An Invitation into the Investigation of the Relationship between Mathematics Anxiety and Learning Styles in Elementary Preservice Teachers

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Two hundred sixty-four students from a large southeastern U.S. university participated in this study which investigated the relationship between mathematics anxiety and learning styles in elementary preservice teachers. The Mathematics Anxiety Rating Scale (MARS) and Style Analysis Survey (SAS) were administered. Scores were analyzed using Pearson product-moment correlations. Results showed a relationship between mathematics anxiety and global learning style (r = 0.42) indicating a tendency for global learners (whole picture learners) to have higher levels of mathematics anxiety.

Introduction

Invitational Education was developed to provide a model of practice to promote people to realize their potential in all areas of worthwhile endeavors. IE presents a paradigm that sees teaching as a force for positive social change. It is a theory of practice that emanates from the self-concept theory and the perceptual tradition. It is deliberately directed towards broader goals than learners and their performance alone. IE seeks to value and recognize the strengths of every student while helping the student improve on weaknesses. It breaks down the emotional, intellectual, physical, and psychological barriers that prevent learners from achieving their true potential. As educators, we have to make the effort to encourage each student to share his or her true gifts with the world.

Mathematics Anxiety

Mathematics anxiety has gained heightened awareness by mathematics educators as an important factor in the learning and teaching of mathematics (Aiken, 1970, 1976; Kulm, 1980, Reyes, 1987; McLeod, 1988; Sloan, T., Daane, C., & Geisen, J., 2002; Vinson, 2001) Educators believe that studying the manner in which individuals learn is also at the heart of educational enhancement (Oxford, 1994; 1995). Research reveals particularly high levels of mathematics anxiety in elementary preservice teachers (Battista, 1986; Gresham, 2004; Kelly & Tomhave, 1985; Singh, Granville, & Dika, 2002; Sovchik, Meconi, & Steiner, 1981; and Vinson, 2001; Zettle & Raines, 2002).

Mathematics anxiety has been defined as a feeling of uncertainty, of not being able to do well in mathematics or with numbers, (Tobias, 1998). More than a dislike or negative attitude towards mathematics, Smith (1997) described it as uneasiness when asked to do mathematics, an inability to perform well on tests, a feeling of physical illness, faintness, and dread. Tobias (1976) gave the shortest definition saying it is the “I can’t” syndrome. She stated, “People almost experience sudden death with mathematics anxiety. It is an extreme feeling of uncertainty and disengagement, as if a curtain has been drawn, like an impenetrable wall ahead, or seemingly standing on the edge of a cliff ready to fall off." (p. 45). Tobias and Weissbroad (1980) identified mathematics anxiety as the panic, helplessness, paralysis, and mental disorganization that arises among some people when they are required to solve a mathematical problem. It is a phenomenon where students suffer from the irrational fear of mathematics to the extent that they are unable to think about, learn, or be comfortable with mathematics. Inevitably, this fear has been known to cause low self-esteem, frustration, and sometimes academic failure in students (Tobias, 1998; Gresham, 2004).

Bandura (1997) has suggested that "self-affirming beliefs promote development of skills and a sense of personal self-efficacy" (p. 101). Mathematics anxiety conflicts with and influences students' ability and beliefs that "I can" do mathematics and do so successfully. Students' mathematics anxiety levels are directly related and influenced by teachers. This is consistent with Purkey and Novak's (1996) description of how the influence of teachers affects one's own beliefs. All of which is to suggest the powerful hand teachers have in the mental habits that an individual creates and develops. Purkey and Novak (1996) contended that the environment teachers create must be carefully prepared. Critical to this preparation is the offering of an inviting, supportive, and safe environment. The quality of mathematics instruction and the environment in the elementary classroom depends on the preparation of preservice teachers to teach mathematics (Battista, 1986).

Learning Styles

Knowing each student and their individual differences is essential to preparation for facilitating, structuring, and validating successful learning in the classroom for all students (Guild, 1994). The opportunity for every child to succeed depends upon the teacher having a full understanding of learning styles (Oxford, 1995). Oxford, Ehrman and Lavine (1991) defined learning styles as "a person's general approach to learning" (p. 2). The term "leaning style" indicates preferred or habitual patterns of mental functioning and dealing with new information (Oxford, 1994). It is the way individuals concentrate on, absorb, and retain such new and different information (Dunn & Dunn, 1978; Oxford, 1994; Sloan, Daane, & Geisen, 2002).

Bennett's work (1990) served as a benchmark to compare and respond to the definition of learning styles as a consistent pattern of behaviors and performance by, which an individual approaches educational experiences. An individual's learning style is formed deep in the structure of neural organization and personality, which molds and is molded by human development and the cultural experience of home, school, and society (Bennett, 1990). Individual learning styles are categorized as global or analytical learners. Global learners or relational learners begins with the whole picture and has trouble discerning the important details from a confusing language background. In contrast, analytical learners like details better than the overall picture and can separate the details from the background (Oxford, 1994; 1995).

The Offering of Invitational Education

Invitations, learning styles, and mathematics anxiety share similar effects. They influence the academic choices that students' make, their resilience to hardships, the level of anxiety they experience, and the success they ultimately have (Pajares & Zeldin, 1999). Invitational Education offers us a way to think about mathematics anxiety and learning styles preferences. IE is respectful, caring, and supportive of other's growth and development. Success expectations are closely related to self-concept, self-esteem, and self-efficacy; constructs that are essential to understanding invitation education and other approaches offered to student learning that emphasizes the perception tradition (Purkey & Novak, 1996; Purkey & Schmidt, 1987, Purkey & Stanley, 1991). With a better understanding of mathematics anxiety and its relationship to learning styles, we are forced to think more deeply and perhaps try something new in a safe environment where there are many opportunities for students to succeed.

Disinviting Learning Experiences

Lack of understanding learning styles and their roots is not necessarily the fault of teachers. Many teacher education programs do not provide experiences that help develop skills in identifying students' learning styles and in handling style differences (Oxford, 1995) or in addressing the teacher's own mathematics anxiety (McCarthy, 1987; Sloan, Daane, & Geisen, 2001; Tobias, 1993). Some researchers have proposed that mathematics anxiety may stem from teaching methods that are more conventional, and rule bound (Ashcraft, 2002; Cote & Levine, 2000, Furner & Duffy, 2002; Hembree, 1990; Pintrich & Schunk, 2002; Singh, Granville, Dika, 2002; Tobias, 1993; Williams & Ivey, 2001; Zettle & Raines, 2000). These methods are usually employed by pre-service teachers who themselves possess high levels of mathematics anxiety and negative attitudes toward mathematics (Bush, 1989; Karp, 1991; Tobias, 1993, 1998).

According to Oliver (2002), a quality learning experience meets the following criteria if it has authentic content, provides multiple perspectives, involves mindful engagement and reflection, encourages collaboration, incorporates authentic assessment, and involves the teacher as a coach/facilitator. Further, the National Council of Teachers Mathematics Standards (1989, 2000) advised teachers to use a variety of instructional techniques and strategies to benefit all types of learners in the classroom. Tobias (1993, 1998) and Gresham (2004) pointed out that most mathematics classrooms do not meet those criteria. Most mathematics instructional practices involve a "traditional" approach to teaching. That is, where rote memorization of facts and lecture practices occur with very little emphasis geared toward strategies that actually engage the learner. In other words, mathematics lessons are often not designed to be intentionally inviting. Unfortunately, many mathematics educators who teach in the traditional approach do not employ a variety of activities. They often neglect to meet the learning styles of all students which ultimately perpetuates mathematics anxiety (Hodges, 1983, Sloan, Daane, & Geisen, 2001; Tobias, 1998; Zaslavsky, 1994).

Design of the Study

Two hundred sixty-four elementary preservice teachers (247 females, 17 males) enrolled in an elementary mathematics methods course at a large southeastern university were invited to participate in this study. All students had completed at least 3 university mathematics courses and 1 elementary mathematics content course.

Two instruments were used to obtain the data: the Mathematics Anxiety Rating Scale (MARS) and the Style Analysis Survey (SAS). The MARS (Richardson and Suinn, 1972) is a 98-item instrument, self-rating Likert-type scale which can be administered either individually or to groups. Each item on the scale represents a situation which may arouse mathematics anxiety by indicating: *not at all* = 1; *a little* = 2; *a fair amount* = 3; *much* = 4; or *very much* = 5. Mathematics anxiety may be elevated by the scaling of items with possible scores range from 98 to 490 with high scores indicating a high level of mathematics anxiety.

The SAS is a 110-item instrument designed to identify how individuals prefer to learn, concentrate, and perform in both educational and work environments (Oxford, 1990). The instrument has 11 subscales and uses a Likert-type scale with the following responses: 0 = *never*; 1 = *sometimes*; 2 = *very often*; 3 = a*lways*. Here again, the scaling itself could generate a level of mathematics anxiety in the respondent. Cronbach reliability coefficients for the subscales ranged from 0.73 to 0.89. The subscales are combined into five major categories: (a) Category 1- how you use physical senses for study and work (visual, auditory, hands-on), (b) Category 2-how you deal with other people (extroverted and introverted), (c) Category 3- how you handle possibilities (concrete-sequential, intuitive), (d) Category 4- how you approach tasks (open, closure-oriented), (e) Category 5- how you deal with ideas, (analytic and global). If the scores in each category are within 2 points of each other, respondents are considered to be combinations of each category. Respondents can be categorized as analytical, global, or analytical/global depending on the closeness of their scores. Scores obtained from each of the SAS subscales and the MARS were analyzed using Pearson product-moment correlations to determine if there was a connection between learning styles and mathematics anxiety.

Results and Discussion

Of the eleven subscales from the SAS, only one subscale within Category 5 (global-dealing with ideas) was related to mathematics anxiety at the $p < .05$ level of significance. The data in this category indicated that out of 264 elementary preservice teachers involved in the study, 179 (68%) were categorized as global learners, 8 (3%) were analytic, and 77 (29%) were a combination of global/analytic. A comparison of the SAS learning style subscales revealed that there was a positive correlation ($r = .42$) between global orientation and mathematics anxiety.

Thus it is known there was a relationship between mathematics anxiety and a global learning style (See Table 1). As global orientation scores increased, mathematics anxiety scores increased as well. The results of this study support Sloan, Daane, and Giesen’s (2002)

Table 1
Pearson Product Moment Correlations Between Learning Style Preferences (SAS) and Mathematics Anxiety Scores (MARS)

Learning Style Preference	Mathematics Anxiety Scores
Category 1	
Visual	.09
Auditory	.05
Tactile (Hands-On)	.04
Category 2	
Extroverted	.17
Introverted	.03
Category 3	
Intuitive-Random	.09
Concrete Sequential	.15
Category 4	
Closure-Oriented	.19
Open	.01
Category 5	
Global	.42*
Analytic	.25

*$p < .05$

research regarding thirty-eight elementary preservice teachers' learning styles and mathematics anxiety. They found that only one subscale of the SAS (global) was related to mathematics anxiety. They too determined that as global orientation scores increased, mathematics anxiety scores increased as well. However, only 7.8% of the variance in mathematics anxiety was accounted for by global learning styles in their study. They contended that other variables, such as instructional methods, mathematics achievement levels, confidence in doing mathematics, and levels of mathematics anxiety, may have accounted for more of the variance (Sloan, Daane, & Geisen, 2002).

Researchers have characterized global learners as holistic, spatial, divergent, intuitive, and imaginative (Edwards, 1989; McCarthy, 1997, Oxford & Anderson, 1995). The global learner begins with the whole picture, seeking the big picture right away while trying to establish meaning only in relation to the whole, might have trouble with details, is more interested in fluency than accuracy, and likes learning that is integrative (Oxford & Anderson, 1995). Kinsella (1995) indicated that global learners are highly visual, relational, and contextual (parts-and-whole together) learners. Global or right-brain dominant individuals approach problems in an intuitive manner, whereas most mathematics courses are taught through systematic problem solving in a step-by-step linear fashion (Sloan, Daane, & Giesen, 2002). In addition, many mathematics problems are often geared toward finding only one solution or right answer and many teachers teach in this manner. However, open ended instruction is preferred by global learners who approach problems in a divergent manner. Analytical learners prefer instruction that is sequential, traditional, and rule-based (Oxford & Anderson, 1995). In contrast, an analytical learner likes details better than the overall picture and can separate the details from the background (Oxford & Anderson, 1995). Ellis (1989) implied analytical learners naturally prefer to engage in formal language learning aimed at achieving accuracy, while the global learner might prefer learning that is aimed at and takes place through communication. According to Tobias (1993), all types of learners are capable of learning mathematics. However, she stressed that some types of learners do not learn as well when taught in the traditional manner that is prevalent in mathematics courses, even today. Mathematics courses which traditionally emphasized sequential, step-by-step, deductive and rule based instruction have caused global learners to experience difficulties in difficulties in learning mathematics (Oxford & Anderson, 1995; Sloan, Daane, & Giesen, 2002).

Invitational Recommendations

Purkey (1978) has described masterfully how the teacher and the curriculum create an environment in which verbal and nonverbal messages to students are either inviting or disinviting. The creation of a classroom environment that invites all students to experience rewarding success should be the goal of every teacher. Whitmore (1982) indicated that there are some specific invitations which students particularly need to receive in order to gain the most from school experiences, to have the most positive attitudes toward classroom learning, and to regenerate motivation to participate if negatives attitudes are formed. Students often become discouraged and develop a self-fulfilling prophecy that they cannot succeed and are doomed for failure when mathematics anxiety is encountered or experienced. When mathematics anxiety and learning style preferences are addressed and teaching strategies are geared toward the specific needs of the learner, success is eminent. Below are some suggestions for creating an inviting learning environment for students.

- Place an emphasis on students' learning style differences and what part learning styles have on the role of the learning process.
- Embrace mathematics. Make the learning environment a safe, secure, and inviting one by recognizing the variance of learning styles in students.
- Help students understand that they are a part of a learning community where learning styles are respected.

- Know that achieving academic success is highly dependent on an understanding of the relationship between mathematics anxiety and students' individual learning style differences. Let students know that their individual learning needs will be met.
- Praise students for their accomplishments in mathematics. Support them by using positive statements and feedback.
- Offer an inviting, safe, environment to guide students. Encourage and help them set and achieve mathematical goals.
- Be aware that mathematics anxiety does exist in students *and* in teachers.
- Allow students to share and describe their feelings about their mathematics anxiety.
- Transform the environment to a nurturing one. Be aware, understand, and adopt effective, non-traditional, motivating, active teaching practices, strategies, and learning experiences. Provide a curriculum that is relevant, challenging, integrative, and exploratory.
- Use multiple teaching approaches to respond to the various learning style differences of students.
- Mathematics anxiety can be debilitating. Therefore, engage in quality work, enhance problem-solving, and improve students' mathematical skills.

Conclusion

Invitational theory (Purkey & Novak, 1988; Purkey & Schmidt, 1990; Purkey & Stanley, 1991) is a "fresh conception of education—forming a new image of what teachers can do" (p. 13). Invitational education seeks to provide a means of intentionally summoning people to realize their potential in all areas of worthwhile human endeavor. It is a "democratically perceptually anchored, self-concept approach to the educative process" (Purkey & Novak, 1996, p. 3). The aim of invitational theory is to "create an educational culture that summons everyone involved to become lifelong learners" Purkey & Novak, 1996, p. 5). It is a method of creating environments in which self-concept could be enhanced and human potential more fully developed. Effective education decisions and practices must emanate from an understanding of the way individuals learn. Students are more successful when using their style strengths, therefore diverse teaching styles are essential (Guild, 1994). Dunn and Dunn (1978) and Oxford (1995) indicated that students learn faster and with greater ease when teachers gear instruction to student's learning styles. Increasingly, educational leaders are recognizing that the process of learning is critically important and understanding the way individuals learn is the key to educational improvement (Tobias, 1998). Classroom teachers accommodating student learning styles can result in improved attitudes towards learning and an increase in productivity and academic achievement (Oxford, 1994). Educators who work with preservice teachers may be able offer a greater awareness of learning styles within the classroom. This awareness could be explored to help preservice teachers improve the efficiency and effectiveness of instructional materials and methods used in the mathematics classroom. One's learning style is as unique as a fingerprint (Oxford & Anderson, 1995). Classrooms and curriculum strategies need to accommodate the variety of learning style preferences for students. It is important for preservice teachers (and those providing instruction for them) to be aware of learning style differences so they can offer an inviting learning environment, maximize learning, and minimize stress thereby taking the first step in reducing mathematics anxiety in their students. By returning civility to an uncivilized society, we can reduce barriers (mathematics anxiety) for student success and achievement.

References

Aiken, L. (1970). Attitudes toward mathematics. *Review of Educational Research*, *40*, 551-596.

Ashcraft, M. (2002) Math anxiety: Personal, educational, and cognitive consequences. *Current Directions in Psychological Science, 11*, 181-185.

Battista, M. (1986). The relationship of mathematics anxiety and mathematical knowledge to the learning of mathematical pedagogy by preservice elementary teachers. *School Science and Mathematics*. *86*, 10-19.

Bennett, C. (1990). *Comprehensive multicultural education: Theory and practice*. Allyn & Bacon. Boston.

Bush, W. (1989). Mathematics anxiety in upper elementary school teachers. *School Science and Mathematics*, *89*, 499-509.

Cote, J. & Levine, C. (2000). Attitude vs. aptitude: Is intelligence or motivation more important for positive higher educational outcomes? *Journal of Adolescent Research 15*(1), 58-80.

Dunn, R., & Dunn, K. (1978). *Teaching students through their individual learning styles: A practical approach*. Reston, PA: Prentice Hall.

Edwards, B. (1989). *Drawing on the right side of the brain: A course in enhancing creativity and artistic confidence*. Los Angeles: J. P. Tarcher.

Furner J. & Duffy, M. (2002). Equity of for all students in the new millennium: Disabling math anxiety. *Intervention in School and Clinic*, *38*, 67-74.

Gresham, G. (2004). Mathematics anxiety in elementary students. *CMC ComMuniCator, 29*(2), 28-29.

Guild, P. (1994). The culture/learning style connection. *Educational Leadership*, 16-21.

Hembree, R. (1990). The nature, effects, and relief of mathe anxiety. *Journal of Research in Mathematics Education*, *21*(1), 33-46.

Hodges, H. (1983). Learning styles. Rx for mathophobia. *Arithmetic Teacher*, *30*(7), 17-20.

Karp, K. (1991). Elementary school teachers' attitudes toward mathematics: The impact on students' autonomous learning skills. *School Science and Mathematics*, *91*, 265-270.

Kelly, W. & Tomhave, W. (1985). A study of math anxiety/math avoidance in preserivce elementary teachers. *Arithmetic Teacher, 32*(5), 51-53.

Kinsella, K. (1995). *Understanding and empowering diverse learners in the ESL classroom.* In J. Reid (ed), Learning styles in the ESL/EFL classroom. 170-94.

McCarthy, B. (1987). The 4-MAT system: *Teaching to learning styles with right/left mode techniques.* Barrington, IL: EXCEL, Inc.

McCarthy, B. (1997). A tale of four learners: 4MATS's learning styles. *Educational Leadership*, *54*(6), 46-51.

McLeod, D. (1988). Affective issues in mathematical problem solving: Some theoretical considerations. *Journal for Research in Mathematics Education*, *19*, 134-141.

National Council of Teachers of Mathematics. (1989). *Curriculum and evaluation standards for school mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics, (2000). *Principles and standards for school mathematics.* Reston, VA: Author.

Oliver, R. (2002). *Teaching and learning perspectives on learning objects*. Paper presented at the NCODE Flexible learning Australasia Conference, Sydney, Australia.

Oxford, R. (1990). *Language learning strategies and beyond: A look at strategies in the context of styles.* In S. S. Magnan (ed) Shifting the instructional focus to the learner 35-55, Middlebury VT: Northeast Conference on the Teaching of Foreign Languages.

Oxford, R. (1994). Individual differences among your students: Why a single method can't work. *Journal of Intensive English Studies*, 7, 27-42.

Oxford, R. (1995). *Gender differences in language learning styles: What do they mean?* In J. Reid (ed) Learning styles in the ESL/EFL classroom, 34-46. Boston: Heinle & Heinle.

Oxford, R. & Anderson, N. (1995). A crosscultural view of learning styles. *Language Teaching*, *28*, 201-215.

Oxford, R., Ehrman, M., & Lavine, R. (1991). Style wars: Teacher-student style conflicts worldwide with the ESL/EFL version of the Strategy Inventory for Language Learning (SILL) *System*, *23*(2), 153-157.

Pajares, F., & Zeldin, A. (1999). Inviting self-efficacy revisited: The role of invitations in the lives of women in mathematics related careers. *Journal of Invitational Theory and Practice*. *6*(1), 48-67.

Pintrich, P., & Schunk, D. (2002). *Motivation in Education: Theory, research, and applications*, (2nd ed). Upper Saddle River, NJ: Merrill Prentice Hall.

Purkey, W. (1978*). Inviting school success: A self-concept approach to teaching, learning, and democratic practice*. Belmont, CA: Wadsworth Publishing Company.

Purkey, W. & Novak, J. (1996*). Inviting school success: A self-concept approach to teaching, learning, and democratic practice* (3rd ed.). Belmont, CA: Wadsworth Publishing Company.

Purkey, W. & Schmidt, J. (1990). An invitational approach to ethical practice in teaching. The *Educational Forum*, *63*(1), 37-43.

Purkey W. & Stanley, P. (1991). *Invitational teaching, learning, and living*. Washington, DC: National Education Association.

Reyes, L. (1987). *Describing the affective domain: Describing what we mean*. Paper presented at the annual meeting of the National Council of Teachers of Mathematics, Anaheim, CA.

Richardson, R., & Suinn, R. (1972). The mathematic anxiety rating scale. Psychometric data. *Journal of Counseling Psychology*. *19*, 551-554.

Singh, K., Granville, M., & Dika. S. (2002). Mathematics and science achievement: Effects of motivation, interest, and academic engagement. *Journal of Educational Research*, *95*, 323-332.

Sloan, T., Daane, C., & Geisen, J. (2002). Mathematics anxiety and learning styles: What is the relationship in elementary preservice teachers? *School Science and Mathematics*, 84-87.

Smith, S. (1997). *Early childhood mathematics*. Boston: Allyn & Bacon.

Sovick, R., Meconi, L., & Steiner, E. (1981). Mathematics anxiety of preservice elementary mathematics methods students. *School Science and Mathematics*, *81*, 643-648.

Tobias, S. (1993). *Overcoming math anxiety*. New York: W. W. Norton & Company.

Tobias, S. (1998). Anxiety and mathematics. *Harvard Education Review*. *50*, 63-70.

Vinson, B. (2001). A comparison of preservice teachers mathematics anxiety before and after a methods class emphasizing manipulatives. *Early Childhoood Education Journal*, *29*(2). 89-94.

Williams, S., & Ivey, K. (2001). Affective assessment and mathematics classroom engagement: A case Study. *Educational Studies in Mathematics*, *47*, 75-100.

Zaslarsky, C. (1994). *Fear of math: How to get over it and get on with your life*. New Brunswick, NJ: Rutgers University Press.

Zettle, R., & Raines, S. (2002). The relationship of trait and test anxiety with mathematics anxiety. *College Student Journal*, *34*, 246-258.

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