MATHEMATICS TEACHERS' ATTITUDES TOWARD THE COMPUTERS

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ABSTRACT
This study reports an investigation of the effects of gender, age, and racial and ethnicity on the attitudes of mathematics teachers towards computer use. The participants of the study were mathematics teachers working in a wide range of New York public schools (n=50). A Confidence with Computers in Mathematics Teachers (CCMT) rating scale was developed and a 3-way analysis of variance (ANOVA) was used to analyze the data. The results indicated that there is a significant difference between effects of gender age, and race and attitudes of mathematics teachers on the use of the computer. Teachers with high age group experience low confidence while teachers with low age group favor using the computers efficiently. Results demonstrated that mathematics teachers differed by their use of the computers, the confidence in using it, the knowledge about the computers. Implications of the study give valuable insight to the future use of the computers inside mathematics classroom, and teachers' attitudes toward the computers.

Technology is described as the process by which people try to improve and organize the world (Yildirim, 2000). Despite its increasing popularity in the society, most educational places have struggled to give appropriate computer technology that is available to enhance human potential and teaching. Although the availability of computer use in K-12 classrooms is increasing, the use of such resources continues to be low (Ertmer, Addison, Lane, Ross, & Woods, 1999). There is growing evidence that teachers' attitudes toward the use of computer technology interfere with the willingness to use computers and to collaborate on integrating computer resources into classroom practices (Gos, 1996).

Yildirim (2000) has found that teachers' attitudes (anxiety, confidence, and liking) significantly improved after the computer literacy course. Koszalka (2001) has argued that teachers' prior computer use, a professor's willingness to teach, and the current use of technology in the schools at which they work also influenced their attitudes toward and use of computers. Among the studies that have investigated teachers' attitudes towards computers, the most numerous are those that study male-female differences. Dupagne & Krendi (1992) found positive relationships between years of teaching experience and hours of computer training and between age and microcomputer training. Researchers are also looking at the dynamics of race and class, in relation to computers. Butler (2000) reports that both a gender and a racial gap exist in the field of computer technology.

It is obvious that in the 21st century, almost all jobs will involve computers in some way. It is crucial, therefore, for mathematics teachers to have appropriate technology training during their education, if they are to meet their student needs for the next century.

STATEMENT OF THE PROBLEM

The purpose of this study is to investigate the effects of gender, race or ethnicity, and age on computer anxiety and confidence level of mathematics teachers. For the purpose of this study, computer anxiety and confidence refers to computer experience, confidence level, and attitudes towards the use of computers as an instructional tool in the mathematics classroom. Mathematics teachers of different genders, ages, and ethnic background will be asked to learn their attitudes toward the use of the computers in classroom, as well as their confidence or anxiety.

REVIEW OF THE RELATED LITERATURE

Researchers have formulated many definitions of computer anxiety (Cole& Conlon, 1994; Harris& Grandgenett, 1996; Norton, McRobbie & Cooper, 2000), and much work has been done in the study of factors correlated with computer anxiety, such as math, age, gender, academic major, and especially, experience. In addition, over the past decade there has been a great deal of research into gender and mathematics. What the studies have indicated is that gender significantly influences many attributes related to computer use. As Woodrow (1992) noted, there is strong evidence of gender differences in attitudes toward computers, particularly when other factors such as math, age, experience, and curriculum are included in the equation.

Butler (2000) found females were more favorable toward computer-assisted courses while males were more positive about using computer programming in mathematics. Woodrow (1992) noted that most studies, his own included, find that males have a higher degree of computer enthusiasm than do females and concluded that the lower computer confidence among females may inhibit female teachers from incorporating computers into mathematics classrooms. Males also have been found to be more internal in their locus of control with respect to the use of computers and more committed to the actual use of computers in the class environment (Woodrow, 1992). There may be a certain degree of ability and understanding needed before a mathematic teacher will be interested in, use, and promote computers. Indeed, Gos (1996) suggested that the lack of computer experience among female teachers may be a contributing factor to their passive role toward computer integration.

Many studies have also focused on race issue in relation to computers. Kramer & Lehman (1990) and Norton, McRobbie & Cooper (2000) reported that both a gender and a racial gap exist in the field of computer technology. Butler (2000) found that women of color mentoring adolescent girls in computer technology could affect not only middle level students but also everyone positively.

Other studies of teachers' attitudes toward computers have reported that age does influence teachers' attitudes. (Harris & Grandgenett, 1996). For example, Lockheed & Mandinach (1986) reported a serious and significant decline in interest in computing science among high school seniors. They suggested that it may be possible to argue this issue by developing better computer courses. The same conclusion is relevant to computer training courses for teachers (Lockheed &Mandinach, 1986). Yildirim (2000) reported that early childhood teachers significantly differed in their attitudes toward computers on the basis of gender and years of teaching experience. Similarly, another study (Lockheed & Mandinach, 1986) found significant (positive) relationships between years of teaching experience and hours of computer training and between age and microcomputer training.

The literature indicates that personal characteristics (gender, age, and ethnicity) have strong impact on teacher attitudes toward computers in mathematics classes. Some studies suggest that male teachers tend to show slightly more favorable attitudes toward computer use than do females (Dupagne, & Krendi, 1992; Ertmer, Addison, Lane, Ross, & Woods, 1999). Other studies, however, report little or no differences in teacher attitudes on the basis of gender (Koszalka, 2001; Kramer, P.E., & Lehman, 1990). In general, years of teaching experience and age appear to have impact on attitudes toward computers, the level of knowledge about computers, and willingness to use computers.

STATEMENT OF THE HYPOTHESIS

The literature suggests that the effects of gender, age, and racial and ethnicity are important factors on the attitude of mathematics teachers towards computer use. Therefore, it was hypothesized that attitudes toward the use of computers in the classroom by mathematics teachers will be affected by gender, age, and racial and ethnicity.

METHODOLOGY

Subjects

The original sample (n=50) included mathematics teachers working in a wide range of New York public schools-urban and suburban; elementary, middle, and high; large and small; conventional and charter. The participants were selected in cooperation with their school principal or supervisor to represent diversity among mathematics teachers. This process insured the representatives of mathematics teachers within the teacher population in terms of the gender, race and ethnicity. The size of this sample (n=50) proves adequate power (power = .84; alpha = .05; effect size = small).

Although the sample is best viewed as a purposive sample, and the sample size is small, characteristics of teachers represent a similar case from the large population (Male=22, Female=26; white= 31, Person in color= 17; age between 22 and 38=29, age between 39 and 54= 19). In total, only two teachers who were contacted chose not to participate in the study.

Instrument

Based on prior work by Woodrow (1991), Meskill & Melendez (1997) in the area of teacher confidence, a Confidence with Computers in Mathematics Teachers (CCMT) rating scale was developed (See Appendix B). CCMT was a 10-item Likert scale designed to be administered to mathematics teachers in their school environments, and to take no more than 10 minutes to complete. For each 10 statements (e.g., “I get easily frustrated when I use computer in mathematic class”, “The use of computer in the mathematics classroom is important”), the mathematic teacher was asked to circle a number form 1 to 5(5=strongly Agree, 4=Agree, 3=Undecided, 2=Disagree, 1=Strongly Disagree). The directions indicated that every question must be answered.

Two experts in mathematics education independently reviewed the instrument and verified that it had content and construct validity. Based on the scores resulting from administration of the CCMT scale in this study, the instrument has demonstrated internal consistency reliability. (r =. 80).

Design

The design applied in this study was causal-comparative in nature. (See Figure 1). This design was selected because of attempt to determine the consequences of differences that already exist among people. There were three independent variables, each having two values. Gender was the first independent variable (being male or female), race was the second (being white or person in color), and age was the last independent variable using two values (being under 38 years of age or over 38 years of age). The level of confidence as assessed for each participant was the dependent variable. A potential threat to this study associated with internal validity, as the presented groups may not include equivalence on important group variables. Also, the causation can not be established, while the relationship between independent and dependent variables may be identified.

Independent Variable	Value	Dependent Variable
Gender	Male/Female	Confidence
Race	White/Nonwhite	Confidence
Age	Over 38/Under 38	Confidence

Figure 1. Experimental Design

Procedure

All subjects in the sample group were Mathematics Teachers at public schools in upper New York State. All participants were purposely chosen from each of the schools' mathematics teachers, who at the same time were teaching mathematics classes actively. The Likert scale developed for the purpose of the study was conducted with a consent form and requested to complete the survey and returned it immediately. School' library or lunch break were used as a time to conduct the questionnaire. All 48 of the questionnaires were completed and returned within the requested time limit.

Results

A 3-way analysis of variance (ANOVA) was used to analyze the data (See Appendix A). The 3-fixed categorical independent variables were gender with 2 levels (being male and female), ethnicity with 2 levels (being white and person in color) and age with 2 levels (being under 38 or over 38). The random, continuous dependent variable was mathematic teachers' confidence level in using computers in the mathematics classrooms. Presented in Table 1 are means and standard deviations of the confidence level of mathematics teachers in using computers in the classroom. Summarized in Table 2 are the results of analysis of variance.

Table 1
Means and Standards Deviations for Confidence Level by Gender, Race and Age

Gender	Age	Race	Mean	SD	n
Male	Under 38	White	4.05	0.16	9
		Nonwhite	3.85	0.47	7
	Over 38	White	2.30	0.30	5
		Nonwhite	3.70	-	1
Female	Under 38	White	4.00	0.00	9
		Nonwhite	3.77	0.95	4
	Over 38	White	2.43	0.41	8
		Nonwhite	1.90	0.74	5

Table2
Source Table for Analysis of Variance

Between Subject Effects

Source	SS	df	MS	F
Gender	1.51	1	1.51	7.5*
Race	9.10	1	9.10	0.5
Age	13.38	1	13.38	66.17*
Gender*Race	1.80	1	1.80	8.9*
Gender*Age	1.09	1	0.4	5.4*
Race*Age	0.8	1	0.8	3.8
Gender*Race*Age	1.8	1	1.8	8.44*
Error	8.09	40	0.2	
Total	566.98	48		

*p< .05

Examination of Table 2 indicated that there is a significant difference for gender by age and race (F=8.4; df =1, 40; p< .05). As indicated in Figure 2, the largest difference in confidence level as indicated by score was between white male under 38 age ($\bar{x}$ =4.05) and nonwhite males over 38 age ($\bar{x}$ =1.90). White males under the age of 38($\bar{x}$ =4.05) scored higher than nonwhite males under 38($\bar{x}$ =3.85). However, white males over 38($\bar{x}$ =2.30) scored les than nonwhite males over 38($\bar{x}$ =3.70). In females' situation, both white females under the age of 38($\bar{x}$ =4.00) and over 38 ($\bar{x}$ =2.43) and scored more than nonwhite males under 38($\bar{x}$ =3.77) and over 38($\bar{x}$ =1.90).

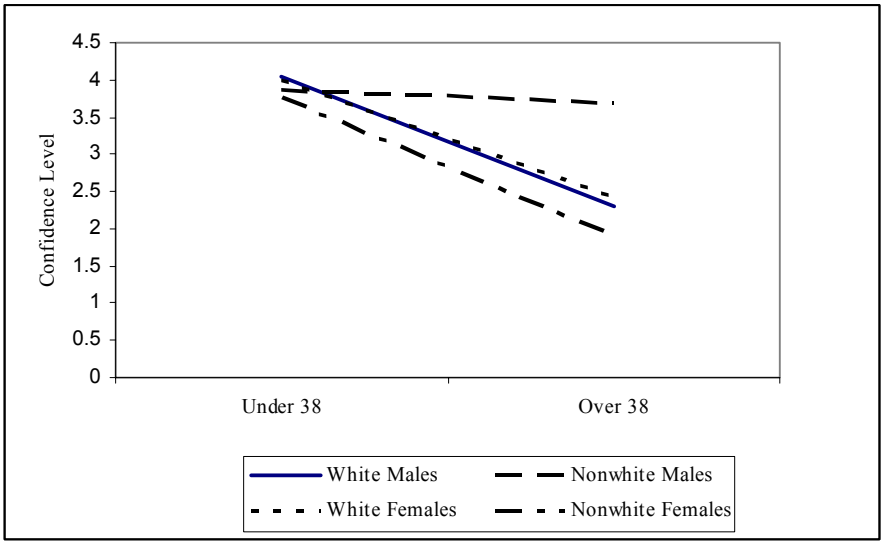

Figure 2. Difference in confidence level for males and females by age

Examination of the combined means indicates that the confidence of all males under 38 ($\bar{x}$ =3.97) was more than the confidence of all males over the age of 38 ($\bar{x}$ =2.53). Same trend was found for female mathematics teachers' interaction. All females under the age of 38($\bar{x}$ =3.93) showed a higher confidence in using computers in math classes compared to all females over the age of 38($\bar{x}$ =2.23).

White and nonwhite males under 38($\bar{x}$ =3.96) showed almost equal confidence compared to both white and nonwhite females under the age of 38($\bar{x}$ =3.93). White and nonwhite males over 38($\bar{x}$ =2.53) showed a slightly higher confidence in the using computer than white and nonwhite females ($\bar{x}$ =2.23). Males showed a higher confidence level than did females. All mathematics teachers under the age of 38 showed a higher confidence in

the using computer in the class environment compared to mathematics teacher over 38. Overall, gender by race and age accounted for approximately 17% of the variability in confidence level of using computer technology in the classroom.

DISCUSSION AND IMPLICATIONS

The findings of this study indicate that the issue of gender continues to be a problem. This study found consistent and significant gender differences in computer confidence and anxiety among mathematics teachers. These findings are consistent with literature in using computer for mathematic education (Gos, 1996; Dupagne & Krendis, 1992; Jones & Smart, 1995). This study suggests that young generation of mathematics teachers tend to show more favorable attitudes toward the computers than older teachers. As Woods (1992) indicated, both male and white mathematics teachers with low age group reported a higher confidence in using of computer technology. Older teachers do not appear more knowledgeable about computers or more willing to use them in the math classrooms than do younger teachers. Consistent with some researchers, white male and female teachers express greater knowledge about computers than nonwhite male and female teachers.

In general, the findings of this study support the findings of much of the research conducted in this area (Ihor, 2000; Kramer & Lehman, 1990; Harris & Grandgenatt, 1996). The use of computer technology among mathematics teachers showed that computers play crucial role in students' understanding of mathematics. Computers give teachers and students different opportunities to look at mathematical topics different aspects. It appears that educators need to examine the relationships between ethnic and gender issues of mathematics teachers with computer technology. It seemed clear that effective use of computer technology in mathematics classrooms would be expected from all mathematics teachers in the future. Therefore, more research on gender, age, and ethnic background in technology is needed to understand how mathematics teachers work with computers and use them as learning tool in the class environment.

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Appendix A

Alpha Level

Hypotheses: $\alpha = .05$ $\beta = .05$ $\gamma = .05$ Experiment-wise: $\alpha\beta\gamma = .35$

Assumptions

R-Randomness, N-Normality, H-Homogeneity, I-Independence

Test Statistics

Variable	*df*	*F*
Gender	G-1	MSg/MSe
Age	A-1	MSa/MSe
Ethnicity	E-1	MSe/MSe
Gender*Age	(G-1)(A-1)	MSga/MSe
Gender*Ethnicity	(G-1)(E-1)	MSge/MSe
Age*Ethnicity	(A-1)(E-1)	MSae/MSe
Gender*Age*Ethnicity	(G-1)(A-1)(E-1)	MSgae/MSe
Error Term	N-(G*A*E)	

Strength of Association

Eta Squared= SSb/SSt

Critical Values from F Table

Factor	df	Critical Value (df=41)
Gender	1, 40	4.08
Age	1, 40	4.08
Ethnicity	1, 40	4.08
Gender*Age	1, 40	4.08
Gender*Ethnicity	1, 40	4.08
Age*Ethnicity	1, 40	4.08
Gender*Age*Ethnicity	1, 40	4.08

Statistical Hypothesis

H: $\alpha i = \alpha i$ for all i
H: $\alpha i \neq \alpha i$ for all i

H: $\beta j = \beta j$ for all j
H: $\beta j \neq \beta j$ for all j

H: $\gamma k = \gamma k$ for all k
H: $\gamma k \neq \gamma k$ for all k

H: $\alpha i \beta j = \alpha i \beta j$ for all i, j
H: $\alpha i \beta j \neq \alpha i \beta j$ for all i, j

H: $\alpha i = \gamma k$ for all i,k
H: $\alpha i \neq \gamma k$ for all i,k

H: $\beta j = \gamma k$ for all j,k
H: $\beta j \neq \gamma k$ for all j,k

H: $\alpha i\ \beta j\ \gamma k = \alpha i\ \beta j\ \gamma k$ for all i,j,k
H: $\alpha i\ \beta j\ \gamma k = \alpha i\ \beta j\ \gamma k$ for all i,j,k

Appendix B

Please circle one of them as your answer:

What is your gender? ___Male ___Female
What is your age? ___ Under 38 ___Over 38
What is your ethnicity? ___ White ___Person in Color

Please circle the number for each question indicating your belief about each of the sentences below.
1. Strongly Agree 2. Agree 3. Undecided 4. Disagree 5. Strongly Disagree

Sentence					
1. Once I start with computer, I would find it hard to stop	1	2	3	4	5
2. The use of computer in the mathematics classroom is important	1	2	3	4	5
3. I have a lot of experience when it comes working with computers	1	2	3	4	5
4. I am not that kind of person that does well with computers	1	2	3	4	5
5. I get easily frustrated when I use computer in mathematic class	1	2	3	4	5
6. Computers could take over some of teaching in the math classroom	1	2	3	4	5
7. Every math teacher should use computers efficiently in the classroom	1	2	3	4	5
8. I do not understand how math teachers can spend so much time working with computers and seem to enjoy it	1	2	3	4	5
9. I look forward to using computers in math classroom	1	2	3	4	5
10.I feel confident that I will use computers effectively in the classroom	1	2	3	4	5