

Mathematics Education Technology  
Research: A Look at Purposes and  
Quality Over the Past Four Decades

# Number of Manuscripts by Decade

<b>Year</b>	<b>Number of Manuscripts</b>
<b>1960-1969</b>	2
<b>1970-1979</b>	22
<b>1980-1989</b>	41
<b>1990-1999</b>	295
<b>2000-2009</b>	789

n = 1149

# Research Questions

1. How have the purposes of the studies changed over the past four decades?
2. How has the quality of mathematics education technology research changed over the past four decades?

**PRELIMINARY  
RESULTS**

# Research Question 1: How Have the Purposes of the Studies Changed Over the Past Four Decades?

## Areas Examined:

- Professional Development (n=38)
- Student and Teacher Outcomes (n=1149;  $n_s=96$ )
- Technology Types and Use (n=1149;  $n_s=96$ )
- Student Populations ( $n_s=96$ )

Where  $n_s$  represents the size of a random subsample

# How Has Mathematics Education Technology Professional Development Evolved Over the Past Four Decades?

## Definition & Criteria for Professional Development

- Guskey's (2000) definition: PD "is defined as those processes and activities designed to enhance the professional knowledge, skills, and attitudes of educators so that they might, in turn, improve the learning of students" (p. 16).
- must be beyond initial teacher certification (pre-service education is not included) and
- must be non-credit bearing (not part of a degree program).

# Emphasis on PD Has Not Increased Over the Decades

<b>Date</b>	<b>Research</b>	<b>Non-Research</b>	<b>Percent of Decade Total</b>
1980-1989	2	0	4.88% (2/41)
1990-1999	8	0	2.71% (8/295)
2000-2009	24	4	3.55% (28/789)

# Technology Type, Content Area, Grade

	Algebra					Statistics and Probability			General Mathematics or Problem Solving					
	Calcs	Comp Soft	Probe-ware	Pro-gramming/ Gen Tech Use	Web	Calcs	Computer Software	Probeware/ Programming/ Gen Tech Use/ Web	Calcs	Comp Soft	Probe-ware	Pro-gramming	Gen Tech Use	Web
K-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980-1989	0	0	0	0	0	0	0	0	1	0	0	0	0	0
1990-1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000-2009	0	0	0	0	0	0	0	0	0	1	0	0	0	2
6-8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980-1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990-1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000-2009	0	0	0	0	0	0	1	0	2	7	1	0	1	2
9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980-1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990-1999	0	1	0	0	0	0	0	0	1	1	0	0	0	0
2000-2009	1	0	0	0	0	0	0	0	2	4	1	0	0	2
TD or NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980-1989	0	0	0	0	0	0	0	0	1	0	0	1	0	0
1990-1999	0	0	0	0	0	0	0	0	4	5	2	0	0	6
2000-2009	4	1	1	0	1	0	2	0	4	10	1	0	3	9
PS Graduate	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980-1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990-1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000-2009	0	0	0	0	0	0	0	0	1	1	0	0	0	1
<b>Total</b>	<b>5</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>16</b>	<b>29</b>	<b>5</b>	<b>1</b>	<b>4</b>	<b>22</b>



# Discussion of Professional Development in Mathematics Education Technology Research

- Absolute but not relative increase in PD studies
- With each decade, a wider variety of different technology types have been used in PD. Growing use of internet-based technologies in 2000's.
- The PD tends to be general in nature. Supovitz and Turner (2000) stated that “staff development must engage teachers in concrete teaching tasks and be based on teachers’ experiences with students ” (p. 964).

# What are the Trends in Student and Teacher Outcomes Studied Over the Past Four Decades?

- Student Outcomes: achievement, conceptual learning, procedural learning, orientation (affective), discernment (cognitive), and behavior.
- Teacher Outcomes: subject matter knowledge, pedagogical knowledge, environment knowledge, discernment knowledge, orientation knowledge, individual knowledge, and teacher orientation.

# Number of Outcomes in 1149 Papers

	Student Achievement	Student Learning Conceptual	Student Learning Procedural	Student Orientation	Student Discernment	Student Behavior	Teacher Knowledge Subject Matter	Teacher Knowledge Pedagogy	Teacher Knowledge Discernment	Teacher Knowledge Orientation	Teacher Knowledge Individual	Teacher Knowledge Environment	Teacher Orientation	
1960's	1	0	0	0	0	0	0	0	0	0	0	0	0	1
1970's	10	3	1	6	0	1	0	0	0	0	0	0	1	22
1980's	21	3	4	12	0	2	1	2	0	2	0	0	6	53
1990's	133	54	21	80	12	22	15	36	9	17	4	7	61	471
2000's	257	143	36	175	44	91	41	94	26	34	10	21	105	1077
	422	203	62	273	56	116	57	132	35	53	14	28	173	1624

# What Do The Student and Teacher Outcomes Studies Look Like?

Analysis of a random subsample of 96/1149  
(24 from each decade):

- A common design for student outcomes focused on student achievement/knowledge and attitude by giving a pretest followed by a posttest (21 out of the 96). Of these 21, 11 were procedural in nature, 7 conceptual, and 3 both. Similar to Rakes et al. (2010).

## Five Most Common Combinations of Teacher and Student Outcomes

	Teacher Orientation and Student Achievement	Teacher Knowledge Pedagogy and Student Conceptual Learning	Teacher Knowledge Pedagogy and Student Orientation	Teacher Knowledge Pedagogy and Student Achievement	Teacher Knowledge Pedagogy and Student Discernment
1960-1969	0	0	0	0	0
1970-1979	0	0	0	0	0
1980-1989	1	0	1	1	0
1990-1999	16	4	3	4	2
2000-2009	14	18	10	8	11
<b>Total</b>	<b>31</b>	<b>22</b>	<b>14</b>	<b>13</b>	<b>13</b>

n = 1149 manuscripts

n (five most common) = 93 manuscripts

n (remaining combinations) = 134 manuscripts

n (all combinations) = 227 manuscripts

# **How Has the Type of Technology Studied Changed Over the Past Four Decades?**

# Calculator Studies by Decade

Decade	Non-Scientific Calculator	Scientific Calculator	Graphing Calculator	Other Calculator (Advanced)
1960-1969	0	0	0	1
1970-1979	19	2	0	0
1980-1989	19	6	2	0
1990-1999	20	15	93	28
2000-2009	23	13	180	86
<b>Grand Total</b>	<b>81</b>	<b>36</b>	<b>275</b>	<b>115</b>

n = 1149

Technology

# Computer Studies by Decade

Decade	Computer Geometry	Computer Graphing	Computer Algebra	Computer Statistics & Instruction	Computer Spreadsheet	Computer Presentation	Computer Tutorial	Computer Other
1960-1969	0	0	0	0	0	0	0	0
1970-1979	0	0	0	3	0	0	2	2
1980-1989	2	3	0	0	1	0	4	1
1990-1999	32	20	21	14	15	5	52	27
2000-2009	152	16	35	37	72	18	114	53
<b>Total</b>	<b>186</b>	<b>39</b>	<b>56</b>	<b>54</b>	<b>88</b>	<b>23</b>	<b>172</b>	<b>83</b>

n = 1149



# Internet Technology

Decade	Internet Virtual Manipulatives	Internet Applets	Internet Distance Learning	Internet Web Sites, Quests, Wikis	Internet Other
1960-1969	0	0	0	0	2
1970-1979	0	0	0	0	4
1980-1989	0	0	2	0	15
1990-1999	1	3	11	4	89
2000-2009	29	19	50	39	249
Grand Total	30	22	63	43	359

n = 1149

# What Student Population Subgroups do the Studies Examine?

Subsample of 96/1149 studies

- In the 1960's/1970's, no studies in our subsample focused on a subgroup
- In the 1980's, some subgroups were examined
  - 1/24 compared high to low ability students,
  - 1/24 examined students by gender and SES, and
  - 1/24 studied perceptually impaired students.
- In the 1990's
  - 3/24 studies focused on gender differences and
  - 1/24 focused on ethnicity.
- In the 2000's
  - 2/24 focused on learning disabled,
  - 1/24 focused on ethnicity, and
  - 1/24 focused on ESL.

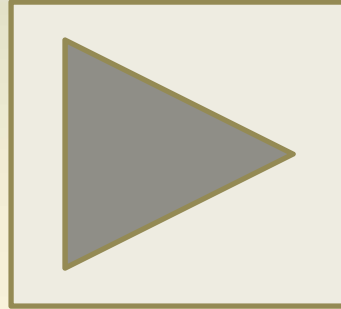
# **Research Question 2: How Has the Quality of Mathematics Education Technology Research Changed Over the Past Four Decades?**

- Trends in the quality of mathematics education technology research by decade organized by research type.

# Quality Index by Z Score

Decade	No. Manuscripts	Minimum	Mean	SD	Max
1960-69	2	-0.67	-0.20	0.67	0.28
1970-79	22	-1.91	-0.32	1.01	1.71
1980-89	41	-1.87	-0.16	0.85	1.35
1990-99	295	-2.49	0.02	0.91	2.64
2000-09	789	-2.49	0.01	1.04	2.64
Grand Total	<b>1149</b>	-2.49	<b>0.00</b>	1.00	2.64

# Questions



# Percent Quality Index Scale – All Manuscripts by Decade

	0%	0-25%	26-50%	51-75%	76-100%
1960-1969	1		1		
1970-1979	10	4	7	1	
1980-1989	6	13	21	1	
1990-1999	45	87	137	23	3
2000-2009	180	242	280	63	24
<b>Grand Total</b>	<b>242</b>	<b>346</b>	<b>446</b>	<b>88</b>	<b>27</b>

# Technology Addressed by Decade

	1980-1989	1990-1999	2000-2009
8			Dynamic geometry software
6			Spreadsheet software, general technology use
3		Graphing calculators	Probe ware, e-mentoring
2		Distance learning, graphing software, probe ware, dynamic geometry software	Graphing software, statistical instructional software, presentation software
1	Scientific calculators, programming	Video conferencing, algebraic software, tutorial software, applet software, word processing software, general technology use	Four function calculator, virtual manipulatives, statistical software, blogs, internet searches, PDA's, Elluminate, Information and communication technology, Inter_Math, Learning Management Software, Online discussion forum, teleconferencing

# Grade Bands and Content Areas

Grade Band	Studies
K-5	3
6-8	8
9-12	5
General Teacher Development or Not Addressed	23

Content Area	Studies
Algebra	6
General and algebra	1
Problem Solving	1
General and Problem Solving	2
Probability and Statistics	2
General Mathematics	27



# Outcomes of the Professional Development

- Five had statistically significant outcomes,
- Two had non-statistically significant outcomes,
- Twenty-four stated positive outcomes from the professional development (qualitative), and
- Nine were inconclusive or had no clear outcomes

# What Technologies are Being Studied?

## **Analysis of a random subsample (96/1149, 24 from each decade):**

- From 1960-1975, the technology used in the studies consisted of computer software (4/4).
- From 1976-1989, the focus shifted to calculators (30/44), with remaining studies consisting of computer software or unspecified technology.
- From 1990-1999
  - 6/24 focused on calculators,
  - 8/24 focused on computer software,
  - 1/24 focused on both, and
  - 9/24 focused on internet technologies or unspecified technology.
- From 2000-2009
  - 5/24 focused on calculators,
  - 10/24 focused on computer software, and
  - 9/24 focused on internet technologies or unspecified technology.