

GHANAIAN STUDENT NURSES' ATTITUDES TOWARDS MATHEMATICS

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ABSTRACT

This study aimed to examine the attitudes of Ghanaian student nurses towards mathematics. A sample of 301 undergraduate nursing students at a university in Ghana, selected through census sampling techniques from the first to the third-year students, participated in the study. Data was collected using a 5-point Likert scale questionnaire and analyzed using descriptive and inferential statistics. The study revealed that the students' attitudes towards mathematics are determined by the value they attach to mathematics and their interest in mathematics. At $\alpha=0.01$, Spearman's rho correlation coefficient of $r_s = 0.619$ was significant. This indicates that the more value the student nurses attach to mathematics learning, the more interest they will likely have in learning the subject. The coefficient of determination ($R^2=38\%$), indicates that the students' value for mathematics accounts for 38% of the variability in their interest in mathematics.

ARTICLE INFORMATION

Keywords

Attitude
Interest
Student nurses
Mathematics
Perception

Article History

Submitted Dec 11, 2021
Revised Mar 16, 2022
Accepted Mar 18, 2022

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How to Cite

Awoniyi, F. C., Ogbonnaya, U. I. (2022). Ghanaian Student Nurses' Attitudes Towards Mathematics. *Kalamatika: Jurnal Pendidikan Matematika*, 7(1), 27-42.

<https://doi.org/10.22236/KALAMATIKA.vol7no1.2022pp27-42>

INTRODUCTION

The purpose of the study was to explore the attitudes of student nurses in Ghana toward mathematics by exploring the students' "Value" and "Interest" in learning mathematics. The study also explored the relationship between the students' "Value" and their "Interest" in mathematics. This study was found necessary due to the recognition of mathematics as the backbone of the social, economic, political, and physical development of a country, which prompted the Ghanaian government to make the subject compulsory at the primary and secondary school levels (Education, 2019). Also, some scholars have noted the importance of mathematics for laying a solid foundation for successful tertiary education study in many disciplines, including nursing (Anderton et al., 2016).

Students' attitudes towards mathematics play a critical role in their learning of the subject. Many scholars agree that students' success in mathematics is influenced by their attitudes towards the subject (Ajisukmo & Saputri, 2017). Some decades ago, Bandura (1977) claimed that research indicated that attitude played a substantial role in students' motivation and academic achievement. Similarly, more recent studies Chen et al. (2018) found a substantial link between students' attitudes towards mathematics and their achievement; positive attitudes toward mathematics were found to be significantly connected with higher achievements in mathematics.

Due to the importance of mathematics for the economic wellbeing of a person and a nation and research evidence that students' attitudes towards a subject are related to their meaningful learning, achievement, and utilization of the subject Massolt & Borowski, (2019); Wigfield & Cambria (2010) many studies have investigated the attitude of students towards mathematics at various levels of education. Mazana, Montero, and Casmir (2019) investigated the attitude of primary, secondary, and college students towards mathematics in Tanzania. The study found that the students generally had a positive attitude towards mathematics though the positive attitude decreased as students progressed in schooling. In a study investigating the attitude of preservice mathematics teachers towards mathematics in Ghana, Narh-Kert et al. (2021) found that the participants have a favorable attitude towards mathematics. In a similar study with mathematics education preservice teachers in the Philippines, Gillo (2021, p. 111) found that the preservice teachers who were expected to "have a very favorable attitude towards mathematics" had "only a moderately favorable attitude towards the subject". Arkell and Rutter

(2012), in a study with first-year nursing students in the UK, found that most of the student nurses showed a dislike for mathematics.

While there are many studies on the utility of mathematics in nursing (e.g., Boyd, 2018; Galligan et al., 2017; Hoyles et al., 2001; Stolic, 2014) and the mathematical competencies of student and professional nurses (Bagnasco et al., 2016; Dilles et al., 2011; Wright, 2012), literature search did not yield many studies on the attitudes of student nurses towards mathematics. The sparsity of research studies on the subject makes a case for this study. Therefore, it is expected that this study will contribute to knowledge.

Theoretical Background

Different researchers have defined attitudes in a variety of ways. Abelson and Rosenberg (2007) reported that attitude has as many meanings as there are scholars. Attempts to provide a simple definition of the term "attitude" have been met with difficulty in this case. Appiah (2016) defined attitudes as a long-term favorable or negative sentiment about someone, something, or an issue. This description means that an individual's attitude toward something or someone is always developed depending on how they perceive it, which can be a subject of study or a teacher in a classroom setting.

Riedesel and Pikaart (1969, p. 632) defined attitude towards mathematics as an accumulated size of "a liking or disliking of mathematics, a tendency to engage in or avoid mathematical activities, a belief that one is good or bad at mathematics, and a belief that mathematics is useful or useless". According to Neale's definition, attitude is developed because of various circumstances that interact to influence an individual's subsequent behavior, either positively or adversely. Asante (2012) described an attitude toward mathematics as a tendency toward a mathematical feature that an individual has acquired through his or her beliefs and experiences, but that can be modified. In other words, while attitudes are not permanent, many educators are concerned about not knowing what experiences students might have to positively alter their attitudes about mathematics.

Some scholars, for example Kibrislioglu (2015), defined attitude toward mathematics as alike or disdain for mathematics, while others (e.g., Syveda, 2016) broadened the definition to include beliefs, ability, and utility of mathematics. For Hannula et al. (2018), attitude towards mathematics is a favorable or negative emotional reaction to mathematics. All these definitions of attitude corroborate the earlier definition by Riedesel and Pikaart (1969).

Di Martino and Zan (2009) took a multidimensional approach to attitudes toward mathematics and define an individual's attitude toward mathematics as a more complicated reality defined by the emotions the individual associate with mathematic, the person's ideas about mathematics, and how the person acts toward mathematics. The tendency to be afraid of and apprehensive about mathematics is part of dispositions towards mathematics. Attitudes toward mathematics comprise cognitive, affective, and behavioral components, and they can be generated by any of the three processes outlined previously, just like any other kind of attitude. Because he or she learns to correlate happy experiences or events with mathematics, a student can acquire a favorable attitude toward it. Finally, one of the elements that influence students' attitudes toward mathematics is their observation of teachers and teachers' behavior regarding mathematics.

Some researchers (e.g., Potvin & Hasni, 2014) established connection in the traditional construct of attitude, which consists of three components (cognitive, affective, and behavioral), as well as the concept of positive or negative (like or dislike) tendencies toward an object. Some researchers proposed that attitude is a multi-faceted construct with numerous sub-constructs, among which "interest, enjoyment, motivation, and perceived difficulty" might be included. For example, Sundre et al. (2012) identified a sense of security, value, motivation, and enjoyment as factors of attitude through the "Attitude Towards Mathematics Instrument (ATMI)," whereas Lim and Chapman (2013), recommended the removal of the motivation subscale from the ATMI and treated motivation in mathematics as a separate construct. He classified the sub construct of attitude as enjoyment of mathematics, self-confidence in mathematics, and perceived value of mathematics.

Self-efficacy, identity, utility, professional objectives, beliefs, and feelings were all incorporated by the authors. Some researchers defined and decreased "attitude" according to the instrument they employed, such as the Test of Science-Related Attitudes (TOSRA) (Fraser, 1981). Aside from these experts, only a few others proposed original, marginal, or composite definitions. These were summarized in Potvin & Hasni (2014). Nonetheless, a three-dimensional structure of attitude: academic self-concept, enjoyment, and perceived value, was obtained using a principal component analysis to determine the important components of students' attitudes toward mathematics as measured by the Flemish and international items (Tahar et al., 2010).

However, Fennema and Sherman's (1976) attitude scales upon which this study was based confirmed eight different thematic categories of attitude: confidence/self-concept, enjoyment, gender, perseverance, societal influence, interest, personal ability, and value or usefulness. Related literature unveiled the influences of these sub-constructs on students' performance. Ninety-eight percent of the senior high school students (interviewees) who participated in a study conducted by Awoniyi (2018) claimed that they do not see the relevance of mathematics in real life. This presupposes that they are not likely to be interested in learning the subject because people attach much importance to activities and practices that they see to be of value to their lives and critical to their survival (Anderson & Kriesler, 2018). Thus, it is worth finding out the relationship between "Value" and "Interest" in the learning of mathematics of student nurses guided by the research questions: (1) How can the student nurse's interest in mathematics be described? (2) How do the student nurses value mathematics? (3) What is the relationship between the value and interest of student nurses in mathematics learning?

METHOD

The study employed a descriptive survey research design and a quantitative approach. The instrument that was used for data collection was a questionnaire. The Fennema and Sherman (1976) mathematics attitude scale was adopted for the study. Although the Fennema-Sherman Attitude Scales (FSMAS-R) confirmed the eight different thematic categories of attitude: value, enjoyment, perceived personal ability, interest, confidence, perseverance, social influence, and gender, the initial interactions with the students before and after the pilot test and the results of the pilot test suggest the need to remove those items that were not relevant to the current study. Some items were also removed because they did not load on any factors. Some items have more than two interpretations by the participants. These were either rephrased or completely removed. To ensure the validity of the instrument, the items were vetted by mathematics education researchers. All changes and suggestions were incorporated before the main study was carried out.

The questionnaire was divided into two (2) sections (sections A and B). Items in section A obtained information on the demographic characteristics of the respondents, namely sex, age, and academic level. Section B consists of 13 items on a five-point Likert scale (Strongly Disagree = 1, Disagree = 2, Undecided = 3, Agree = 4, Strongly Agree = 5) that focused on the students' attitude towards mathematics.

The instrument was pretested on 98 students (49 each from the second and third year) in the Cape Coast Nursing and Midwifery Training since they exhibit the same characteristics as the student-nurses of the University of Cape Coast. This was made up of 29% and 71% of males and females, correspondingly. Most of them (83%) were aged between 21 – and 25 years, and about 7% and 10% were aged between 16 – and 20 and 26 and above, respectively. The instrument was also factor analyzed to establish its reliability.

The participants for the study were selected using census sampling. The Census sampling method was used because of the small population size. Thus, all the first-year to third-year student-nurses were expected to participate in the study. Even though 414 students were sampled to participate in the study, 113 could not complete the questionnaire. Therefore, 301 student nurses (94, 118, and 89 from the first, second, and third-year respectively) participated in the study.

Out of 301 respondents, 35% were males, while 65% were females. The majority of the respondents (54%) were aged between 21 – and 25 years, while 40% and 10% were aged between 16 and 20 years and 26 years and above, respectively. The questionnaire was administered in May 2019.

To ensure reliability, a factor analysis was conducted. Data were analyzed using descriptive statistics and inferential statistics in SPSS. For the descriptive analysis, the frequencies, percentages, means, and standard deviations of the students' responses to the questionnaire items were calculated and used to find the student nurse's interest and value for mathematics. For the inferential statistics, the Spearman's rho correlation analysis was carried out at $\alpha = 0.01$ to determine if there were any statistically significant relationship between the value and interest of student nurses in learning mathematics.

RESULT AND DISCUSSION

The frequency and percent of the student nurses' responses to the questionnaire items are presented in Table 1.

Table 1. Frequency distribution of responses on attitude towards mathematics in the university

Statement	SD	D	U	A	SA	Mean	SD
As a student nurse, I enjoy studying mathematics-related courses.	38 (12.6)	54 (17.9)	26 (8.6)	117 (38.9)	66 (21.9)	3.40	1.342
My interest in attending mathematics classes is very high.	20 (6.6)	56 (18.6)	36 (12.0)	115 (38.2)	74 (24.6)	3.55	1.231
I pay attention during mathematics-related lessons.	7 (2.3)	17 (5.6)	18 (6.0)	153 (50.8)	106 (35.2)	4.11	.915

Statement	SD	D	U	A	SA	Mean	SD
I think I can cope with difficult mathematics-related courses.	32 (10.6)	36 (12.0)	49 (16.3)	115 (38.2)	69 (22.9)	3.51	1.261
Understanding the mathematics-related courses we are doing is important to me.	14 (4.7)	23 (7.6)	31 (10.3)	155 (51.5)	78 (25.9)	3.86	1.035
The mathematics we learn in nursing is useful in other courses.	25 (9.3)	21 (7.0)	44 (14.6)	140 (46.5)	71 (23.6)	3.70	1.150
I can easily understand the mathematics-related courses we do in nursing.	25 (8.3)	47 (15.6)	34 (11.3)	143 (47.5)	52 (17.3)	3.50	1.188
My knowledge of mathematics helps me in other courses.	25 (8.3)	25 (8.3)	48 (15.9)	140 (46.5)	63 (20.9)	3.63	1.149
I like mathematics because it is applicable to my everyday life.	22 (7.3)	32 (10.6)	39 (13.0)	128 (42.5)	80 (26.6)	3.70	1.181
In general, I get stressed out when I have to do math in classes. (reversed)	70 (23.3)	82 (27.2)	43 (14.3)	74 (24.6)	32 (10.6)	3.28	1.342
In general, I try to justify the statement I make in maths classes.	24 (8.0)	35 (11.6)	65 (21.6)	128 (42.5)	49 (16.3)	3.48	1.136
Even if I'm not asked to justify something, I still try to use mathematical reasoning and justification to explain how I did it.	40 (13.3)	65 (21.6)	62 (20.6)	100 (33.2)	34 (11.3)	3.08	1.237
In general, I try to see how mathematical ideas within a single class are connected to other courses.	24 (8.0)	48 (15.9)	43 (14.3)	132 (43.9)	54 (17.9)	3.48	1.188

Research Question One: How can the student nurse's interest in mathematics be described?

The majority of the respondents, 61%, agreed with the statement that “as a student nurse, I enjoy studying the mathematics-related courses.” This shows the satisfaction, equity, and natural and positive consequences that the majority experience from working in mathematics (Tapia & Marsh, 2000), even though 31% disagreed with enjoying studying the mathematics-related courses. About 2%, 6%, 6%, 51%, and 35% strongly disagreed, disagreed, undecided, agreed, and strongly agreed, respectively, with the statement that “I pay attention during mathematics-related lessons.” In other words, 86% of the respondents claimed that they pay attention during mathematics-related lessons. Attention deals with the satisfaction, interest, perpetual arousal, inquiry arousal, and variability of students working on mathematics. Also, 61% and 23% of the respondents agreed and disagreed, respectively, with the statement that “I think I can cope with difficult mathematics-related courses.” Respondents believe that they would successfully carry out the mathematical activities, which is a sign of their interest in the subject and acting with a complete choice and reason. In summary, most of the student nurses (61% to 86%) are interested in learning mathematics. Nonetheless, having 14% to 39% of student nurses not interested in mathematics is counterproductive to the rationale for making the learning of mathematics compulsory at all pre-tertiary levels of schooling in Ghana (Ministry

of Education, 2019). More importantly, is the fact that nurses use mathematical knowledge and skills in various aspects of their work.

Research Question Two: How do the student nurses value mathematics?

Most of the respondents (70%) agreed with the statement that “the mathematics we learn in nursing is useful in other courses,” while 16% disagreed with this statement. Thus, showing the degree to which most students value mathematics for its usefulness in other fields of study. Furthermore, about 7%, 11%, 13%, 43%, and 27%, respectively, strongly disagreed, disagreed, were not sure, agreed, and strongly agreed with the statement of liking mathematics because of its application in everyday life. Thereby indicating that the majority (70%) of the student nurses agreed to the usefulness of mathematics in a future endeavor. Hence, it refers to the student nurses' beliefs about the importance of mathematics in every day and later life. In addition, 62% of the students claimed that, in general, they try to see how mathematical ideas within a single class are connected to other courses. The students' choice in trying to make a connection between mathematical ideas and other courses demonstrates the student's way of saying that mathematics is useful or valuable. In conclusion, 62% to 70% of the student nurses value mathematics.

Research Question Three: What is the relationship between the value and interest of student nurses in the learning of mathematics?

Factor Analysis

A principal component factor analysis was conducted on 13 items with varimax rotation. The Kaiser-Meyer-Olkin (KMO) measure verified the sampling adequacy for the analysis, $KMO = 0.911$. This value is ‘marvelous’ according to Hutcheson and Sofroniou (1999). Bartlett's test of sphericity was statistically significant $\chi^2 (78) = 1644.231, p = .000$ for the indicator variables. This means that the correlation matrix's set of correlations was considerably different from zero, indicating that the data is eligible for factor analysis.

An initial analysis was run to obtain eigenvalues for each factor in the data. Three eigenvalues greater than one, which in combination explained 62.56% of the variance in the dataset, were obtained. But the scree plot suggested the extraction of two factors with an explained variance of 54.29%. Two plausible factors were retained after carefully exploring the component and rotated component matrices of the factor loadings. One item, "In general, I get

stressed out when I have to do mathematics in class," did not load on any factor; hence it was deleted from further analysis. The Cronbach's Alpha, $\alpha = .899$ for the 12 items. Using a cutoff point of 0.4 for factor loading, Table 2 shows the factor loading of the items after rotation.

Table 2. Rotated Component Matrix of Student Nurses' Attitude Toward Mathematics

Statement	Component	
	1	2
My interest in attending mathematics classes is very high.	.792	
As a student nurse, I enjoy studying the mathematics-related courses	.755	
I pay attention during mathematics-related lessons	.728	
I can easily understand the mathematics-related courses we do in nursing.	.700	
The mathematics we learn in nursing is useful in other courses	.659	
Understanding the mathematics-related courses we are doing is important to me.	.623	
I think I can cope with difficult mathematics-related courses.	.606	
My knowledge of mathematics helps me in other courses	.548	
In general, I try to see how mathematical ideas within a single class are connected to other courses.		.819
Even if I'm not asked to justify something, I still try to use mathematical reasoning and justification to explain how I did it.		.812
In general, I try to justify the statement I make in maths classes.		.709
I like mathematics because it is applicable to my everyday life.		.552

The items that cluster on the same factor suggest that factor 1 represents "Value" with an explained total variance of 32.29% ($\alpha = .880$, eight items) and factor 2 represents "Interest" with an explained total variance of 22.00% ($\alpha = .787$, four items). The most influential attitude of nursing students toward the study of mathematics at the university is that of "Valuing" mathematics, followed by "Interest" in mathematics.

The data were subjected to a graphical diagnostic test using a scatter plot to determine the relationship between the "Value" of mathematics and "Interest" in mathematics. There was a positive linear relationship between the two variables. This was followed by a correlation analysis of the data. At $\alpha = 0.01$, Spearman's rho correlation coefficient of $r_s = 0.619$ was significant. This indicates that the more value the student nurses attach to the learning of mathematics, the more interest they will have in learning the subject. The coefficient of determination, $R^2 = 38\%$, indicates that "Value" shares 38% of the variability in "Interest". This leaves 62% of the variability still to be accounted for by other variables.

The results of this study showed that the nursing students generally had a positive attitude toward mathematics, as evidenced by the high percentage of their agreement with the statements on positive disposition towards mathematics. This finding suggests that the nursing students have a liking for mathematics. This result is unlike the finding of Arkell and Rutter

(2012) that the nursing students in their study showed a dislike for mathematics. The nurses' positive disposition to mathematics found in this study could be because mathematics is a compulsory subject in primary and secondary schools in Ghana, and to be admitted into nursing at the university, the students must have passed mathematics at the school certificate examination. This implies that the student nurses must have been relatively good at mathematics to be admitted to study nursing. Moreover, the mathematical courses that the student nurses do at the university (e.g., calculation of medication dosages, calculating IV drip rates, unit conversions) require knowledge of school mathematical concepts like arithmetic, fractions, ratio, and percentage (Boyd, 2018; Stolic, 2014) that the students were already familiar with from the mathematics contents at primary and secondary schools.

Many research studies have shown that students' attitudes towards mathematics are associated with their academic achievements in the subject Al-Mutawah and Fateel (2018); Capuno et al. (2019) and that secondary school mathematics success is associated with success in nursing at the university (Anderton et al., 2017; Hine et al., 2015). Therefore, it is likely that the nurses' overall positive attitude towards mathematics could have emanated from their success in the nursing training because of having a solid mathematical knowledge foundation from their pre-nursing education.

The study showed that the students had a high value for and interest in mathematics, and there was a significant positive correlation between the two variables. This finding seems intuitive because if a person considers a subject to be of high value (utility), the person will likely be motivated to study the subject; hence the person will likely have a high interest in the subject. This agrees with the view that utility value is a key motivator in learning (Hulleman et al., 2016; Liebendörfer & Schukajlow, 2020). The students' nurses who have seen the utility of mathematics in nursing might have developed a strong interest in the subject. This makes it imperative for mathematics teachers and lecturers to always integrate the practical (real-life) applications of mathematical knowledge with teaching to motivate students' interest in learning the subject.

CONCLUSION

This study explored the attitude of Ghanaian student nurses towards mathematics by investigating the students' value and interest in mathematics. It also investigated the relationship between the students' value and their interest in learning mathematics. It was found that

respondents' interest in learning mathematics relates to their valuing of mathematics. Even though it cannot be claimed that the value attached to mathematics by the student nurses determines their interest in learning mathematics, nonetheless, the “Value” explains 38% of their interest in learning mathematics. Thus, it is recommended that teachers of mathematics at various levels of teaching should indicate how each topic of their syllabus is useful in different fields of professionalis m to captivate the students' interest.

ACKNOWLEDGMENTS

The authors would like to thank the student nurses that participated in the study.

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