

Research Results

Milwaukee Public Schools, Milwaukee, WI, 1996-97

Abstract

Students at two Milwaukee Public High Schools were given post-tests to assess their performance on both a standardized test (a subset of the Math SAT) and complex mathematical problem solving (a multiple-representations test and a real-world problem solving test developed at Carnegie Mellon University). Experimental classes used Cognitive Tutor Algebra I, while comparison classes used a traditional curriculum. Results showed that the Cognitive Tutor Algebra I group outperformed the control group. The study design and results are comparable to those reported in Koedinger, Anderson, Hadley, and Mark (1997).

Study Design:

Matched control group

Measures:

Standardized exam: Math SAT
Other Exam: Problem Situations test, Multiple Representations test

Study location:

Milwaukee Public Schools, Milwaukee, WI (urban)

Study conducted by:

Milwaukee Public Schools

Data analyzed by:

Milwaukee Public Schools

Course assessed:

Cognitive Tutor Algebra I

Data collection date:

1996 – 1997

District information:

Type: Public, urban
Students Enrolled: 105,645

Ethnic breakdown:

African American: 61%
Asian: 4%
Caucasian: 21%
Hispanic: 12%
Indian: 1%

Participants

Participants were students in two Milwaukee Public High Schools.

Method

Students were administered exams during two class periods near the end of the school year. Three exams were used:

- A subset of the Math SAT (comprising questions pre-selected to emphasize Algebra)
- A Problem Situations test (see Appendix A)
- A Multiple Representations test (see Appendix B)

Results

As shown in Table 1, scores favor the Cognitive Tutor students on all measures. Reporting of inferential statistics awaits a more complete and formal analysis of the data.

	Cognitive Tutor	
	Algebra I	Control
Math SAT subset	.36	.29
Problem Situation Test	.63	.41
Representations Test	.54	.38

Table 1: Student performance (proportion correct) by condition and measure

Discussion

The results favor the Cognitive Tutor students over the control group on all measures.

As would be expected, the differences are largest on the Problem Situation and Representations tests, since those tests are better aligned with the Cognitive Tutor curriculum. The fact that Cognitive Tutor classes did at least as well on the Math SAT subset supports the applicability of Cognitive Tutor course's instruction to the more basic skills covered on those tests.

Although the differences between the Cognitive Tutor classes and the control classes are substantial, the absolute proportions correct for both groups leave much to be improved. In part, the low levels of absolute performance may reflect the fact that students knew that these were low-stakes tests (administered as part of a research study).

Reference:

Koedinger, K. R., Anderson, J. R., Hadley, W. H., & Mark, M. A. (1997). Intelligent tutoring goes to school in the big city. *International Journal of Artificial Intelligence in Education*, 8.

For more information or for additional copies of this report, please go to <http://www.carnegielearning.com/results/reports> or send email to researchpartner@carnegielearning.com

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Appendix A: Problem Situation Test

This is an example of the Problem Situation Test. Several different variants were administered to students, in order to minimize cheating, to sample a wider variety of problems, and to assess what features of problems are most difficult for students.

Currently I have \$1125 in my savings account and I am spending at a rate of \$17 per week. 015

Answer the following questions by filling in the TABLE below.

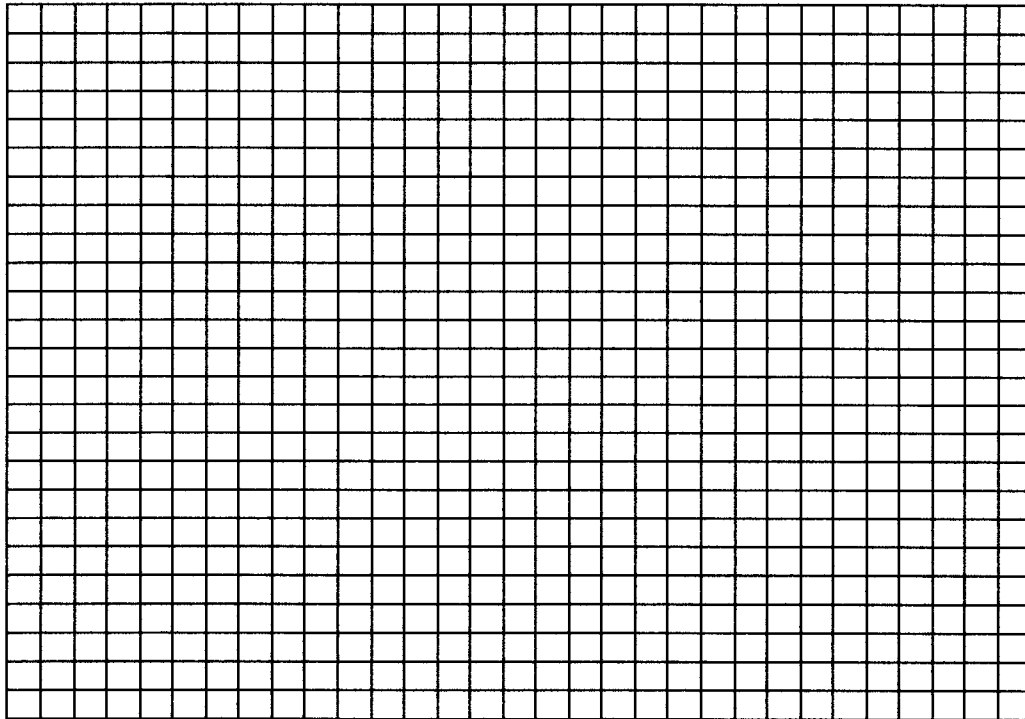
1. How much money do I have after 6 weeks?
2. How much money do I have after 364 days?
3. How many weeks before I have a total of \$3?

TABLE:

	Time (weeks)	Savings
1		
2		
3		

4. Define two variables for time and savings and write an equation that expresses the relationship between them:

5. Create a graph of the relationship between time and savings and plot the 3 points in the Table above. Be sure to label which axis is time and which is savings. Also put numbers on the axes to indicate the scale.



Problem Situation test, page 1

There are 2 Mediterranean Fruit Flies and each minute 3 more are born.

Answer the following questions by filling in the TABLE below.

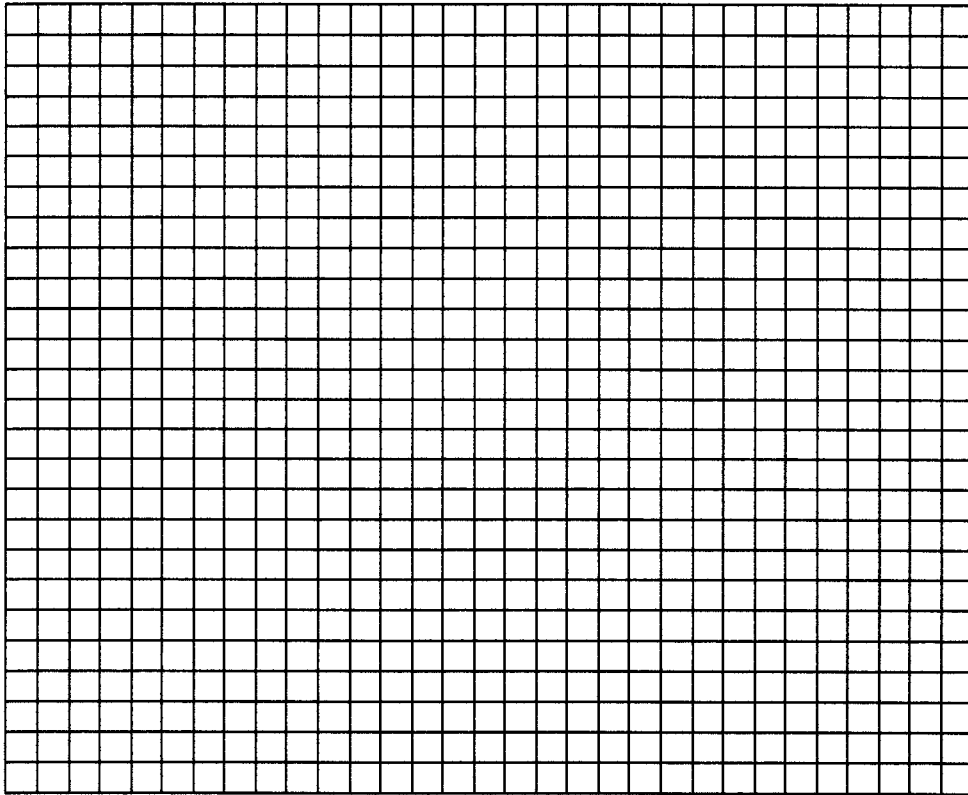
1. How many Fruit Flies are there after 2 minutes?
2. How many Fruit Flies are there after $1/10$ of an hour?
3. How long before there are 17 Fruit Flies?

TABLE:

	Time (minutes)	Fruit Flies
1		
2		
3		

4. Define two variables for time and fruit flies and write an equation that expresses the relationship between them:

5. Create a graph of the relationship between time and fruit flies and plot the 3 points in the Table above. Be sure to label which axis is time and which is fruit flies. Also put numbers on the axes to indicate the scale.

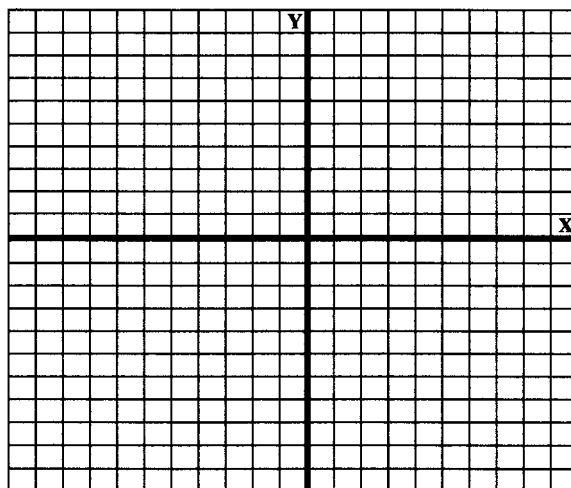


Problem Situation Test, page 2

Appendix B: Multiple Representations Test

ST-1

- 1) Sketch the graph of $Y = 3X - 5$.

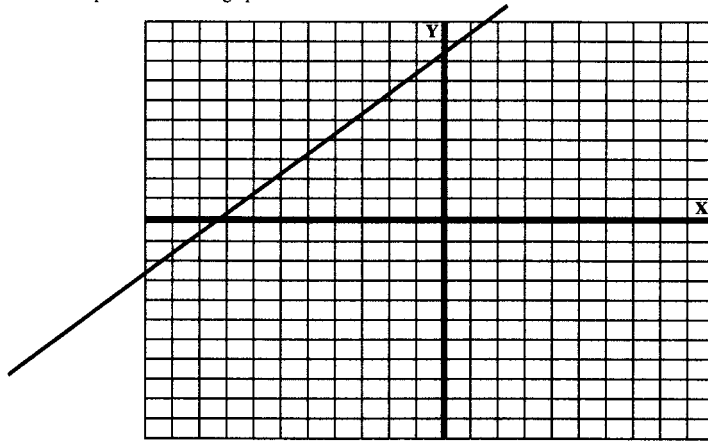


- 2) What is the y-intercept of this graph?
- 3) What is the slope of this graph?
- 4) How would the graph of this equation change if the slope was -2?
- 5) How would the graph of this equation change if the y-intercept was 2?
- 6) Write a situation that could be modeled by the following equation:

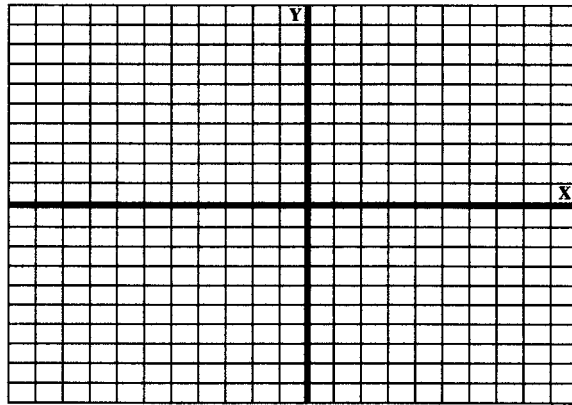
$$Y = 3x + 2$$

Multiple Representations Test, page 1

- 7) Find the equation of the line graphed below:



- 8) Draw the graph of the line parallel to the graph of the line, $Y = 2X + 5$ that passes through the origin.



Multiple Representations Test, page 2