DISPOSITIONS TOWARDS MATHEMATICS: ELEMENTARY PRE-SERVICE TEACHERS IN THE MIDDLE EAST

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Abstract

Teachers' dispositions and attitudes towards mathematics are closely related to the quality of their teaching and the students' learning of mathematics. This study aims to investigate pre-service teachers' dispositions towards mathematics. Mathematics as a subject area is generally thought of as difficult and complicated and, as a result, it is culturally acceptable for a student or a teacher to refer to themselves as "not a math person", while, in contrast it is not acceptable to be "not a reading person" (Epstein and Miller, 2011). This general acceptance of not being good at math stems from an underlying phobia or negative disposition that most students, as well as teachers, have towards mathematics. 57 pre-service teachers were surveyed in Saudi Arabia. In the findings, several functions of mathematical disposition are analyzed. Results and recommendations are further discussed.

Keywords: Mathematical Disposition, Math Anxiety, Teacher Education.

Introduction

The Common Core Standards, which have been adapted widely across the United States, have emphasized mathematical proficiency. Mathematical proficiency implies that students should understand "basic concepts, are fluent in performing basic operations, exercise a repertoire of strategic knowledge, reason clearly and flexibly, and maintain a positive outlook towards mathematics." (National Research Council, 2001) This definition further emphasizes the importance of having positive attitudes towards mathematics.

Generally, people have a conception that mathematics is a difficult subject area and, as a result, it is culturally acceptable for a student or a teacher to refer to themselves as "not a math person", while, in contrast it is not acceptable to be "not a reading person" (Epstein and Miller, 2011). Negative dispositions towards mathematics in general are one of the reasons for this general conception of the difficulty of mathematics. Teacher's beliefs about mathematics have been found to contribute to the quality of their teaching and, consequently, their students' achievement in mathematics (Maasepp & Bobis, 2015).

Researchers have defined and interpreted Mathematical Disposition with several interpretations and might include several psychological attributes that could be measured individually or as a whole, such as self-concept, attitude, anxiety, and motivation; a broad definition of the concept is "a tendency to think and act in positive way" (National Council of Teachers of Mathematics, 1989, p.233; cited in Anku, 1996), which reflects in students' willingness to "persevere" when they are performing mathematical computations and problem solving (Anku, 1996). Beyers (2011) describes the term "disposition towards mathematics" or "Mathematical disposition" (p.18) as including three mental models, "cognitive, affective, and conative" (p.22) which are directly related to students' or teachers' beliefs about the nature of mathematics, the level of difficulty in mathematics, and their attitudes towards mathematics. Consequently, a person's disposition towards mathematics, affects his/her willingness to "engage in a mathematical context (e.g. doing and/or learning mathematics)" (p.22); Beyers' (2011) definition of dispositions is utilized during the subsequent analysis and discussion of the results in this study. Alghazo et.al (2013) conducted a study on 17 pre-service teachers in the United States and found that the majority of students showed good dispositions towards mathematics, while, generally, the majority of students had high level of mathematics anxiety. Moreover, Memnun and Hart (2014) conducted a similar study about pre-service teachers' beliefs about mathematics and compared two samples; the first was a sample from the United States and the second was a sample from Turkey.

They concluded that both samples had positive beliefs about mathematics, and no significant differences were found between the two samples. As a continuation of this research endeavor, this study aims to investigate pre-service teachers' dispositions towards mathematics, as well as their opinions on the reasons that led to that disposition about teaching and learning mathematics in the Middle East and discuss the findings in relation to similar studies in the United States.

Methods

Design and participants

The design of this study included the collection of quantitative data in order to replicate the methods utilized in previous research conducted in the United States. The study utilized the Mathematics Dispositional Functioning Inventory (MDFI) to collect all quantitative data for this study.

Participants of the study were college students in the college of education, who were enrolled in programs leading to teacher certification in both Jordan and Saudi Arabia. Because one of the purposes of the study is to asses differences between the results of this study and previous studies conducted in the united States, students from both countries were grouped together to form a sample representative of Pre-service teachers in the Middle East. The sample included 57 students. 32 students were male and 25 students were female.

Measures/ Instrument:

The Mathematics Dispositional Functioning Inventory (MDFI):

The MDFI is a questionnaire specifically designed to measure pre-service teachers' dispositions towards mathematic as defined by Beyer (2011). The questionnaire consists of 60 questions measured on a Likert scale. There are three categories measured using MDFI which are, Conative, Cognitive, and Affective dispositions towards mathematics. The measure has been developed and carefully tested to enhance the reliability and validity of the instrument; the authors report a coefficient of .90 for the instruments internal validity and .938 for reliability.

Data analysis/ Results:

Conative:

While students showed high levels of anxiety on the cognitive function, the majority of students' responses show that they believed they or anyone else can become a better achiever in mathematics if they persist and try harder to understand any new mathematical concept that might be required to solve a mathematical problem. However, interestingly, students' responses to item (23) of the questionnaire reveal that they had given up on trying to solve or understand some mathematical problems or ideas in their high school mathematics classrooms.

Table 1. Responses to questions relating to Conative Disposition.

Question	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
8) No matter how much effort some people put into learning math, they just won't understand it.	1 (1%)	6 (10%)	14 (24%)	27 (47%)	9 (15%)
22) If I don't figure out something in math pretty quickly, then I probably won't even if I keep trying.	2 (3%)	4 (7%)	3 (5%)	39 (68%)	9 (15%)
23) There were some things in high school math that I just couldn't get, so I stopped trying.	3 (5%)	35 (61%)	3 (5%)	11(19%)	5 (8%)
36) If someone is having difficulties in math, they can eventually do well if they persist.	10 (17%)	35 (61%)	9 (15%)	1 (1%)	2 (3%)
43) In general, if I don't give up right away, I will eventually figure out the mathematics.	15 (26%)	33 (57%)	1 (1%)	6 (10%)	2 (3%)

Cognitive:

Students' responses varied with regard to different functions of disposition towards mathematics. Table 2 shows students' responses to the questions that address their cognitive dispositions; the cognitive function assesses both connections and argumentation functions. The data reveal that students' responses regarding making connections were somewhat evenly distributed on the "agree" and "disagree" responses; however, the data show that students do not engage or participate in mathematical reasoning, justification, or discussion when they are not asked. This is an indication of the students' anxiety when performing mathematical problem solving, as well as the students' lack of confidence in their mathematical abilities. A more detailed analysis of participants anxiety towards mathematics will be provided in later sections (see table 5).

Table 2. Responses to questions pertaining to Cognitive Disposition.

Question	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
19) When I think about mathematical ideas, I try to think about how they connect to other ideas in math.	18 (31%)	20 (35%)	8(14%)	6 (10%)	5 (8%)
27) In general, I try to see how mathematical ideas in different math classes are connected to each other.	8(14%)	20 (35%)	4 (4%)	23 (40%)	2 (3%)
53) In general, I try to see how mathematical ideas in math classes are connected to things outside of school.	4 (7%)	25 (43%)	19 (33%)	6 (10%)	3 (5%)
29) In general, I try to see how mathematical ideas are connected to ideas in other non-math classes.	3 (5%)	20 (35%)	12 (21%)	16 (28%)	6 (10%)
51) In general, I try to see how mathematical ideas within a single class are connected to each other.	5 (8%)	35 (61%)	10 (17%)	5 (8%)	2 (3%)
18) Even if I'm not asked to justify something, I still try to use mathematical reasoning and justification to explain how I did something in math classes.	4 (7%)	10 (17%)	19 (33%)	23 (40%)	1 (1%)
26) Even if I'm not asked to, I try to make and investigate mathematical conjectures in math classes.	3 (5%)	7 (12%)	8 (14%)	37 (64%)	2 (3%)
12) Even if I'm not asked to, I try to use various methods of reasoning in mathematics.	2 (3%)	22 (38%)	10 (17%)	20 (35%)	3 (5%)
48) Even if I'm not asked to, I try to develop and evaluate mathematical arguments to explain things in math classes.	1 (1%)	19 (33%)	12 (21%)	22 (38%)	3 (5%)
14) In general, I try to justify the statements I make in math classes.	3 (5%)	36 (63%)	12 (21%)	5 (8%)	1 (1%)

Affective:

Data revealed that the majority of students display good attitudes towards mathematics, especially in school context; about 55% of students said they "like doing math in school," while only 40% percent agreed that they "do not like math." (See Table 3) Furthermore, responses related to the sub-function *Self-Concept* show that 66% of students reported being "good at math" in their elementary year, and 70% of students believed they are able to learn math when they are taught step by step problem solving techniques. (See Table 4) On the other hand, the majority of students reported they were not very good at math in their high school years, which further emphasizes the difficulties they face when learning multiple ways of solving problems, or problems that require higher order thinking and cognitive skills.

On the *anxiety* sub-function, however, over 70% of students consistently reported having high levels of stress when "doing math" in school. This suggests that anxiety is the one sub-function that negatively affects students' general disposition towards mathematics.

Table 3. Responses to questions related to attitude.

Question	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
11) I like doing math in situations outside of school.	3 (5%)	13 (22%)	10 (17%)	28 (49%)	3 (5%)
15) In general, I don't like doing math in school.	6 (10%)	12 (21%)	7 (12%)	12 (21%)	20 (35%)
49) In general, I don't like math.	3 (5%)	20 (35%)	2 (3%)	26 (45%)	6 (10%)
56) Most of the math I do in school is boring to me.	1 (1%)	7 (12%)	9 (15%)	36(63%)	4 (7%)
52) I like doing math in school.	6 (10%)	25 (43%)	4 (7%)	20 (35%)	2 (3%)

Table 4. Responses to questions related to self-concept.

Question	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
7) In high school, I was really good at math.	4 (7%)	19 (33%)	9 (15%)	15 (26%)	10 (17%)
28) In general, math is too challenging for me to really understand it well.	2 (3%)	3 (5%)	11 (19%)	32 (56%)	9 (15%)
30) In general, I have no problems understanding concepts in mathematics.	1 (1%)	17 (29%)	12 (21%)	25 (43%)	2 (3%)
40) In general, it is really easy for me to learn step-by-step ways to do math problems.	8 (14%)	32 (56%)	6 (10%)	9 (15%)	2 (3%)
46) There is a 'math talent' that makes some people better at math than others.	9 (15%)	26 (45%)	10 (17%)	10 (17%)	2 (3%)
59) In elementary school, I was really good at math.	21 (36%)	19 (33%)	8 (14%)	4 (7%)	5 (8%)

Table 5. Responses to questions related to anxiety.

Question	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1) In general, I don't get stressed when I am doing math in non-school situations.	7 (12%)	25 (43%)	3 (5%)	20 (35%)	2 (3%)
9) In general, I get stressed out when I have to take a math test.	15 (26%)	18 (31%)	2 (3%)	21 (36%)	1 (1%)
37) In general, I get stressed when I have to take any kind of test.	17 (29%)	23 (40%)	3 (5%)	13 (22%)	1 (1%)
42) In general, I get more stressed when I have to take a math test than any other kind of test.	15 (26%)	13 (22%)	7 (12%)	12 (21%)	10 (17%)
57) In general, I get stressed out when I have to do math in math classes.	29 (50%)	13 (22%)	3 (5%)	10 (17%)	2 (3%)

Discussion and Recommendations:

The purpose of the study was to investigate pre-service teachers' dispositions towards mathematics. Also, the study aimed at comparing the results of this study with previous similar study conducted in the United States to check for any differences.

Results of the study indicate that pre-service teachers' dispositions towards mathematics are generally negative during their K-12 school years, and are highly affected by the high *anxiety* levels they are exposed to during their school years. Also, it is worth noting that the findings of this study are similar to those of studies conducted in the United States, which indicates that cultural factors and differences may not affect mathematical dispositions among pre-service teachers.

Differentiated instruction and multiple representations of mathematical ideas are concepts that need to be further emphasized in teacher preparation programs. Also, teacher education programs should emphasize the importance of teacher attitude and its long-term effect on their students' dispositions towards mathematics. "a recent study from the University of Chicago demonstrates that female first- and second-grade teachers' math anxiety has a negative effect on their female students, both in terms of their math achievement and in their endorsement of the gender stereotype that boys are good at math and girls are good at reading.(Epstein and Miller, 2011, p.4) this further emphasizes the need for developing teacher education programs that foster student-centered learning and produces teacher candidates that have sufficient content knowledge and mathematical disposition where they can teach their students" beyond their own knowledge." (Perry, 2011)

References:

Alghazo, Y., McIntyre, C., Alghazo, E.M. (2013). An analysis of pre-service teachers' dispositions towards mathematics. *European Journal of Social Sciences, (41)*1. (pp.94-99)

Anku, S. (1996). Fostering students' disposition towards mathematics: A case from a Canadian university. Education, 116(4), 536.

Beyers, J. (2011). Development and Evaluation of an Instrument to Assess Prospective Teachers' Dispositions with Respect to Mathematics. *International Journal Of Business & Social Science*, *2*(16), 20-32.

Epstein, D., Miller, R. T., & Center for American, P. (2011). Slow off the Mark: Elementary School Teachers and the Crisis in Science, Technology, Engineering, and Math Education. *Center For American Progress*.

Kalder, R. S., & Lesik, S. A. (2011). A Classification of Attitudes and Beliefs towards Mathematics for Secondary Mathematics Pre-Service Teachers and Elementary Pre-Service Teachers: An Exploratory Study Using Latent Class Analysis. *Issues in The Undergraduate Mathematics Preparation Of School Teachers*, *5*

Kilpatrick, J., Swafford, J., & Findell, B. (2001). *Adding it up: helping children learn mathematics / Mathematics Learning Study Committee, Center for Education, Division of Behavioral and Social Sciences and Education, National Research Council ; Jeremy Kilpatrick, Jane Swafford, and Bradford Findell, editors*. Washington, DC : National Academy Press, c2001.

Maasepp, B., & Bobis, J. (2015). Prospective Primary Teachers' Beliefs about Mathematics. *Mathematics Teacher Education and Development,16*(2), 89-107.

Memnun, D. S., & Hart, L. C. (2014). Beliefs about mathematics: What are the differences in US and Turkish pre-service teachers? *International Journal of Academic Research*, *6*(1).

Perry, C. A. (2011). Motivation and Attitude of Preservice Elementary Teachers toward Mathematics. *School Science And Mathematics*, *111*(1), 2-10.