

College Pre-service Teachers' Disposition to Mathematics as They Enter the College

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Abstract This is a descriptive study that aims to investigate pre-service teachers' dispositions toward mathematics (cognitive, affective, and conative). 117 pre-service teachers were purposively sampled for the study. The purpose was to measure their disposition as they join the college community. The findings of this study show that the majority of college freshmen and fresh-women enter college with a negative disposition in all three functions (cognitive, affective, and conative) in mathematics. It was then concluded that a high percentage of these students have a negative disposition towards mathematics. It is recommended that college tutors develop their mathematics disposition by teaching most of the mathematics concepts through activities base.

Keywords: pre-service teachers, mathematic disposition, cognitive, affective, and conative disposition

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1. Introduction

Generally, many people both teachers and students have the perception that mathematics is meant for a particular group of people. That is mathematics is not meant for everyone, unlike other subject areas. For an instant, it is uncommon or unheard of for one to say am not an English person [1]. All these notions can be attributed to one's negative disposition toward mathematics. According to [2], a key factor that influences a teacher's method of teaching is his or her beliefs. As a result, this will consequently affect the learner's achievement.

Mathematical disposition can be viewed from the individual or as a whole. From the individual perspective, the mathematical disposition can be examined as self-concept, attitude, anxiety, and motivation. As a whole or broader perspective, mathematics disposition can be explained as "a tendency to think and ask and act positively" [3]. This will influence learners' willingness to persist when they encounter difficulty in solving a mathematics problem [4]. This will build the individual as he/she transfers it into other fields of study.

The objective of this study is to examine newly admitted pre-service teachers' disposition towards mathematics as they are about to start their college education. This study is very significant because findings from the study will give Tutors an idea about the mathematics disposition level of the students they are about to teach. This idea serves as a guide in the selection of teaching methods and other teaching and learning

materials that will benefit the majority of the class. Also, findings from this study will give a foundation for further studies to be conducted.

2. Literature Review

2.1. Background of the Study

The Ghanaian educational curriculum aims to develop human resources holistically, they can be productive in all aspects of life [5]. That is, Ghana hopes to empower its citizens to be proactive in responding to the difficulties in this rapidly changing world. Learners' mathematics disposition now can be used to predict their attitude and decisions about mathematics in the future [3]. Teachers' attitude and beliefs which form part of mathematics disposition play a major role in classroom activate and particularly influence learners' performance [6]. Studies have shown that mathematics educators possess negative attitudes like impatient, unfriendliness, coercive, and teaching concepts abstractly. These attitudes induce fear, anxiety, and stress in students [7] which results in dislike of the subject and hence poor performance [6]. As it has been established that there is a strong relationship between teachers and students attitude formation towards mathematics, there is the need to measure pre-service teachers mathematics disposition as it will shape the disposition of their students at the basic level and subsequently, their future mathematics disposition (in further education or and daily life) [3]. Some students may not pursue careers in mathematics in the future, but

behaviors like motivation, appreciation, contributions, interests, beliefs, confidence, and perseverance learned from mathematics disposition can be applied in their daily life. Mathematics achievement has been narrowed to only making good grades and attaching less importance to these behaviors. The objective of the study is to determine pre-service teachers' disposition towards mathematics and determine the relationship that exists between pre-service teachers' gender and their disposition to mathematics.

As part of my philosophy, I always find out students' backgrounds in mathematics and their expectation as they go through their college education. This interaction takes place in our first meeting. This helps me as a tutor to know the strength of students in mathematics. This information helps me in my selection of materials and methods of teaching so I will be able to be of help to many of them.

Studies have shown that teachers can influence students' disposition towards mathematics [8,9] and there is a positive relationship between students' disposition to mathematics and performance [10]. Most of these studies focus on examining the disposition of students at the pre-college level, hence the need for this study.

2.2. Theoretical Underpinning

The research is grounded in the social constructivist learning theory as postulated by Lev Vygotsky [11]. The social constructivist theory combines both the cognitive and affective domains as a success in learning [12]. The affective domain forms the foundation for the cognitive domain. It will determine students' reactions towards mathematics which makes it key in students' success in mathematics. Mathematics achievement has been situated in the context of acquiring knowledge and skills only, which is contrary.

Learner's mathematics disposition can be explained as a multi-disciplinary domain capable of enhancing learning, as well as prevent the learning of mathematics which is determined by the learner's affective disposition [13]. NCTM [14] describes a productive mathematical disposition as a person's belief and attitude about mathematics which supports the tendency to consider mathematics as a logical, useful, and valuable thing. Mathematical disposition is made up of three mental models; "cognitive", "effective" and "conative" [15]. Beyer describes cognitive disposition as a process through which a learner acquires knowledge and skill about an object or idea. Some of the mental processes he identified include observing, recognizing, judging, reasoning, sense-making, etc., in mathematics. He also described the affective domain as the likelihood of a feeling and response to an object or idea. The noticeable domain of this disposition includes attitudes, beliefs, likes or dislikes, emotions, or important qualities of emotions, moods, and temperaments and responses to mathematics. Lastly, he described Conation disposition as the learners' desire to give out all their efforts, persistently, and diligently solve a mathematical task. The indicators are effort and persistence.

Alghazo, McIntyre, and Alghazo's [16] study involving 17 pre-service teachers in the United State of America shows that a greater percentage of the participants showed positive mathematical disposition and a higher level of

mathematical anxiety. Memun and Hert's [17] study was on pre-service teachers' beliefs about mathematics. The sample comprises pre-service teachers from the USA and Turkey. Results from their study show that both samples (USA and Turkey) have a positive belief about mathematics and there was no statistically significant difference between the means of the two samples.

On the other hand, [18] also investigated grade 12 students' disposition towards mathematics. They also used the Mathematics Dispositional Functioning Inventory (MDFI). They indicated that students in grade 12 have a negative disposition towards mathematics.

As established that attitude, anxiety, and belief are key factors to examine mathematics disposition, this study aims at examining pre-service teachers' mathematics disposition (cognitive, affective, and conative).

2.3. Research Question

This study was guided by this research question;

What is the level of freshmen and fresh women disposition to mathematics (Cognitive, Affective, and Conative) as they enter the college?

3. Materials and Methods

3.1. Design and Participants

This study was an exploratory research design where St Vincent College of Education was used as a case study. This type of research is the primary stage of research. Its purpose is to achieve new insights into a phenomenon [19]. The focus of this research is to gain more insight into the disposition that pre-service teachers have towards mathematics as they are about to start their college education.

3.2. Population, Sample, and Sampling Technique

Creswell and Clark [20] define a population as a group of individuals identified by common characteristics that interest a researcher. The findings of the study are generalized about the population. The population of this study comprise the population of the college, where the first years were purposively sampled for the study. The purpose was to measure their mathematics disposition as they join the college community. The sample size was 117. This comprise 76 males and 41 females.

3.3. Instrument

This study adapted the Mathematics Dispositional Functioning Inventory (MDFI) to collect the data. This instrument is specifically designed to measure pre-service teachers' and tutor's mathematics disposition [15]. It is a five-level Likert scale questionnaire comprising of 60 questions. For this study, the instrument was adapted to a four-level Likert scale questionnaire. Out of the 60 items, thirty-one items were selected to measure their mathematics disposition; 10 for cognitive, 5 for conative, and 16 for affective disposition towards mathematics. For

this study, “strongly agree” and “agree” were put together and considered as “agree” and have a positive disposition while “strongly disagree” and “disagree” were considered “disagree” and have a negative disposition.

4. Results and Discussion

Students’ entry mathematics disposition (Pre-test)
Cognitive Disposition

The cognitive disposition was measured using 10 items. Pre-service teachers responded by selecting either strongly agree, or agree, or neutral, or disagree or strongly disagree. Table 1 shows pre-service teachers’ responses to cognitive disposition. The data collected were analyzed using frequencies and percentages.

Out of the 10 items, 9 of them recorded high percentage of disagreement to the statement. That is over 50 percent of the respondents disagree to these nine statements. The highest percentage of disagreement was scored on item one. That is over 75% of the respondents disagree that they are able to connect mathematical ideas in their daily lives. Almost the same percentage of students who disagree (47.7%), agrees (47.9%) that, in their mathematics class, they try very hard to identify the connection that exist among mathematical ideas. Hence, It

can then be concluded that majority of the pre-service teachers in their first year have a negative cognitive disposition.

Affective Disposition

The affective disposition was measured using three main constructs, they were attitude, Self-concept, and anxiety. The attitude and anxiety were measured with five items each. The self- concept was measured with 10 items.

Attitude

Table 2 measures pre-service teachers’ attitudes toward mathematics. This attitude is the one they had to bring from SHS to the college. Many (53.0%) of the pre-service teachers indicated that they do not like doing mathematics when they are outside the classroom. Probably their mind is mathematics is learned and applied only in the classroom. This may explain why the majority of them indicated that they are unable to connect mathematical ideas in their daily lives. Over 65% of the respondents indicated that they neither like mathematics nor do it in school. A greater percentage of them also indicated that mathematics they do in school is boring. More than half of the respondents (50.4%) indicated that they do not like doing mathematics in school. About 11% of the respondents on this item were indecisive which high compare to others was.

Table 1. Responses to questions on Cognitive Disposition

Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. When I think about mathematical ideas, I try to think about how they connect to other ideas in math in my daily life.	11(9.4%)	9(7.7%)	9(7.7%)	75(64.1%)	13(11.1%)
2. In general, I try to see how mathematical ideas in different math classes are connected to each other.	17(14.5%)	23(19.7%)	11(9.4%)	39(33.3%)	27(23.1%)
3. In general, I try to see how mathematical ideas in math classes are connected to things outside of school.	14(12.0%)	19 (16.2%)	3(2.6%)	59(50.4%)	22(18.8%)
4. In general, I try to see how mathematical ideas are connected to ideas in other non-math classes.	31(26.5%)	11(9.4%)	9(7.7%)	36(30.8%)	30(25.6%)
5. In general, I try to see how mathematical ideas within a single class are connected to each other	19 (16.2%)	36(30.8%)	6(5.1%)	45(38.5%)	11(9.4%)
6. 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.	28(23.9%)	19 (16.2%)	3(2.6%)	48(41.1%)	19 (16.2%)
7. Even if I’m not asked to, I try to make and investigate mathematical conjectures in math classes	25 (21.4%)	13(11.1%)	6(5.1%)	59(50.4%)	14(12.0%)
8. Even if I’m not asked to, I try to use various methods of reasoning in mathematics.	41(35.0%)	22(18.8%)	3(2.6%)	28(23.9%)	23(19.7%)
9. Even if I’m not asked to, I try to develop and evaluate mathematical arguments to explain things in math classes	25 (21.4%)	22(18.8%)	3(2.6%)	42(35.9%)	22(18.8%)
10. In general, I try to justify the statements I make in math classes.	17(14.5%)	36(30.8%)	0(0.0%)	50(42.7%)	14(12.0%)

Source: Field survey, 2020, N 117.

Table 2. Pre-service teachers’ response to Attitude

Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
11. I like doing math in situations outside of school.	35(29.9%)	20(17.1%)	0(0.0%)	45(38.5%)	17(14.5%)
12. In general, I don’t like doing math in school	39(33.3%)	53(45.3%)	0(0.0%)	11 (9.4%)	14(12.0%)
13. In general, I don’t like math.	50(42.7%)	28(23.9%)	6(5.1%)	11(9.4%)	22(18.8%)
14. Most of the math I do in school is boring to me.	61(52.1%)	31(26.5%)	3(2.6%)	17(14.5%)	5(4.3%)
15. I like doing math in schools	42(35.9%)	3(2.6%)	13(11.1%)	39(33.3%)	20(17.1%)

Source: Field survey, 2020, N 117.

Table 3. Pre-service teachers respond to self – concept

Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
16. In high school, I was good at math.	14(12.0%)	22(18.8%)	3(2.6%)	45(38.5%)	33(28.2%)
17. In general, math is too challenging for me to understand it well.	50(42.7%)	23(19.7%)	8(6.8%)	14(12.0%)	22(18.8%)
18. In general, I have no problems understanding concepts in mathematics	14(12.0%)	20(17.1%)	0(0.0%)	36(30.8%)	47(40.1%)
19. In general, it is really easy for me to learn step-by-step ways to do math problems.	22(18.8%)	28(23.9%)	0(0.0%)	45(38.5%)	22(18.8%)
20. There is a 'math talent' that makes some people better at math than others.	53(45.3%)	22(18.8%)	3(2.6%)	25(21.4%)	14(12.0%)
21. In elementary school, I was good at math.	22(18.8%)	28(23.9%)	7(6.0%)	33(28.2%)	27(23.1%)

Source: Field survey, 2020, N 117.

Self – concept

Table 3, presents a summary of pre-service teachers' self-concept. This self-concept is the one they entered the college with. That is what they had from senior high school.

From Table 3, more than 60% of the respondents indicated that they find mathematics more challenging and as a result find it very difficult to understand the concepts. Recalling from their SHS, 66.7% of them indicated that, they were not good in mathematics though they manage to pass mathematics. Mathematics learning is a systematic process but 57.3% of them admitted that they find it difficult to follow the steps when they are learning mathematics. This explains why they have a challenge in understanding mathematics concepts. More than 60% of them have the mind-set that mathematics is meant for a particular group of people. That is it's okay to not be good at mathematics, possibly you were not born with a mathematical mind. Their challenge with mathematics was also traced to their elementary school performance.

More than 50% of them admitted that they were not good at mathematics.

Anxiety in mathematics

Table 4 measures the pre-service teachers' anxiety toward mathematics. Five items were used to measure their level of anxiety. That is their level of anxiety in mathematics as they enter college.

From Table 4, the majority (64.1%) of them indicated that they become stressed out when they are to do mathematics outside the school environment. More (69.3%) of the respondents indicated that taking mathematics tests put stress on them. while (42.7%) indicated that even non-mathematics tests put stress on them. eighty of them indicated that taking a mathematics test is more stressful than taking any other test. More than 65% agrees that doing mathematics in class is stressful.

Conative Disposition

Table 5 gives a summary of respondents' conative disposition. It was measured using five items.

Table 4. Pre-service teachers' response to mathematics Anxiety

Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
22. In general, I don't get stressed when I am doing math in non-school situations.	17(14.5%)	17(14.5%)	8(6.8%)	53(45.3%)	22(18.8%)
23. In general, I get stressed out when I have to take a math test	45(38.5%)	36(30.8%)	6(5.1%)	22(18.8%)	8(6.8%)
24. In general, I get stressed when I have to take any kind of test.	28(23.9%)	22(18.8%)	8(6.8%)	42(35.9%)	17(14.5%)
25. In general, I get more stressed when I have to take a math test than any other kind of test.	50(42.7%)	30(25.6%)	0(0.0%)	20(17.1%)	17(14.5%)
26. In general, I get stressed out when I have to do math in math classes.	45(38.5%)	33(28.2%)	3(2.6%)	14(12.0%)	22(18.8%)

Source: Field survey, 2020, N 117.

Table 5. Pre-service teachers' response to Conative Disposition

Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
27. No matter how much effort some people put into learning math, they just won't understand it.	50(42.7%)	31(26.5%)	6(5.1%)	17(14.5%)	13(11.1%)
28. If I don't figure out something in math pretty quickly, then I probably won't even if I keep trying.	45(38.5%)	33(28.2%)	0(0.0%)	31(26.5%)	8(6.8%)
29. There were some things in high school math that I just couldn't get, so I stopped trying	56(47.9%)	44(37.6%)	0(0.0%)	6(5.1%)	11(9.4%)
30. If someone is having difficulties in math, they can eventually do well if they persis.	14(12.0%)	11(9.4%)	3(2.6%)	42(35.9%)	47(40.2%)
31. In general, if I don't give up right away, I will eventually figure out the mathematics.	22(18.8%)	14(12.0%)	0(0.0%)	53(45.3%)	28(23.9%)

Source: Field survey, 2020, N 117.

Just as the majority of them indicated that some people are born to do mathematics, 69.2% of them agree that no matter the amount of effort some people put in learning mathematics, they just can't understand it. Over 66% of the respondents agree that doing everything possible to learn and understand mathematics is a waste of effort and time. Eighty - one of them disagree that if they keep on trying to understand the mathematics they will eventually be able to do it. That is if you don't get it for the first time you will never get it no matter how much you continue to try.

The findings of this study support the findings of [10], which states that there is a positive correlation between mathematics achievement and disposition towards mathematics. Students admitted into the college though passed their mathematics before gaining admission into the college but most of them their pass is weak (C6). The majority of students who got above C6 will prefer to be in the University. Also, the majority of these students who gain admission to the college are those who have sat for re-sit several times. This explains why though these students gained admission into the college but had a negative disposition in all the three domains of mathematics disposition. Besides, the findings of this study also affirm that of [18]. They found that students in grade 12 exhibit a negative disposition toward mathematics.

On the other hand, though the population of this study and that of [20] are the same, findings are different. Their finding shows that pre-service teachers have a positive disposition toward mathematics. This may be explained by factors like differences in the educational system, infrastructure, and teaching, and learning materials, methods of teaching, etc. most senior high schools in Ghana face the challenge with infrastructure and teaching and learning materials. This has resulted in overcrowding in the classrooms which force most teachers to resort to direct teaching methods. With the problem of overcrowding and non - availability of teaching and learning materials, most teachers do not use an activity base to teach some concepts in mathematics. This may also explain college freshmen and fresh-women's negative disposition towards mathematics.

5. Conclusion

The study sort to examine students' mathematics disposition as they are about to embark on their college education. It was found that the majority of the students who come from the SHS to the college of Education have a negative disposition in all the three dispositional functions. That is, the higher percentage has a negative disposition in the cognitive, affective, and conative dispositional functions. Hence it can be said that most of these students come to the college with a negative disposition towards mathematics. With this level of mathematics disposition, Tutors are to motivate and encourage students to have an interest in learning mathematics. Tutors will teach mathematics concepts with activities so that these students' disposition will improve and hence improve their performance in mathematics. With a positive disposition, pre-service teachers are likely to develop pupils' mathematics disposition positively.

6. Recommendation and Further Studies

The study was the purpose to examine pre-service teacher's disposition towards mathematics. All three functions were examined. The conclusion of their disposition towards mathematics was based on all three functions.

Since it has been established that college freshmen and fresh-women have a negative disposition towards mathematics, it is recommended that college tutors develop their mathematics disposition. They can do this by teaching most of the mathematics concepts through activities. Pre-service teachers' positive or negative disposition towards mathematics can be transferred to students, hence the need to improve their disposition towards mathematics. This will also improve their performance in mathematics and other mathematics-related courses.

A longitudinal study can be performed on these students to determine whether the college mathematics curriculum has improved their mathematics disposition or not.

Availability of Data and Materials

The data that was generated during the study are not publicly available. The reason being to protect respondents' identity. However, the data are available from the corresponding author on reasonable request.

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Competing Interests

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