences exist between the CTA1 students and similar TMA1 students in terms of their total test score. This is true for both the total group and subgroup comparisons. On the content strand of Expressions and Operation, the TMA1 group outperformed the CTA1 group. Again, this is true for both the total group comparison ($p < .01$) as well as for the Black and Hispanic subgroup comparison ($p < .05$). In terms of Equations and Inequalities as well as Statistics, the CTA1 group demonstrated a slightly better performance than the TMA1 group, but the differences are not statistically significant. Minor differences are also observed in the results of subgroup analyses, but again, the differences do not amount to statistical significance. These data indicate that, except on one content strand, the CTA1 program students performed as well as similar TMA1 students on the SOL Algebra 1 test both as

a group and as subgroups. Again, it should be noted that the limited time in the program may have resulted in the current non-superior performance of the CTA1 students on the SOL test. Subsequent analyses with data from a full school year will provide additional insight on the impact of the program on student achievement.

IMPLICATIONS OF FINDINGS

After six months of implementation of the CTA1 program, this report provides insight into the progress made by the participating schools. The implications of the findings associated with teacher training, program implementation, student attitudes and achievement, teaching, and costs of the program are discussed in this section.

Most of the teachers felt that they had sufficient training to implement the CTA1 curriculum, although some of them found it challenging to implement the collaborative learning activities as prescribed by the CTA1 program. Additional experience with the program is likely to resolve this issue.

Most CTA1 students expressed positive attitudes about learning mathematics, had good attendance and participation rates while enrolled in the CTA1 program, and experienced a greater increase in percentage of passing grades than similar TMA1 students. Nevertheless, Year 1 data did not reveal significant advantage of the CTA1 program over the TMA1 program in enhancing student performance on the SOL Algebra 1 test. This may be attributed to two reasons. First, the CTA1 program was implemented in January 2002, half way through the 2001-2002 school year, so students only had a few months' exposure to the CTA1 curriculum. Second, the switch to the CTA1 curriculum and student-centered instructional approach half way through the school year may affect the smooth flow of mathematics instruction for both teachers and students. These two factors may explain the lack of advantage of the CTA1 curriculum over the TMA1 approach in raising student achievement on the standardized test in spite of the positive reaction to the CTA1 curriculum on the part of the students. The findings on achievement will be used as baseline data to facilitate subsequent investigation of the impact of the program on student achievement.

The impact of the CTA1 program on teaching is mainly manifested via collaborative learning and alignment with SOL tests. The implementation of collaborative learning requires adjustment in content pacing and instructional strategies. Lack of format alignment between the CTA1 assessment materials and the SOL Algebra 1 test also requires additional efforts from teachers in test preparation. Nevertheless, teachers applaud the CTA1 curriculum for its merit of increasing student participation and involvement in the learning process and its merit of facilitating the development of higher-order thinking skills on the part of students.

Finally, the cost of teacher training can be reduced significantly if FCPS teachers who have used the program are trained as CTA1 trainers to run the training workshop. In comparison to the regular Algebra 1 program for which the textbook is approximately \$60 per copy, the cost for the CTA1 textbook is a bargain. This advantage, however, is minimized over time since the consumable CTA1 textbook needs to be purchased every year.

RECOMMENDATIONS

Based on the evaluation results, the following recommendations are provided to central office staff and principals:

1. In future training extend teachers' opportunities to learn how to use collaborative learning activities in the CTA1 classrooms. Special attention should be directed to modeling how to engage each student in group work and class presentation for Algebra 1.
2. Also in future training help teachers to develop the skills as a CTA1 facilitator. Special efforts should be made to help teachers develop skills to ask questions that encourage students to think and engage in learning Algebra 1.
3. It is recommended that the program be continued through at least the 2003-2004 school year to allow for informed decision-making and adequate evaluation of the impact of the program.

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APPENDIX A
EVALUATION DESIGN

Program Evaluation Summary

PART I GENERAL PROJECT INFORMATION

Project/Program Title:	Carnegie Learning Cognitive Tutor Algebra 1 Program
Project/Program Office and Contact:	Gerald Gambino
Projected Evaluation Start Date:	May 2002
Projected Evaluation Completion Date:	November 2004
Expected Deliverables:	Interim Reports (October 2002, 2003) Final Report (October 2004)
OPE Lead Evaluator:	Zhicheng Zhang, Office of Program Evaluation (OPE), Department of Educational Accountability, (DEA)
Evaluation Team Members:	Recardo V. Sockwell, OPE, DEA Gerald Gambino, Instructional Services Department (ISD) Ray Diroll, Office of Student Testing (OST), DEA Jennifer Coyne Cassata, OPE, DEA Kenneth Hinson, OPE, DEA MaryLouise Rothman, Centreville High School Ginny Yeager, Hayfield Secondary School
Source of Request for the Evaluation:	ISD
Purpose of the Evaluation:	The evaluation aims to achieve four objectives: <ol style="list-style-type: none">1. to investigate the implementation of the Cognitive Tutor Algebra 1 (CTA1) program and determine how it can be improved,2. to investigate the impact of the CTA1 program on teaching,3. to investigate the impact of the CTA1 program on student attitudes about learning mathematics, and4. to investigate the impact of the CTA1 program on student mathematics achievement.

PART II EVALUATION DESIGN

Evaluation Title: Carnegie Learning Cognitive Tutor Algebra 1 Evaluation

Lead Evaluator: Zhicheng Zhang

EVALUATION QUESTIONS	DATA SOURCE	DATA COLLECTION METHOD	DATA ANALYSIS	TIMELINE	RESPONSIBLE OFFICE/PERSON
<i>Teacher Preparation</i>					
1. To what extent are teachers prepared to implement the CTA1 program?	CTA1 Teachers	Interviews	Content Analysis	May 2002, 2003, 2004	OPE
	CTA1 Teachers	Surveys	Frequencies	April 2003, 2004	OPE
<i>Program Implementation</i>					
2. To what extent is the CTA1 program implemented and operational as prescribed?	CTA1 Teachers	Interviews Surveys	Content Analysis Frequencies	May 2002, 2003, 2004 April 2003, 2004	OPE OPE
	CTA1 Classes	Observation	Frequencies, Descriptive	Feb./March 2003, 2004	OPE
	Prescribed instructional materials, approaches, and practices.	Document Review	Content Analysis	August 2002, 2003	OPE
<i>Program Impact on Teaching</i>					
3. In what ways has the CTA1 program changed teachers' beliefs about teaching and learning Algebra 1 and Geometry?	CTA1 Teachers	Interviews	Content Analysis	May 2003, 2004	OPE
	CTA1 Teachers	Surveys	Frequencies	April 2003, 2004	OPE
4. What impact does the CTA1 program have on teachers in terms of -course preparation, -pacing of course content, -instructional strategies, -course assessments, and -special preparations for SOL tests	CTA1 Teachers	Interviews	Content Analysis	May 2002, 2003, 2004	OPE
	CTA1 Teachers	Surveys	Frequencies	April 2003, 2004	OPE
<i>Program Impact (in Year 1 Establish Baseline Data) on Student Attitudes and Achievement</i>					
5. What are the attitudes of CTA1 students about learning Algebra 1?	CTA1 Students	Surveys	Frequencies	May 2002, 2003, 2004	OST/DIT, OPE
	CTA1 Teachers	Interviews	Content Analysis	May 2002, 2003, 2004	OPE

6. How do the grades of CTA1 students differ from those earned by similar students in the TM Algebra 1 (TMA1) classes?	CTA1 Teachers CTA1 Students and Matching TMA1 Students	Interviews Course Marks	Content Analysis Percent of Passing Grades	May 2002, 2003, 2004 May 2002, 2003, 2004	OPE OST/DIT, OPE
7. How do the SOL mathematics scores of CTA1 students compare with those of similar TMA1 students?	CTA1 Students and Matching TMA1 Students	SOL Algebra 1 and Geometry test data files for the 2001-2002, 2002-2003, and 2003-2004 school years, 8 th grade SOL or 9 th grade Stanford 9 math test data file	ANCOVA using 8 th grade SOL or 9 th grade Stanford 9 math test score as a covariate, analysis will be done at the content strand level and for the total test. (Annual CTA1 to TMA1 comparison on Algebra 1) (Annual CT to TM comparison on Geometry)	August 2002, Sept. 2003, 2004	OST/DIT, OPE

APPENDIX B
TEACHER INTERVIEW QUESTIONS

CARNEGIE LEARNING COGNITIVE TUTOR ALGEBRA 1
Teacher Interview Questions

School: _____ Teacher: _____
Date: _____ CT course code and class size: (1) _____ (2) _____
(3) _____ Interviewer: _____

- 1.** How adequately prepared do you feel you are to use the Cognitive Tutor Algebra 1 (CTA1) program?
(Alternatively: How would you judge the adequacy of your preparation to teach this program?)

Follow-up: what additional support do you need to ensure the successful implementation of the program?

- 2.** To what extent are all the components of the CTA1 program implemented in your classes?
(Prompt: Have all the components such as lab, group work, student presentations, teacher lecture, assignments, and assessment been implemented as you were trained to do?)
- 3.** Describe the profile (demographics and achievement) of the class you targeted for the CTA1 program.
How typical is this profile of the regular Algebra 1 classes that you teach?
- 4a.** How does the level of mathematics achievement compare between the students in the CTA1 program and the students in your regular Algebra 1 classes?
- 4b.** Does the pattern of achievement level in your CTA1 classes hold for students of different gender, ethnic background, and special needs?
- 5a.** How does the level of motivation compare between the students in the CTA1 program and the students in your regular Algebra 1 classes? Please illustrate your point with some examples.
- 5b.** Does the pattern of motivation level in your CTA1 classes hold for students of different gender, ethnic background, achievement level, and special needs?
- 6a.** What impact does the CTA1 program have on your teaching in the following areas?
- Course Preparation
 - Pacing of Course Content Course Preparation
 - Instructional Strategies
 - Course Assessments
 - Special Preparations for SOL Tests
- 6b.** Does the CTA1 program require you to do anything above and beyond what you normally do? Does it save you from anything that you would normally need to do?
- 7.** How have your attitudes about (or perception of) teaching and learning Algebra 1 changed since you started using the CTA1 program?
- 8.** What improvements could be made to the CTA1 program to make it more effective?
- 9.** Would you recommend the CTA1 program to others? If so, why? If not, why not?

APPENDIX C

**STUDENT SURVEY
(Hard Copy Attached)**