



# Assessing the Impact of the E.nopi MATH Program

[Supporting Mathematical Proficiency  
through Computational Fluency]

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# 1. Summary

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## Purpose:

The purpose of this study is to examine the **impact of E.nopi MATH**, a program that supports students' computational fluency, on students' mathematical proficiency and on the development of students' positive attitudes to learning mathematics.



## How:

1. In the school year of 2004~2005, 91 4<sup>th</sup> grader students were recruited for the study [44 experimental and 47 control group]
2. 4 Teachers from upstate New York volunteered for the study [Assigned 1 teacher to the experimental group and assigned 3 teachers to the control group]
3. Students completed the grade appropriate District Math Inventory Test and New York State Math Test as pre and post tests at the beginning and end of the year.
4. A Simplified Fennema-Sherman Mathematics Attitudes Scale was used to test the students' attitudes towards math learning.

- Experimental group: Using E.nopi MATH as a supplementary program in addition to regular textbook.
- Control group: Without employing E.nopi MATH program, using only regular textbook and its worksheets.





## Results:

Results showed that, the fourth grade students who had used **E.nopi MATH** for a school year **showed statistically significant scores** on the New York State Math Test and scored higher on attitudes toward math than the control group.





## 2. Introduction (Background)

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### Problems:

Improving students' mathematical fluency has been a major concern for American educators during the past years. Several international and national assessments have revealed a low level of performance in mathematics of American students.

1. Trends in International Mathematics and Science Study (TIMSS)
2. Programme for International Student Assessment (PISA)

Over the past 10 years, American students tend to have a limited understanding of fundamental mathematical concepts and have trouble applying mathematical skills even on simple problems. (National Research Council, 2001)

Yet, American educators tend to highlight the importance of conceptual proficiency over the other strands in primary grades



## NCTM Direction:

Mathematics educators expect students to become  
“**Mathematically Proficient**” .

Which means, they should to be able to go beyond the mastery of disconnected facts and procedures, to learn conceptually, to problem solve and to apply their mathematics knowledge to new situations.

Thus, this approach requires mathematics educators to move away from placing a heavy emphasis on computation, rote memorization and repeated practice of procedures.

### Mathematical Proficiency?

Mathematical Proficiency is composed of **5 strands**:

Conceptual  
understanding

Procedural  
fluency

Strategic  
competence

Adaptive  
reasoning

Productive  
disposition





## US History of Mathematics:

- **1950s~1960s:** “back-to-basics” movement overemphasized computational competency
- **1980s~1990s:** A new reform movement pushed the direction toward conceptual learning and the development of thinking processes such as reasoning, solving problems, connecting mathematical ideas and communicating ideas of mathematics with others.
- **2003:** Prioritizing conceptual understanding while reducing the attention on computational skills has led to an imbalance in students’ mathematics education.

“ Conceptual understanding has proved to be somewhat more effective than the traditional emphasis on computational proficiency in terms of students’ performance in the TIMSS & PISA studies. ”





“ The **purpose** of this study is to examine the impact of **E.nopi MATH** on students’ **mathematical proficiency** and the development of students’ positive attitudes toward learning mathematics. ”



## 3. E.nopi MATH

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### What is E.nopi math?



- ❖ Study materials that develops mathematical thinking ability by experiencing various math questions in all areas.
- ❖ Step-by-step and individualized math programs which pinpoints the parts that students often make mistakes and provides proactive feedback.
- ❖ Small-step approach: self-learning program which enables students to develop the ability to study independently.
- ❖ Through teaching tools, students will enhance problem solving skills and spatial sense with real objects.





## E.nopi MATH Overview

### Objective/Target

- Building solid Math skills along with confidence and motivation
- Kindergarten ~ Middle School

### Advantages

- Easy Step-by-Step system
- Diagnostic Test
- Instructor monitoring
- Basic & Critical Thinking Math
- Program individualized for students
- Encourage Creativity

### Structure

Target	Level	Booklet	Usage/wk	Studying Tools
Kinder. ~ Elem.	Level 1~ 23	30	3 Booklets	Numerical Figures, Blocks and Shapes, Clear Paper, Colored Blocks, Mirror, Wooden Blocks
Middle School	Level 24~32	24	3 Booklets	Brick,Cube,Pento



## Learning procedure

(1) Assessment

➔ Diagnostic Test

(2) Initializing the starting point of E.nopi

➔ Starting Point

(3) Continuous study of E.nopi Math

➔ Complementing academic

(4) Improvement of school performance

weakness  
➔ Improving students' academic progress with additional studies



## 4. Methodology

### Setting:

- Target school: Homer intermediate school
- Location: Upstate New York
- Number of students: Approx. 600 students
- Race/Ethnicity: Caucasian (97%) and Others (3%)
- Performance of Homer: Higher than the average of the state level [77% of passing 4<sup>th</sup> grade Mathematics test rate]







## Participants: [Period: 2004~2005]

Experimental (E.nopi) Group	Group	Control Group
2 Classes	Sample	3 Classes
44 Students	# of student	47 Student
Ms. Leesa Ferris	Teacher	3 different teachers

- In order to control for selection bias, we verified that both groups of students were selected randomly when they were originally assigned to their classes in September 2004. All 5 participating classes were inclusive classrooms.
- Ms. Leesa Ferris volunteered to be in the experimental group and to us E.nopi MATH in her two 4<sup>th</sup> grade math classes.
- The parents of participating students from both classes signed a permission slip prior to the onset of the study



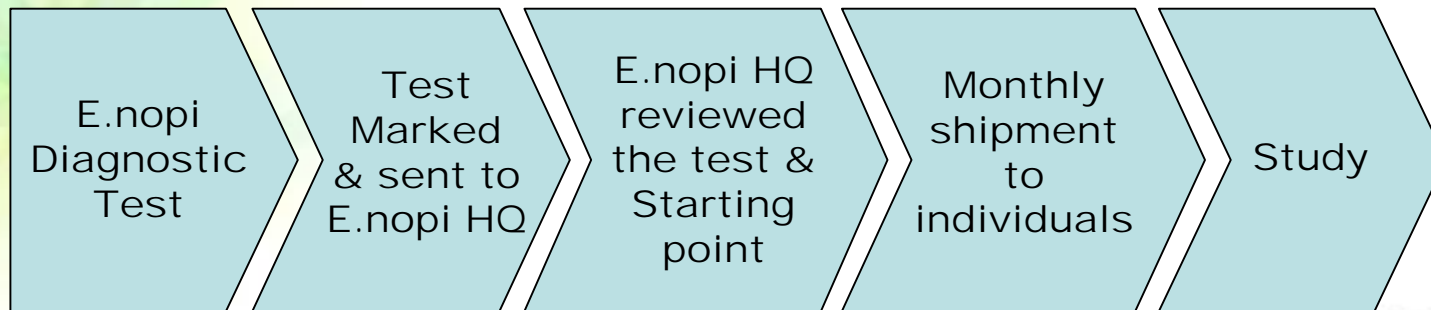


## Implementation:

- Use: Originally developed for after-school home use, but for the purpose of this study, used it within the school setting.
- Study period: Entire school year of 2004~2005

Experimental (E.nopi) Group	Group	Control Group
E.nopi MATH (20 min.) Scott Foresman (25 min.)	Math study	Scott Foresman (45 min.)
Ms. Leesa Ferris (1 assistant for grading)	Teacher	3 different teachers

- Initial computation level determination process: [Experiment group]





- Time line for E.nopi MATH study: [Experiment group]

Date	Description	Time spent on E.nopi MATH
September 2004	E.nopi MATH	25/45 minutes
September 2004	Pre tests taken	-
January 2005	E.nopi MATH	12/45 minutes
March 2005	E.nopi MATH	10/45 minutes
May, June 2005	Post tests taken	

- Regulated as 8 pages of work per day, but since students were doing 8 pages in 25 minutes and the fact that they were losing concentration that the E.nopi team had to reduce the time to increase their concentration and it worked.





- Pre and Post Test: [Experiment & Control group]

Pre Test	Post Test
Mathematics Inventory Homer [District Test, Sept. 2004]	New York State 4 <sup>th</sup> Grade [Mathematics Test, May 2005]
Math Attitudes Test [Sept. 2004]	Math Attitudes Test [June 2005]

- In addition to the **E.nopi Diagnostic test** and the follow up of students' progress in their booklets, other **assessment tools** were used to collect data about students' knowledge of mathematics and their progress throughout the year as well as the students' attitude towards mathematics.
- Grade level appropriate **District Inventory Test** and the **New York State Math Test** were used to measure mathematical fluency and a Simplified Fennema-Sherman Mathematics Attitudes Scale was used to measure pre and post attitude changes.



# 5. Results

## Statistics for Math Achievement

Analysis of pre-test math scores and pre attitude scores showed **no statistical differences** between the two groups. **But**, the analysis showed **significantly higher post-test means for the E.nopi group** than for the control group on the math post-test and on the math attitude post-test.

	Statistical Test	E.nopi Mean	Control Mean	Difference Probability	E.nopi Std. Error	Control Std. Error	F ratio
Pre-test	ANOVA	21.72	23.85	.147 (ns)	1.05	1.01	2.135
NYScore	ANOVA	676.6	659.2	.001	3.57	3.45	12.275

**Thus**, the students in the experimental group who received lessons using E.nopi showed greater achievement gains than did students who received the same content without E.nopi.



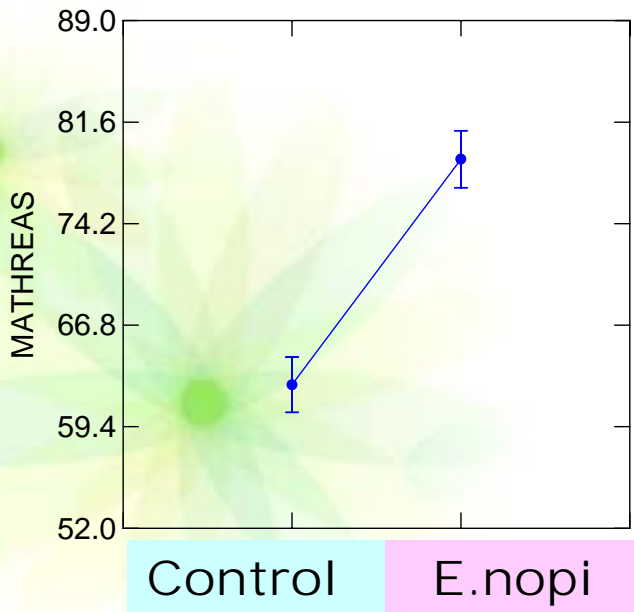


## Statistics for Math Achievement-Subscales (ANOVA)

E.nopi MATH group demonstrated higher score in all of 7 key areas and the scores of 6 out of those 7 key areas showed statistically meaningful.

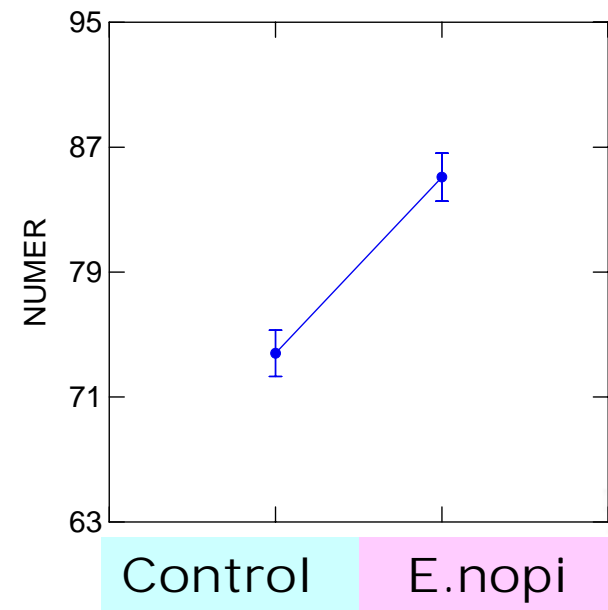
### 1. Mathematical Reasoning

Least Squares Means



### 2. Number and Numeration

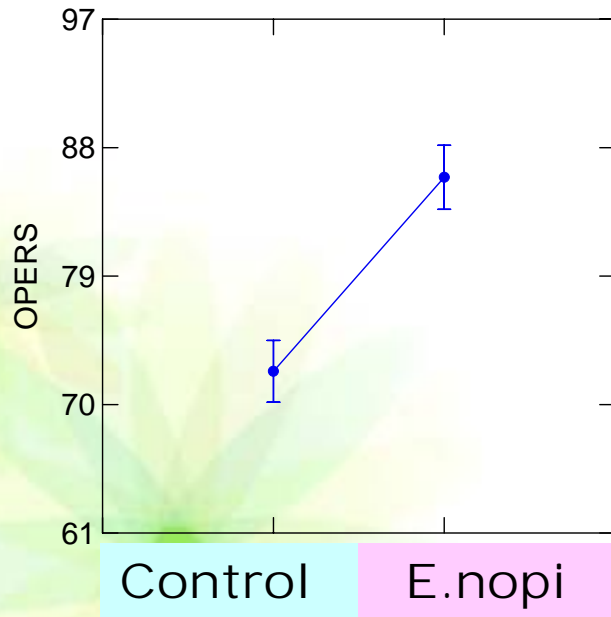
Least Squares Means





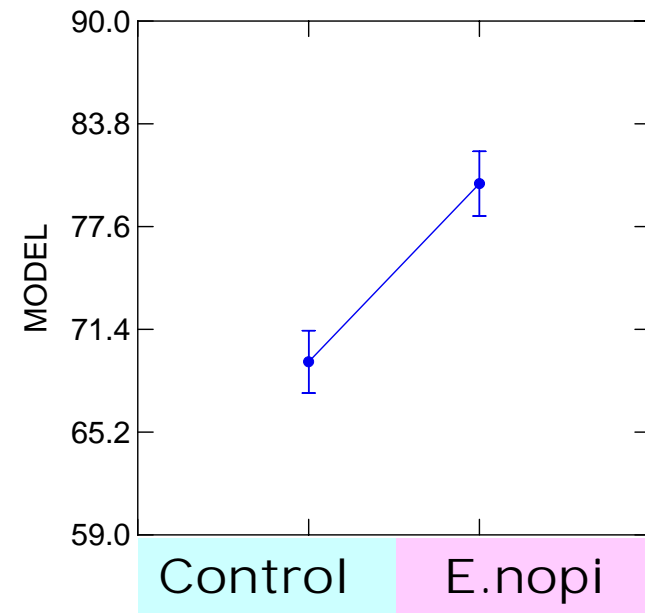
### 3. Operations

Least Squares Means



### 4. Modeling/Multiple Representation

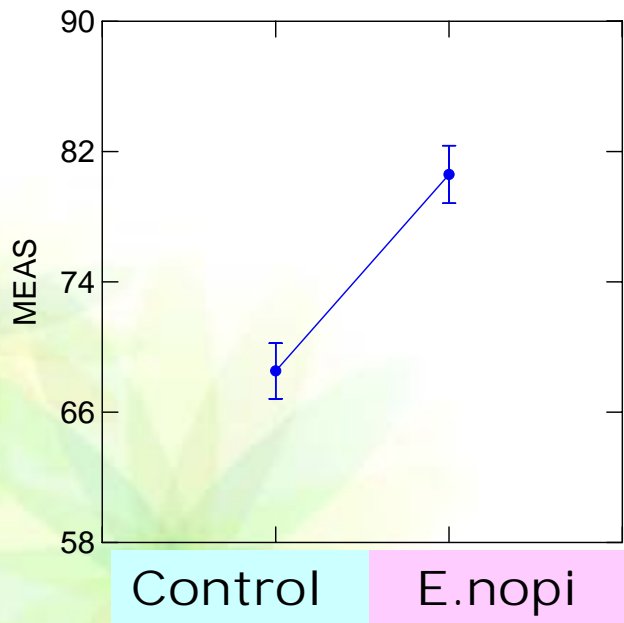
Least Squares Means





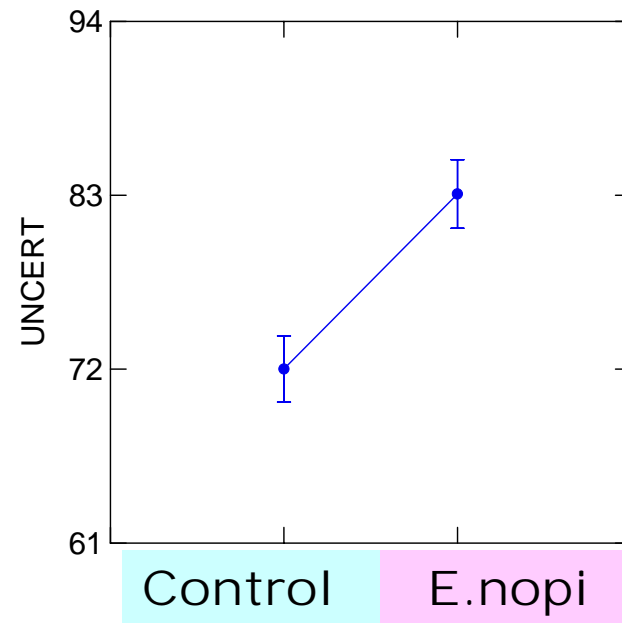
## 5. Measurement

Least Squares Means



## 6. Uncertainty

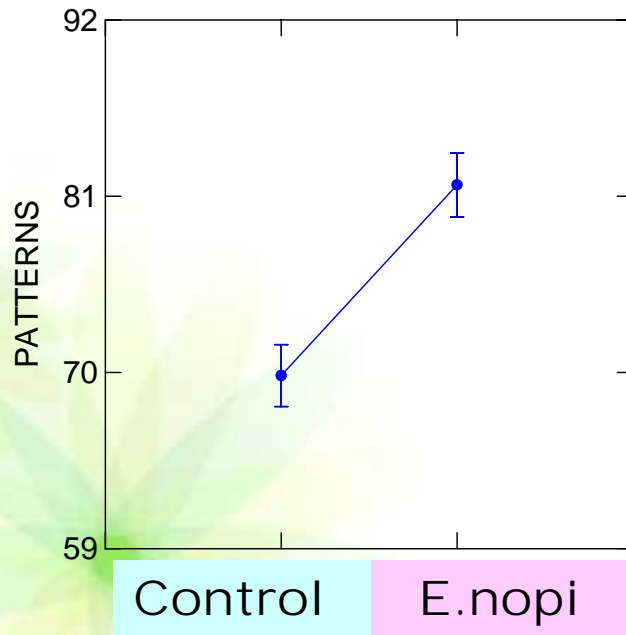
Least Squares Means





## 7. Patterns/functions

Least Squares Means





## Statistics for Math Attitude

Table below summarizes pre- and post- math attitude differences between the two groups.

	Statistical	E.nopi	Control	Difference	E.nopi	Control	F ratio
	Test	Mean	Mean	Probability	Std. Error	Std. Error	
Pre-Attitude	ANOVA	118.2	116.8	.652 (ns)	2.25	2.18	0.205
NYScore	ANOVA	138.5	115.1	.000	1.81	1.75	87.059

**Thus**, the students in the experimental group who received lessons using E.nopi MATH showed better math attitudes after the study than the control group.





## 6. Conclusion

The results were highly successful!!!

First, we found that the E.nopi MATH program can positively affect students' mathematical fluency and attitudes toward mathematics. Based on other observations made during the study, such as students' lack of efficient strategies for computations, we believe that implementation of E.nopi MATH program would have a major impact if it is done in primary grades.

With this pilot study, we have learned;

1. When and how long the students should work on E.nopi booklets in order to concentrate and be productive at school.
2. The differences between E.nopi and regular lessons should be discussed with the students. [Repeated practice.]



## 7. Comments from students

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" Like, when I got into it, it (math) was like kinda hard, but now it's like, it's easier than you think it is. It's much easier, and it makes me feel good. "

-Interview with Don  
(Student of Homer School)



" I'd say it's (E.nopi MATH) helped me with my multiplication and subtraction... But with the E.nopi it showed me step by step, and I got it. I can do math faster... I've learned it so well what I like is when your doing it, when you first do it, like what I said the directions... And like, when you do that, when you do it step by step you'll learn it and when you do more problems you'll get faster and faster at it. "

-Interview with Miki  
(Student of Homer School)



**E.nopi**



" Um, it helped me learn how to not go so fast. To not make so many mistakes. Um, it makes me feel better about myself. I don't make as many mistakes. "

-Interview with Lisa  
(Student of Homer School)





# Q & A

