MATH ANXIETY IN PRE-SERVICE ELEMENTARY SCHOOL TEACHERS

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This research article examines math anxiety in pre-service teachers. The Mathematics Anxiety Scale-Revised (MARS-R) was administered to 481 university students. Significant results were found in areas of gender, educational level, and educational major.

Does the thought of math cause you to feel helpless, panicky, and to have difficulty in breathing, or ability to concentrate? If so, you are not alone. According to Trujillo (1999), Cemen, 1987; Posamentier & Stepelman, (1990, p. 210) report that "feelings of math anxiety can lead to panic, tension, helplessness, fear, distress, shame, inability to cope, sweaty palms, nervous stomach, difficulty breathing, and loss of ability to concentrate."

Math anxiety is an extremely common phenomenon among college and university students today. Stephen G. Krantz (1999, p.1) as reported in (Perry, 2004) describes an extreme form of this syndrome: "Math anxiety is an inability by an otherwise intelligent person to cope with quantification, and more generally, mathematics ... When confronted with a math problem, the sufferer has sweaty palms, is nauseous, has heart palpitations, and experiences paralysis of thought."

**Background**
Mathematics anxiety has been the topic of more research than any other in the affective domain. According to Tooke (1998), although math anxiety may have serious consequences in both daily life and in work, mathematics anxiety has its roots in teaching and teachers (Williams, 1988), and has been tied to poor academic performance of students, as well as to the effectiveness of elementary teachers (Bush, 1989; Hembree, 1990). Mathematicians and mathematics educators have great concern that teachers' attitudes toward mathematics may affect more than their students' values and attitudes toward mathematics; these attitudes may affect the

As stated in Trujillo (1999), there is a particular concern in the case of elementary teachers, because it has been reported that a disproportionately large percentage experience significant levels of mathematics anxiety (Buhlman & Young, 1982; Levine, 1996). This leads to doubts as to their potential effectiveness in teaching mathematics to young children (Trice & Ogden, 1986).

These concerns about the levels of mathematics anxiety among pre-service teachers and their potential effectiveness in teaching mathematics to young children were the bases for the research we conducted during the 2005-2006 school year at Arkansas State University. This study was directed at determining the level of math anxiety among pre-service elementary school teachers on the main campus and two branch campuses.

Method

Since students with math anxiety are difficult to identify in groups, we chose as our sample groups of students that we believed would exhibit math anxiety. These groups included college students with non-science majors taking physical science labs (a general required course), early childhood teacher education majors, and middle school teacher education majors. The education majors were further subdivided by whether or not they were interns (last semester seniors). Middle school teacher education majors were grouped by areas of concentration: language arts/social studies, or math/science.

In order to assess mathematics anxiety, we chose to administer the Mathematics Anxiety Rating Scale – Revised (MARS-R), a 24 item self-rating scale, developed by Plake and Parker in 1982, and based upon the original 98 item MARS rating scale (Richardson & Suinn, 1972). According to Hopko (2003, p.339),

The MARS-R measures anxiety in math-related situations with the composite score being a total of two subscales: LME and MEA. Items are answered on a 5-point Likert scale ranging from 0 (no anxiety) to 4 (high anxiety). The MARS-R which has yielded a coefficient alpha reliability of .98, is correlated .97 with the full-scale MARS (Plake & Parker, 1982).

After taking the 24 item MARS-R, students were asked to respond true or false to 12 math myths. The math myths were taken from an article (Platonic Realms MiniTexts, 2004).

Our hypotheses were formulated as follows:

1) There is a significant difference in math anxiety scores based on gender as reflected on the MARS-R.
2) There is a correlation between the age of students and the anxiety scores achieved on the MARS-R. Older students are more likely to express higher levels of anxiety that younger students.
3) There is a significant difference between the anxiety scores of students majoring in mid-level math/science and students majoring in mid-level language
4) There is a significant difference between the anxiety scores of interns majoring in mid-level math/science and student interns majoring in mid-level language arts/social studies as reflected on the MARS-R.

5) There is less anxiety presented on the MARS-R by interns as opposed to other levels of education.

6) There will be no significance for the statements presented as math myths.

The test was given to 481 university students; 392 female, 88 male, and one not reported by gender. Of these students, most were in the 19-24 year age span (271). There were 85 over the age of 30; 66 in the 25-30 age bracket; and 59 less than 19 years old. In terms of ethnicity/cultural group, most of the students were white (419). There were also 46 African-American; 4 Native-American; 4 Hispanic; and 4 Asian. There were also 3 students who chose not to report by ethnicity/cultural group, and one missing score among those reported. In terms of college majors, there were 279 pre-service elementary school majors broken down as follows: 134 early childhood; 45 middle level language arts/social studies; 36 middle level math/science; 56 early childhood interns; 12 middle level language arts/social studies interns; and 13 middle level math/science interns. There were also 184 non-science majors enrolled in physical science labs (a general required course).

Results

An ANOVA of mean scores for the MARS-R and gender indicated a significant difference \( F(479) = 5.158, p = .024 \) between males \( (M = 58.89, SD = 25.597) \) and females \( (M = 65.64, 25.124) \). Data indicated that our first hypothesis could be accepted.

A bivariate correlation indicated there was a small significant correlation \( r(481) = .120, p = .008 \) between age and scores on the MARS-R. The first part of the second hypothesis could be accepted.

Because the shared variance accounts for only 1.44% of the correlation, further analysis of age groups indicated a significant difference \( F(481) = 3.380, p = .018 \) between age groups. The largest difference appeared to be between scores for students under 19 years of age \( (M = 56.29, SD = 25.039) \) and students 25-30 years of age \( (M = 69.42, SD = 27.423) \). When groups were compared, there was a significant difference between students under 19 and students between the ages of 25-30 \( (t(123) = -2.785, p = .006) \) and between students under 19 years of age and students over 30 years old \( (t(142) = -2.4456, p = .015) \). There was not a significant linear trend \( (F = 1.562, p = .211) \) and the oldest group of students did not have the highest mean; therefore the second part of the second hypothesis could not be accepted.

An independent samples t-test was conducted on students majoring in midlevel math/science and students majoring in midlevel language arts/social studies. Findings indicated a significant difference \( t(79) = -5.085, p = .000 \) between the two groups. As shown in Table 1, the scores for students majoring in math/science were
Math Anxiety ...

Table 1
Scores of Math Anxiety Rating Scale-Revised by Education

<table>
<thead>
<tr>
<th>Education</th>
<th>Mean</th>
<th>N</th>
<th>Std. D.</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-level LA/SS</td>
<td>72.16</td>
<td>45.0</td>
<td>23.17</td>
<td>39.0</td>
</tr>
<tr>
<td>Mid-level LA/SS Intern</td>
<td>70.33</td>
<td>12.0</td>
<td>27.84</td>
<td>43.0</td>
</tr>
<tr>
<td>ECH</td>
<td>68.82</td>
<td>134.0</td>
<td>27.14</td>
<td>63.0</td>
</tr>
<tr>
<td>ECH INTERN</td>
<td>68.48</td>
<td>56.0</td>
<td>23.05</td>
<td>71.5</td>
</tr>
<tr>
<td>Other majors</td>
<td>62.15</td>
<td>184.0</td>
<td>24.63</td>
<td>70.0</td>
</tr>
<tr>
<td>Mid-level MAT/SCI</td>
<td>48.31</td>
<td>36.0</td>
<td>18.06</td>
<td>72.0</td>
</tr>
<tr>
<td>Mid-level MATH/SCI Intern</td>
<td>45.46</td>
<td>13.0</td>
<td>17.67</td>
<td>71.0</td>
</tr>
</tbody>
</table>

Figure 1

Mean Scores

lower than the scores for students majoring in language arts/social studies. Based on this information, our third hypothesis could be accepted.

Using a graphic representation of the above data can aid in examining possible interpretations of this information. Figure 1 illustrates the information from Table 1 in a graph.

An independent samples t-test was run between the interns majoring in math/science and interns majoring in language arts/social studies. The t-test indicated a significant difference ($t (23) = -2.690, p = .013$) between the two groups of interns. As shown in Table 1, the math/science
Table 2
Mean scores of MARS-R

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asian</td>
<td>4</td>
<td>47.350</td>
<td>24.295</td>
</tr>
<tr>
<td>Native American</td>
<td>4</td>
<td>51.250</td>
<td>31.501</td>
</tr>
<tr>
<td>White</td>
<td>419</td>
<td>64.160</td>
<td>25.318</td>
</tr>
<tr>
<td>African American</td>
<td>46</td>
<td>67.740</td>
<td>24.085</td>
</tr>
<tr>
<td>Hispanic</td>
<td>4</td>
<td>81.000</td>
<td>19.201</td>
</tr>
</tbody>
</table>

Interns' scores were lower than the scores of the language arts/social studies interns. Based on this information our fourth hypothesis could be accepted.

After compiling scores into three groups (interns, education majors and other) we analyzed the data for support of the fifth hypothesis. An independent samples t-test compared mean scores of all interns and the mean scores of students majoring in educational studies, and a second independent samples t-test compared mean scores of interns to other students. The data indicated no significant difference for either test; therefore our fifth hypothesis could not be accepted.

A one-way ANOVA was conducted to explore the differences related to our sixth hypothesis. Data indicated that mean scores on the MARS-R and the first ($F (95) = 1.3111, p = .041$) and fourth ($F (95) = 1.344, p = .028$) myths were significantly different.

The mean scores on the other ten myths were not significantly different. The findings suggested that we could not accept our sixth hypothesis.

Although no hypothesis was generated for ethnicity, results of the one-way ANOVA indicated a significant difference ($F (479) = 1.560, p = .0020$) between ethnicity and MARS-R. Further evaluation of the data indicated the highest scores for the MARS-R were reported by Hispanic students ($M = 81.00, SD = 19.201$) and the lowest scores were reported by Asian students ($M = 47.50, SD = 29.783$). Additional mean scores for each group are shown in Table 2.

Limitations of this study may include the small number of minority participants and a limited number of interns who chose to participate. This study did not determine if the students had similar feelings in other subject areas in addition to math, so caution should be taken in assuming all math anxiety reported is exclusive to math only.

Conclusions

As reported by Woodard, (2004), in the early grades, there is no significant difference in the math anxiety experienced in either gender (Gierl & Bisanz, 1995), but
females exhibit more math anxiety in secondary school and in college (Bernstein, Reilly, & Cote-Bonnano, 1992; Campbell & Evans, 1997). Our data is consistent with this research.

Some studies, according to Woodard (2004) support the belief that nontraditional-aged students exhibit more math anxiety than traditional-aged students (Betz, 1978; Royce & Rompf, 1992). However, Bitner, Austin, & Wadlington (1994) found no evidence of this trend, although they did find that nontraditional-aged students reported more anxiety in general than traditional-aged students. Our data indicates that there is a correlation between age and math anxiety. However, a significant linear trend could not be established among the age groups; therefore we could not conclude that older students expressed higher levels of math anxiety than younger students.

It was hypothesized in our study that none of the myths would be significant for our population. However, the first myth, "men are better at math than women", and the fourth myth, "math is not creative" both turned out to be significant for our population. The remaining ten myths were not significant for our population.

It was the purpose of this study to determine the level of math anxiety among our students. For our total sample, self-reported math anxiety was (M=62.24, SD = 23.08). This is somewhat comparable to the Plake and Parker (1982) study (M =59.84, SD= 20.6) as reported by Hopko (2003). Our Likert scale, however, ranged from 1 to 5 while the Plake and Parker (1982) study used a Likert scale of 0 to 4.

The results of this study should be viewed as more suggestive than definitive. The data suggests that at least some of our students are experiencing math anxiety.

**Recommendations**

Because this math anxiety may affect their own achievement and that of their future students, it is incumbent upon us as teacher educators to find ways to lessen the math anxiety of our students. This can be accomplished through further research, and by incorporating recommendations from available research into our pre-service teacher education curriculum.