Infinity Journal of Mathematics Education
Volume 11, No. 1, February 2022
p-ISSN 2089-6867
e–ISSN 2460-9285
https://doi.org/10.22460/infinity.v11i1.p115-132

THE RELATIONSHIP BETWEEN PRE-SERVICE TEACHERS' ATTITUDE TOWARDS STATISTICS AND ATTITUDE TOWARDS PROBABILITY

Anas Seidu Salifu*, Mohammed Emmanuel Dokurugu
E.P. College of Education, Bimbilla, Ghana

Article Info

Article history:

Received Oct 25, 2021
Revised Dec 24, 2021
Accepted Jan 10, 2022

Keywords:

Attitude,
Pre-service Teachers,
Probability,
Relationship,
Statistics

ABSTRACT

In this study, attitudes of pre-service teachers (PSTs) towards statistics and towards probability were examined. A sample of 184 level 300 students of the Evangelical Presbyterian (E. P.) College of Education, Bimbilla who undertook the Statistics and Probability II course for the second semester of the 2020/2021 academic year was used to conduct the study. The main objective of the study was to determine PSTs attitude towards statistics, attitude towards probability, and the differences in attitude that exist among them. The study also investigated the relationship between attitudes towards statistics and attitudes towards probability. The sample was selected through purposive and simple random techniques from level 300 students who either pursue mathematics as a major or as a minor subject. Two sets of questionnaires, one for attitudes towards statistics and the other for attitudes towards probability were administered to the selected respondents. The data was analyzed using SPSS version 24 by employing both descriptive and inferential statistics such as frequency counts, percentage, mean, standard deviation, paired sample t-test, and correlation. The results revealed that pre-service teachers have a positive attitude towards statistics than probability. Also, 93.5% and 83.2% of the Pre-service Teachers respectively consider statistics and probability very useful and necessary courses that will prepare them for the job market. Again, the Pearson correlation coefficient revealed a moderate positive association between Pre-service Teachers' attitudes towards statistics and towards probability.

Corresponding Author:

Anas Seidu Salifu,
Mathematics and ICT Department,
E.P. College of Education, Bimbilla, Ghana
2 Street 3, Bimbila, Ghana
Email: salifuanas@gmail.com

How to Cite:

Salifu, A. S., & Dokurugu, M. E. (2022). The relationship between pre-service teachers' attitude towards statistics and attitude towards probability. *Infinity*, *11*(1), 115-132.

1. INTRODUCTION

Statistics and probability are inseparable courses in the Ghanaian Colleges of Education curriculum and are therefore taught as single course. The researchers have had the privilege of teaching the Statistics and Probability II course in E. P. College of Education, Bimbilla for the past two (2) academic years and have observed unsatisfactory performances of some students in the several assessments conducted during the period of the course. Hence the objective of assisting every student to pass the Statistics and Probability II course in the college has proved futile over the past two (2) academic years.

Myriad of definitions of statistics and probability have been given by several authors around the globe. According to Blueman (2009), statistics is the science of conducting studies to collect, organize, summarize, analyse, and draw conclusions from data. Also, Mason (1990) defines statistics as the science of collecting, organizing, presenting, analysing, and interpreting data for the purpose of assisting in making a more effective decision.

According to Evans and Rosenthal (2009), probability is the science of uncertainty. Also, Blueman (2009) defined probability as the chance of an event occurring. Furthermore, Maity (2018) defined probability as the measure of chance of occurrence of a particular event. For example, from the time we wake up till the time we go to bed, we make choices concerning the probable events that are overseen at least in part by chance. Other examples are, today do I need to pick long an umbrella to work? Will the battery of my car continue to function until the end of the year? Do I have to accept that new job? Probability provides precise mathematical rules for understanding and analysing our own unawareness. It gives no information about tomorrow's weather or stock prices next week or the subsequent weeks; it rather provides us with a framework for working with our imperfect familiarity and for making serviceable pronouncements grounded on what we do know or do not know. For instance, to say there is a 60% likelihood of rain tomorrow is not mean we are definite of tomorrow's weather. This means we are about 40% not definite of tomorrow's weather. Many people are acquainted with probability from their daily lives of witnessing or playing games of chance.

Examples include card games, slot machines, or lotteries. Aside from being used in games of chance, probability theory is used in other fields such as insurance, investments, and weather forecasting and other very important aspects of life.

Statistics and probability are used in almost all fields of human endeavour. Students, teachers and managers of educational institutions all make good use of statistics and probability in one way or the other. Like professional people, students must be able to read and understand the various statistical studies performed in their fields. To have this understanding, they must be well-informed about the terminologies, symbols, concepts, and statistical procedures used in these studies. Also, students require the knowledge of statistics and probability measures and tools to carry out research in their fields. To accomplish this, they must be able to design experiments; collect, organize, analyse, and summarize data; and possibly make unswerving predictions or forecasts for future use. They must also be able to communicate the results of the study in your own words. Again, students can use the knowledge gained from studying statistics to become better consumers and citizens. For example, they can make intelligent decisions about what products to purchase based on consumer studies, about government spending based on utilization studies, and so on.

In education, an investigation may be conducted to know if new methods of teaching are better than old ones and the probability of students performing better in an examination after improved and better teaching methods are implemented. Additionally, teachers use statistics to monitor performances and progress of students. Teachers often conduct class tests, exercises, assignments, quizzes and end of term or semester examinations and scores from these assessments are often recorded. These assessments are aimed at keeping tract and follow-up the performances of students to know if they are performing well. The statistical information from these assessments is useful to the students and the teacher as it helps the teacher to organize remedial classes for students who have low cognitive ability. Results from the assessments may also help the teacher to determine the probability of a student passing a final examination. Statistics also enables educationists or teachers to evaluate their own performances in terms of the methodology used in teaching students. That is, with information on the performance of students, teachers are able to assess themselves to know whether or not they are teaching well. Again, statistics can be used by educational institutions and district or regional education directorates to assess the performance of students in a particular subject. This may be done after WASSCE or BECE results of candidates are released. The analysis of the results of candidates will show where there is possible room for improvement and statistical decisions that can be made to improve performance. Furthermore, educational managers or administrators use statistical data for their day-to-day decision making. For instance, to make purchases of stationaries or furniture, educational managers use statistical data on class size, enrolment, and the ages of students to arrive at the quantities to be purchased.

Statistics and probability are very useful in other areas of life. In sports, for example, a statistician may keep records of the number of kilometres covered each player during a football game, or the number of hits a baseball player gets in a season or the number of goal assists made by a footballer in a season. In probability terms, a statistician may be interested in the chance or likelihood of a national team qualifying to the FIFA 2022 World Cup. In public health, the Ghana Health Service might be concerned with the number of people who contract Covid-19 during a certain period or the probability of a resident of a high-risk area contracting the disease. Thus, in medical and health sciences, information of births, deaths, temperature, weight and blood pressure of individuals are vital to public health administrators. Hospital administrators may also wish to know the average waiting time at the vital signs point, consulting rooms, laboratories, dispensary/pharmacy so that services to clients can be improved. In agriculture, statisticians may want to study the methods and procedures used in collecting, organizing and interpreting data or information on the agricultural production, agro-processing, agricultural marketing and consumption for effective decision making in the face of uncertainty.

Again, a farmer may wish to know the number of bags of fertilizer that needs to be applied on an acre of maize farm or the number of bags of maize that needs to be used to feed 1000 poultry birds for a particular period. In business, an operations manager of a supermarket, applies statistics in determining the quantities of goods sold out within a given period, the quantities of goods remaining within the period for restocking to be done, the preferences of customers, the average waiting time at the payment point, among others. These help the manager to make informed and strategic decisions in order to improve sales and hence profit.

Additionally, Probability theory provides us with an exact comprehension of uncertainty. This understanding can aid us make better forecasts, make healthier pronouncements, evaluate risk, and even make some cash. In fact, the development of the insurance industry helps us manage with risk. Probability is the tool used to determine what you pay to lessen your risk or to recompense you or your family in case of a personal injury. Furthermore, statistics is used to analyse the results of surveys and as a tool in scientific research to make decisions based on controlled experiments. Other uses of statistics include operations research, quality control, estimation, and prediction.

Statistics and probability are embedded in the mathematics curricula for basic, secondary and tertiary levels in Ghana. In an information-based society today, the demands of swift change have predisposed statistics programs in various ways. The talents desirable for jobs requires innovative workers who are concerned with problem solving regardless of their gender, cultural and socio-economic circumstances. It is therefore imperative for students to view statistics as a significant part of our culture, not only for its valuable scientific applications but also for its enrichment of our cultural life. Furthermore, as the problems confronted by individuals or groups become more difficult, there is the need to polish and advance our rough, instinctive thoughts about probability to enhance a clear and accurate approach, the need to study probability and statistics as a subject. Statistics and probability are therefore studied in the Ghanaian curriculum to achieve the following objectives. For students to be able to read and understand the various statistical studies performed in their various fields. To have this understanding, they must be knowledgeable about the vocabulary, symbols, concepts, and statistical and probabilistic procedures used in these studies. To conduct research in their different fields, since statistical and probabilistic dealings are elementary to research.

To accomplish this, they must be able to design experiments; collect, organize, analyse, and summarize data; and possibly make reliable predictions or forecasts for future use. They must also be able to communicate the results of the study in their own words. Again, the knowledge gained from studying statistics and probability can assist one to become better consumers. For example, they can make better and intellectual choices about what products to acquire based on studies about consumers, about government expenditure based on consumption studies, and so on. Also, to expose students to the use of ICT tools (calculators, computers, etc) in solving real life situations of statistics and probability.

Statistics and Probability are related and are taught together in Ghanaian Colleges of Education as a single course but the performance are not encouraging in the last decade. Despite the numerous benefits of statistics and probability outlined above, some students still do not appreciate their (statistics and probability) importance. This was evident in the general performance of students in the course in the end of semester examinations. It has been mind boggling to figure out whether the poor performance was attributed to statistics or probability questions. This study is unique because there is no known study investigating Pre-service teacher's attitude towards statistics and attitude towards probability together. This study will give a clearer picture of the problem because attitude contributes to performance. This study again will improve the teaching methods and ameliorate students' performance in the course.

1.1. Studies on Pre-service Teachers' Attitudes Towards Statistics

Taşgın and Kaya (2018) investigated the relationship between pre-service teachers' attitudes towards statistics and their research anxiety with a sample of 257 participants. The study results suggested that the female pre-service teachers had more positive attitudes towards statistics than the male pre-service teachers. On the other hand, the male pre-service teachers' anxiety levels were lower than the female pre-service teachers. Finally, a positive correlation was found between the research anxiety and the attitudes towards statistics levels of the participants. Again, Peiró-Signes et al. (2020) carried out research on attitudes towards statistics in secondary education with a sample of 95 secondary school students in Spain. The results indicated that self-confidence and motivation are important factors in these recipes, but there is no single necessary condition that ensures lower levels of anxiety.

Additionally, León-Mantero et al. (2020) worked on aspects of mathematical attitudes among students from a variety of disciplines with a sample of 145 trained teachers. The results revealed that students studying social science see statistics as a reliable subject but do not know how to apply it when faced with problems in everyday life. On their part, Mustam et al. (2020) conducted a study on the attitude of pre-service teachers towards statistics with 80 undergraduate students. The study found that pre-service teachers' attitudes toward mathematics were averaged. Again, Lancaster (2008) conducted a study of teachers' attitudes toward their role as students of mathematics and the implications for future professional development in statistics with 56 primary school teachers. The results suggested that current self-efficacy to learn statistics in the future is a moderate predictor of pre-service primary teacher beliefs that future professional development in statistics will help their classroom teaching. It was also revealed that the current efforts to learn statistics in the future may differ from primary school teachers during their preparation based on lessons and teachers.

Also, Ashaari et al. (2011) examined students' attitudes towards statistics course in Malaysia. The results indicated that, the students showed a highly positive attitude in making necessary efforts to understand the subject better. The results further showed that the students have shown great effort and are prepared to learn the statistics course. However, they feel this course is not relevant for their field of study, as well as for their future career, thus demonstrated some negative attitude towards the subject. Again, Chiesi and Primi (2015), worked on gender differences in attitudes toward statistics with 179 psychology students enrolled in a statistical course. The results showed that women did not differ in their abilities but showed less self-confidence and negative attitudes compared to men. Moreover, confidence and attitude played a role on achievement in women but not in men.

In a similar study, Nasser (2004) revealed a small positive effect of attitudes toward statistics when 167 prospective teachers in Egypt taking part in an introductory statistics course which examined the relationships among attitudes towards statistics. Furthermore, Gopal et al. (2018) investigated the influence of self-efficacy and attitudes towards statistics with 293 students. The results indicated that students' attitudes towards statistics was positive. Again, the investigation revealed that attitudes towards statistics had a superior impact on statistics engagement than self-efficacy. Also, Ashaari et al. (2011) investigated the relationship between the six factors to the demographical variable of the students. The results showed a highly positive attitude towards statistics. The study again showed that the six contributory factors to the attitude are affective factor, cognitive capability, value, difficulty, interest and student's effort.

1.2. Studies on Pre-service Teachers' Attitudes Towards Probability

de Oliveira-Júnior et al. (2018) investigated students' attitudes towards probability and statistics and academic achievement on higher education with a sample of 134 students. Some of the results indicated that students lack confidence in solving statistical and probabilistic problems, noting that there is no great anxiety about probability and statistics. They again noted that students presented an initial motivation and this fact generated better results in the first evaluation.

In addition, Ruz et al. (2020) examined attitudes towards probability and its teaching in prospective mathematics teachers from Chile and Spain with 126 participants. The findings revealed a positive attitude towards the probability. Again, Estrada et al. (2018) assessed teachers' attitudes towards probability and its teaching using a sample of 232 prospective teachers in Spain. The results proposed that potential teachers' attitudes towards probability and its teaching are largely positive in all the mechanisms considered.

Additionally, Estrada and Batanero (2020) investigated prospective primary school teachers' attitudes towards probability and its teaching with a sample of 416. The results of the organized data discovered that teachers recognized the value of probability and its teaching and are enthusiastic to teach probability, but feel not well prepared for this task and do not like topic in particular. Furthermore, Tan et al. (2011) examined the effectiveness of graphing calculator (GC) interactive learning, particularly on students' attitudes towards probability with 65 elementary students. The results showed significant difference in the improved attitude towards probability between the groups, particularly in terms of usefulness of probability, interest in probability and self-concept probability. The study therefore provided enough evidence to suggest that learning probability with GCs benefits students. In a similar study, Pale (2016) investigated the effect of "teacher" and "student based" instructions on probability achievement outcomes and attitudes of secondary school students. The results indicated that "student based" method of instruction improved students' attitudes toward probability and probability achievement. Also, Bukari and Asiedu-Addo (2019) examined Problem-Based Learning on pre-service teachers' achievement in, and attitude toward Probability with a sample of 100 pre-service teachers in colleges of education in Ghana. Their study results indicated that pre-service teacher's attitude towards probability was positive. Again, further analysis from their study revealed that pre-service teacher's confidence level has increased extremely toward probability. They also found probability concepts interesting and joyful.

From the review of literature, there is no single study that examined the relationship between attitude towards statistics and attitude towards probability. In Ghana Colleges of Education, Statistics and Probability is a single course that is taught and pre-service teachers find it difficult because some of them fail the course. When this failure occurs, tutors are confused about whether is a result of the statistics component or the probability component that has contributed to the failure. Hence, the need to find pre-service teachers' attitudes in this course will go a long way to help teachers solve the attitudinal problems that will arise from the study. Therefore, this study is unique in that it investigated the differences in pre-service teachers' attitude towards statistics and attitude towards probability and correlation between attitude towards statistics, and attitude towards probability in E. P. College of Education, Ghana with the motive of bridging the prevailing research gap in this area.

1.3. Statement of the Problem

Numerous studies have concentrated on pre-service teachers' attitudes towards statistics, probability and achievements and not finding the relationship of pre-service teachers' attitude towards statistics and attitude towards probability. For instance, (Ashaari et al., 2011; Chiesi & Primi, 2015; Lancaster, 2008; León-Mantero et al., 2020; Mustam et al., 2020; Peiró-Signes et al., 2020; Taşgın & Kaya, 2018) have conducted studies on students' attitudes towards statistics. While Ailton et al. 2018 investigated students' attitude towards statistics and probability and achievements. Also, other studies examined attitude towards probability and its teaching (Estrada & Batanero, 2020; Estrada et al., 2018; Ruz et al., 2020). Despite the several studies in statistics and probability available, there is limited research in examining relationship of pre-service teachers' attitude towards statistics and attitude towards probability in Colleges of Education in Ghana. Hence, this study was fashioned to examine difference in pre-service teachers' attitude towards statistics and attitude towards probability and correlation between attitude towards statistics, and attitude towards probability in E. P. College of Education, Ghana to bridge the existing research gap in this area.

1.4. Significance of the study

Examining and reporting or documenting pre-service teachers' attitude towards statistics and attitude towards probability can contribute to a better understanding of how they view teaching of statistics and probability. The study sought to add to the body of knowledge on pre-service teacher's attitude towards statistics and attitude towards probability. Findings of this study can assist and give direction for future researchers and to policy makers in making curriculum and teacher development policy decisions. Since attitude have a way of changing or shaping the way people learn.

1.5. Purpose of the study

Pre-service teacher attitude towards any subject or course is so significant for teachers to make amendments during teaching. The purpose of the study was to determine PSTs attitude towards statistics, attitude towards probability and the differences in attitude that exist among them. Also, the study sought to investigate the relationship between attitudes towards statistics and attitudes towards probability.

1.6. Research Questions and Hypothesis

Attitude towards any course of study is very pivotal to Pre-service teachers' comprehension of knowledge with regards to teacher preparation. Hence, the study was guided by the following questions: (1) What is the Pre-service teachers' attitude towards statistics? (2) What is the Pre-service teachers' attitude towards probability? (3) What is the correlation between Pre-service teachers' attitude towards statistics and attitude towards probability? (4) Is there significant difference between Pre-service teachers' attitude towards statistics and attitude towards probability?

The hypothesis in this study is that there is no significant difference between the attitudes of pre-service teachers to statistics and attitudes to probability.

2. METHOD

2.1. Research Design

The study used descriptive research designed to discover the relationship between pre-service teachers' attitude towards statistics and attitude towards probability. Creswell (2012), asserted that descriptive survey design provides a quantitative or numeric description of trends, attitude or opinions of a population by studying a sample of the population. This type of design is ideal because it helped the researcher to test the four research questions and one hypothesis to draw meaningful conclusions concerning the current status of the participants of the study.

2.2. Population, Sample and Sampling Procedure

The study population was four hundred and eighteen (418) level 300 PSTS in E.P college of Education, Bimbilla. Out of the population, a sample of 184 was selected through purposive and simple random techniques, 111 were offering mathematics as Major while 73 were offering mathematics as minor. From the 184 (50 were females and 134 males) with an average age of 25.

2.3. Instrument and Pilot Study

The researchers adapted the multi-factorial scale of attitudes towards statistics (MSATS) by Auzmendi Escribano (1992). On the other hand, the researchers also manipulated the MSATS to generate the multi-factorial scale of attitudes towards probability (MSATP). This study used two instruments measuring PSTs attitudes towards statistics and probability. Each of the questionnaires had 25 items (15 positively and 10 negatively questionnaire worded statements) measuring the following constructs; anxiety (9 items), enjoyment (4 items), motivation (3 items), usefulness (6 items) and confidence (3 items). The instrument used 5-point Likert scale (1 to 5) that is from strongly disagree to strongly agree. The two questionnaires were in two parts. The first part focused on the biographical data of the respondents while the second part focused on PSTs attitudes towards statistics and attitudes towards probability. The questionnaire was piloted in the same college but to

50 PSTs in level 200 who were not part of the main study. The choice for the piloting was as a result of the similarities borne by the selected sample for the main study. The objective of the pilot study was to guide the researchers to identify errors in the study and make corrections before conducting the main study.

2.4. Validity and Reliability

The items of the questionnaires were vetted and approved by 3 experienced mathematics tutors in a sister college of education taking into consideration the objectives of the study. The suggestions from the experience mathematics tutors were the justification for its validation. The data retrieved from the pilot study was used to calculate the Cronbach alpha reliability coefficient. The Cronbach alpha method was used because it provides a stable measure of homogeneity of the items in the questionnaire. The overall internal consistency reliabilities coefficients for the statistics and probability questionnaire are 0.793 and 0.788 respectively which are good for the main study. Table 1 shows the reliabilities of the various construct on the statistics and probability questionnaires.

Table 1. Reliability coefficient for the various construct

Constructs of statistics and probability	Cronbach alpha reliability statistics	Cronbach alpha reliability probability
Anxiety	0.769	0.698
Enjoyment	0.405	0.280
Usefulness	0.440	0.602
Motivation	0.226	0.351
Confidence	0.563	0.387

2.5. Data Collection Procedure

The administration of the two questionnaires was done in the 2020/2021 academic year, in the second semester of the 4-year bachelor of Education program on 15th August, 2021. The PSTs completed the two questionnaires within 60 minutes. The return rate of the questionnaires was 97%.

2.6. Date Analysis

After the data was collected, all the negatively worded statements were recoded before the analysis. Descriptive statistics was employed to answer research questions 1 and 2. Responses to items addressing the research questions were analyzed using frequency counts, percentage, mean and standard deviations. Research questions 3 used paired sample t- test to determine whether there was difference between the PSTs attitude in statistics and that of probability.

For research hypothesis 1, bivariate correlation was used to establish the relationship between PSTs attitude towards statistics and that of probability. The data was analyzed using SPSS version 24 by employing both descriptive and inferential statistics such as correlation.

3. RESULTS AND DISCUSSION

3.1. Results

This section presents the results of the analysis of the research questions and hypothesis raised for the study.

Research Question 1: What is the PSTs attitude towards statistics?

The purpose of this research question 1 was to investigate PSTs attitude towards statistics. The result of the analysis is presented in Table 2 are used to answer research question 1.

Table 2. Descriptive statistics on pre-service teachers' attitude towards statistics

S/No.	Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Standard deviation
Usefulness Construct								
1	I consider statistics as a very necessary subject in my studies	1 (0.5%)	3 (1.6%)	8 (4.3%)	61 (33.2%)	111 (60.3%)	4.51	0.709
6	I want to have a deeper understanding of Statistics	6 (3.3%)	13 (7.1%)	7 (3.8%)	45 (24.5%)	113 (61.4%)	4.34	1.059
21	For my professional future, statistics is one of the most important subjects I have to study.	8 (4.3%)	19 (10.3%)	23 (12.5%)	65 (35.3%)	69 (37.5%)	3.91	1.142
15	I hope to have little use of statistics in my professional life.	12 (6.5%)	22 (12.0%)	21 (11.4%)	68 (37.0%)	61 (33.2%)	3.78	1.213
16	I consider that there are other matters more important than statistics for my future profession.	32 (17.4%)	40 (21.7%)	47 (25.5%)	50 (27.2%)	15 (8.2%)	2.87	1.226
19	I would like to have an occupation in which I have to use statistics.	13 (7.1%)	19 (10.3	26 (14.1%)	73 (39.7%)	53 (28.8%)	3.73	1.188
				Average of Usefulness Construct			**3.86**	**1.089**
Anxiety Construct								
7	Statistics is one of the subjects that I fear the most.	11 (6.0%)	21 (11.4%)	20 (10.9%)	73 (39.7%)	59 (32.1%)	3.80	1.180
8	I have confidence in myself when I face a statistical problem	5 (2.7%)	18 (9.8%0	34 (18.5%0	80 (43.5%0	47 (30.0%)	3.81	1.062
17	Working with statistics makes me feel nervous.	15 (8.2%)	36 (19.6%)	38 (20.7%)	68 (37.0%)	27 (14.7%)	3.30	1.180
18	I don't get upset when I have to work on statistics problems.	6 (3.3%)	20 (10.9%)	35 (19.0%)	83 (45.1%)	40 (26.2%)	3.73	1.072
2	I'm pretty bad at statistics	8 (4.3%)	18 (9.8%)	35 (19.0%)	69 (37.5%)	54 (29.3%)	3.78	1.106
12	When I face a statistical problem, I feel unable to think clearly.	14 (7.6%)	31 (16.8%)	26 (14.1%)	79 (42.9%)	34 (18.5%)	3.48	1.192

S/No.	Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Standard deviation
13	I am calm when I face a problem of statistics.	2 (1.1%)	22 (12.0%)	27 (14.7%)	102 (55.4%)	31 (16.8%)	3.75	0.913
3	Studying or working with statistics doesn't scare me at all.	10 (5.4%)	13 (7.1%)	30 (16.3%)	73 (39.7%)	58 (31.5%)	3.85	1.111
22	Statistics makes me feel uncomfortable and nervous.	14 (7.6%)	24 (13.0%)	25 (13.6%)	78 (42.4%)	43 (23.4%)	3.61	1.196
					Average of Anxiety Construct		**3.68**	**1.112**
Enjoyment Construct								
4	Using statistics is fun for me.	11 (6.0%)	31 (16.8%)	31 (16.8%)	76 (41.3%)	35 (19.0%)	3.51	1.155
14	Statistics is nice and challenging for me.	30 (16.3%)	91 (49.5%)	30 (16.3%)	28 (15.2%)	5 (2.7%)	2.39	1.018
24	If I had the opportunity, I would enrol in more statistics courses than are required.	9 (4.9%)	17 (9.2%)	27 (14.7%)	70 (38.0%)	61 (33.2%)	3.85	1.128
9	I enjoy talking to others about statistics.	12 (6.5%)	24 (13.0%)	36 (19.6%)	85 (46.2%)	27 (14.7%)	3.49	1.096
					Average of Enjoyment Construct		**3.31**	**1.099**
Motivation Construct								
10	Statistics can be useful for those who decide to pursue a science career, but not for other students.	19 (10.3%)	18 (9.8%)	13 (7.1%)	65 (35.3%)	69 (37.5%)	3.80	1.317
25	The things taught in statistics classes are very uninteresting	49 (26.6%)	77 (41.8%)	20 (10.9%)	21 (11.4%)	17 (9.2%)	2.35	1.245
5	Statistics is too theoretical for me to be of any use.	24 (13.0%)	33 (17.9%)	18 (9.8%)	78 (42.4%)	31 (16.8%)	3.32	1.306
					Average of Motivation Construct		**3.16**	**1.289**
Confidence Construct								
23	If I put my mind to it, I think I can master statistics.	5 (2.7%)	7 (3.8%)	13 (7.1%)	56 (30.4%)	103 (56.0%)	4.33	0.960
20	It gives me great satisfaction to solve statistical problems.	5 (2.7%)	17 (9.2%)	28 (15.2%)	84 (45.7%)	50 (27.2%)	3.85	1.011
11	Having a good knowledge of statistics will increase my job possibilities.	8 (4.3%)	14 (7.6%)	24 (13.0%)	67 (36.4%)	71 (38.6%)	3.97	1.104
			Average of Confidence Construct				**4.05**	**1.025**
	Overall Mean and standard deviation on attitude towards Statistics						**3.64**	**1.12**

As shown in Table 2, the PSTs considered statistics useful because majority of them claimed that statistics is a very necessary subject with (SA=60.3%, A=24.5%, mean =4.34, SD=1.059). Lastly, on the usefulness of statistics construct, majority of the PSTs either disagree or indicated neutral to the statement that "there are other matters more important than statistics in their future profession" with (mean=2.87, SD=1.226). Again, from Table 2, the results on the anxiety construct indicated that, PSTs are not scared at all when working or studying statistics course with (SA=31.5%, A=39.7%, mean 3.85, SD=1.111). Also, the PSTs responded that they have confidence in themselves when they face statistics problems with majority (73.5%) agreeing to that statement, with (mean =3.81, SD=1.062).

On the part of enjoyment construct, the PSTs responded that they would enrol in more statistics courses than are required when given the opportunity with majority (71.2%) affirming that statement with (mean=3.85, SD=1.128). Also, majority (68.4%) of the PSTs disagree to the statement that "the things taught in statistics classes are very uninteresting" with (mean=2.35, SD = 1.245). Also, the PSTs responded that having a good knowledge of statistics will increase their job possibilities with majority (75.0%) affirming that statement with (mean =3.97, SD=1.104). Lastly, on the confidence construct, majority (86.4%) indicated that if they put their minds on statistics, they can master it with (mean=4.33, SD=0.960).

Research Question 2: What are the mathematics PSTs attitudes towards probability?

This research question 2 sought to examine PSTs attitude towards probability. The results are shown in Table 3.

Table 3. Descriptive statistics on pre-service teachers' attitude towards Probability

S/No.	Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Standard deviation
Usefulness Construct								
1	I consider probability as a very necessary subject in my studies	7 (3.8%)	9 (4.9%)	15 (8.2%)	71 (38.6%)	82 (44.6%)	4.15	1.024
15	I hope to have little use of probability in my professional life.	9 (4.9%)	28 (15.2%)	21 (11.4%)	76 (41.3%)	50 (27.2%)	3.71	1.164
16	I consider that there are other matters more important than probability for my future profession.	28 (15.2%)	60 (32.6%)	36 (19.6%)	36 (19.6%)	24 (13.0%)	2.83	1.277
19	I would like to have an occupation in which I have to use probability.	13 (7.1%)	27 (14.7%)	32 (17.4%)	61 (33.2%)	51 (27.7%)	3.60	1.233
21	For my professional future, probability is one of the most important subjects I have to study.	15 (8.2%)	30 (16.3%)	28 (15.2%)	63 (34.2%)	48 (26.1%)	3.54	1.263
6	I want to have a deeper understanding of probability	6 (3.3%)	10 (5.4%)	11 (6.0%)	60 (32.6%)	97 (52.7%)	4.26	1.018
					Average of Usefulness Construct		**3.59**	**1.163**

S/No.	Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Standard deviation
Anxiety Construct								
7	Probability is one of the subjects that I fear the most.	13 (7.1%)	20 (10.9%)	30 (16.3%)	66 (35.9%)	55 (29.9%)	3.71	1.206
8	I have confidence in myself when I face a probability problem	10 (5.4%)	18 (9.8%)	32 (17.4%)	77 (41.8%)	47 (30.0%)	3.72	1.110
12	When I face a probability problem, I feel unable to think clearly.	16 (8.7%)	34 (18.5%)	31 (16.8%)	72 (39.1%)	31 (16.8%)	3.37	1.212
13	I am calm when I face a problem of probability.	11 (6.0%)	21 (11.4%)	32 (17.4%)	84 (45.7%)	36 (19.6%)	3.61	1.105
22	Probability makes me feel uncomfortable and nervous.	21 (11.4%)	34 (18.5%)	24 (13.0%)	70 (38.0%)	35 (19.0%)	3.35	1.293
17	Working with probability makes me feel nervous.	21 (11.4%)	42 (22.8%)	32 (17.4%)	61 (33.2%)	28 (15.2%)	3.18	1.256
18	I don't get upset when I have to work on probability problems.	9 (4.9%)	31 (16.8%)	27 (14.7%)	81 (44.0%)	36 (19.6%)	3.57	1.129
2	I'm pretty bad at probability	12 (6.5%)	22 (12.0%)	34 (18.5%)	76 (41.3%)	40 (21.7%)	3.60	1.146
3	Studying or working with probability doesn't scare me at all.	7 (3.8%)	18 (9.8%)	35 (19.0%)	80 (43.5%)	44 (23.9%)	3.74	1.049
					Average of Anxiety Construct		**3.54**	**1.167**
Enjoyment Construct								
14	Probability is nice and challenging for me.	34 (18.5%)	85 (46.2%)	27 (14.7%)	25 (13.6%)	13 (7.1%)	2.45	1.149
24	If I had the opportunity, I would enroll in more probability courses than are required.	9 (4.9%)	30 (16.3%)	28 (15.2%)	74 (40.2%)	43 (23.4%)	3.61	1.154
4	Using probability is fun for me.	10 (5.4%)	31 (16.8%)	34 (18.5%)	80 (43.5%)	29 (15.8%)	3.47	1.111
9	I enjoy talking to others about probability	13 (7.1%)	31 (16.8%)	33 (17.9%)	72 (39.1%)	35 (19.0%)	3.46	1.182
					Average of Enjoyment Construct		**3.25**	**1.149**
Motivation Construct								
25	The things taught in probability classes are very uninteresting	49 (26.6%)	52 (28.3%)	24 (13.0%)	34 (18.5%)	25 (13.6%)	2.64	1.399

S/No.	Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Standard deviation
5	Probability is too theoretical for me to be of any use.	24 (13.0%)	39 (21.2%)	25 (13.6%)	67 (36.4%)	29 (15.8%)	3.21	1.302
10	Probability can be useful for those who decide to pursue a science career, but not for other students.	18 (9.8%)	24 (13.0%)	17 (9.2%)	62 (33.7%)	63 (34.2%)	3.70	1.324
				Average of Motivation Construct			**3.183**	**1.342**
Confidence Construct								
20	It gives me great satisfaction to solve probability problems.	11 (6.0%)	26 (14.1%)	27 (14.7%)	76 (41.3%)	44 (23.9%)	3.63	1.166
11	Having a good knowledge of probability will increase my job possibilities.	12 (6.5%)	21 (11.4%)	31 (16.8%)	68 (37.0%)	52 (28.3%)	3.69	1.186
23	If I put my mind to it, I think I can master probability.	8 (4.3%)	8 (4.3%)	17 (9.2%)	69 (37.5%)	82 (44.6%)	4.14	1.044
	Average of Confidence Construct						**3.82**	**1.132**
	Overall Mean and standard deviation on attitude towards Probability						**3.52**	**1.180**

As shown in Table 3, majority of respondents believe the usefulness of probability by indicating that they consider probability as a very necessary subject in their studies with (mean=4.15, SD=1.024). Also, they claimed that they want to have a deeper understanding of probability with (mean =4.26, SD=1.018). On the part of the anxiety construct, the PSTs indicated that they are calm when they face problems of probability with 65.3% affirming the assertion. Also, on the statement “I have confidence in myself when I face probability problem” majority (71.8%) asserted to the statement. On part of feeling nervous when working probability 34.2% disagree, 07.4% indicated neutral and 48.4% agree to that statement. For the enjoyment construct majority of (64.7%) disagree to the statement that “probability is challenging for them”. Also, 59.3% of PSTs indicated that using probability is fun for them, while 58.1% further stated that they enjoy talking to others about probability. For the motivations construct, 67.9% of the respondents stated clearly that probability is useful for those who decide to pursue a science carrier, on item 5, the PSTs stated that probability is too theoretical for them with (mean 3.21, SD=1.302).

Lastly, on the confidence construct, majority (86.4%) the PST asserted that if they put their mind on probability, they can master the concepts with (mean 4.33, SD= 0.960). Also, the PST affirmed that having a good knowledge of probability will enhance their search or probability for jobs with (mean 3.97, SD= 1.104) with 75.0% of the PST agreeing to the statement.

Research Question 3: What is correlation between the mathematics PSTs attitude towards statistics and attitude towards probability?

The results on research question 3 on determining the correlations and attitude probability are presented in Table 4.

Table 4. Pearson correlation coefficient and significance of attitude towards statistics and attitude towards probability

		STATISTICS	PROBABILITY
STATISTICS	Pearson Correlation	1	0.464**
	Sig. (2-tailed)		0.000
	N	184	184
PROBABILITY	Pearson Correlation	0.464**	1
	Sig. (2-tailed)	0.000	
	N	184	184

**. Correlation is significant at the 0.01 level (2-tailed).

Pearson correlation coefficient was estimated to determine the relationship between PSTs attitude towards statistics and probability. The obtained results are presented in Table 4. From Table 4, the result shows that there is a significant positive moderate relationship between PSTs attitude towards statistics and probability with [r = 0.464, p= 0.000<0.05, n =184). The scatter plot in Figure 1 shows the pictorial relationship between the attitudes towards statistics and probability.

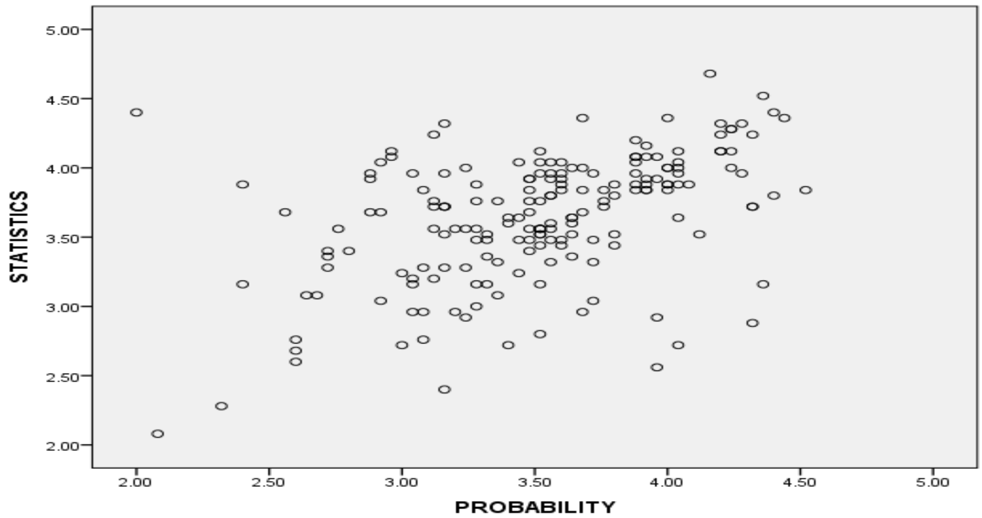

Figure 1. Pictorial relationship between the attitudes towards statistics and probability

Research Question 4: Is there significant difference between mathematics PSTs attitude towards statistics and attitude towards probability?

The purpose of research question 4 was to investigate whether significant difference exist between PSTs attitude towards statistics and attitude towards probability by employing paired sample test to answer the research question.

Table 5. Paired samples statistics showing attitude towards statistics and attitude towards probability

		N	**Mean**	**Std. Deviation**	**Std. Error Mean**
Pair 1	STATISTICS	184	3.64	0.46	0.03391
	PROBABILITY	184	3.52	0.50	0.03649

Table 6. Paired samples t-test of attitude towards statistics and attitude towards probability

		Paired Differences					T	Df	Sig. (2-tailed)
		Mean	Std. Dev	Std. Error Mean	95% Confidence Interval of the Difference: Lower	Upper			
Pair 1	STATISTICS - PROBABILITY	0.1239	0.495	0.0365	0.0519	0.1959	3.395	183	0.001

Table 5 shows the paired sample t-test of PSTs attitude towards statistics and attitude towards probability. It shows that, there was statistically significant difference in attitude towards statistics and attitude towards probability which favoured the attitude towards statistics at (3.395, df =183, p=0.001<0.05) with a mean difference of 0.124 as depicted in Table 6. From Table 5, the mean and standard deviation for statistics is 3.64 and 0.46 respectively while with that of probability mean and standard deviation is 3.52 and 0.50 respectively. The overall responses for attitude towards statistics was between (3.18 - 4.10) while attitude towards probability is between (3.02 - 4.02). Hence, the hypothesis that there is no significant difference between PSTs attitude towards statistics and attitude towards probability is rejected. There has been a growing correction in educational research that statistical significance alone may not be practical because it does not quantify the extent to which the attitude means differ. The effect size was calculated to determine the extent of the differences in attitude towards statistics and attitude towards probability.

$d = \frac{\text{t} - \text{value}}{\sqrt{n}} = \frac{3.395}{\sqrt{184}} = \frac{3.395}{\sqrt{13.56}} = 0.25$. The effect size d= 0.25 is a small effect size

3.2. Discussion

The result of the study simply confirms that statistics and probability are useful to the PSTs studies with overall means of 3.8 for statistics and 3.59 for probability, which are closer to agreement. The overall spread of responses on the useful construct for attitude towards statistics and attitude towards probability were neutral to strongly agree for statistics and disagree to strongly disagree for probability. For the anxiety construct, the PSTs overall mean scores for anxiety towards statistics and towards probability are 3.68 and 3.54 respectively which is almost agreement. The PSTs also indicated that, they have confidence in themselves when they face a statistics and probability problem with at least 71% of the PSTs asserting to that fact.

At least 63.6% representing the majority of the respondents indicated that, they don't feel upset when they have to work on statistics or probability problems. The overall spread of responses on the anxiety construct for attitude towards statistics and attitude towards probability were both disagree to agree for statistics and probability.

This confirms the PSTs assertion that, when they face a statistics or probability problem, they are unable to think clearly. Also, the PSTs agreed that Statistics or probability is one of the subjects that they fear most. On the part of the enjoyment construct, the mean scores for statistics and probability are 3.31 and 3.25 respectively which mean the PSTs neither like or dislike statistics and probability. Majority of the spread of the responses were between disagree to agree for both statistics and probability enjoyment construct. For the motivation construct majority of at least 64% agree that the concepts taught in statistics and probability lessons are very interesting. The PSTs also overwhelmingly agree that statistics and probability are useful for those students who decide to pursue a science career but not for other students. The PSTs also indicated that probability and statistics are too theoretical for them to be of any use with at least 42.2% indicating that for probability while 59.2% also agreeing for statistics. The overall spread of responses for the motivation construct is between disagree to agree for both statistics and probability. For the confidence construct, majority of at least 60% confirms that, it gives them great satisfaction to solve probability and statistics problems.

They also indicated that having a good knowledge of statistics and probability will increase their chances of finding jobs after school. The PSTs overwhelmingly agree that, if they put their mind on statistics and probability, they can master concepts that will be taught to them. The spread of responses for the confidence construct toward statistics and probability is between neutral to strongly agree. In conclusion, the PSTs attitude towards statistics is between neutral to strongly agree while attitude towards probability is between disagree to strongly agree. This is better than their attitude towards probability. On the part of statistics, this study concluded that the pre-service teachers have positive attitude towards statistics which is also similar to the study of Gopal et al. (2018) who also reported that students had positive attitude to statistics. Also, this study agrees with Taşgın and Kaya (2018) who indicated that both female and male pre-service teachers have positive attitude towards statistics.

Again, this study agrees with that of Mustam et al. (2020) and Nasser (2004) who indicated that pre-service teachers have medium and small positive attitude to statistics respectively. Also, this research corroborates the findings of Ashaari et al. (2011) who indicated that students showed a highly positive attitude towards statistics and making necessary efforts to understand the subject better. On the part of probability, this study revealed that pre-service teachers have positive attitude towards probability which tallies with those of Ruz et al. (2020), Bukari and Asiedu-Addo (2019), and Estrada et al. (2018) who reported that pre-service teachers have positive attitude towards probability.

From the analysis, there was a positive relationship between PSTs attitude towards statistics and attitude towards probability. This means that a lot of PSTs whose attitude towards statistics and attitude towards probability are both positive or their attitude influence one another. This study is similar to Taşgın and Kaya (2018) whose study also indicated a positive relationship anxiety and the attitudes towards statistics levels.

From the analysis, the PSTs see usefulness of statistics better than the usefulness of probability. All the statement recorded high affirmative responses in statistics than in probability. Also, the PSTs anxiety construct towards statistics is higher than their anxiety towards probability. This is evident because all the statements recorded high agreement responses in statistics than in probability in anxiety construct.

Again, the PSTs enjoy statistics better than probability as can be verified from the responses. The only statement the PSTs enjoy in probability better than statistics is item 14 which states that "Probability is nice and challenging for me". The PSTs are highly motivated in learning probability than statistics. Items 5 and 10 favoured motivation constructs towards statistics while item 25 favoured motivation construct towards probability. Finally, the PSTs have more confidence in statistics than in probability.

4. CONCLUSION

The PSTs attitude towards statistics and attitude towards probability were both found to be positive. There was again a positive correlation between the PSTs attitude towards statistics and attitude towards probability, which was also statistically significant. Lastly, there was a significant difference in attitude towards statistics and attitude towards probability, which was in favour of attitudes towards statistics with small effect size.

The findings in this study reveals that there is a need to address the issue of the anxiety and confidence levels among pre-service teachers in E. P College of Education, Bimbilla campus. We therefore recommend that tutors of statistics and probability courses employ the think-pair-share teaching methodology in their lesson deliveries. This idea helps improve to improve level of reasoning of students, builds their oral communication, improves their overall confidence levels and interest in learning statistics and probability. This is imperative since statistics is a foundation course to pave the way for pre-service teachers to implant within themselves the knowledge of basic statistics and probability. Again, research is a vital part and parcel of an educator's life. It is therefore recommended that tutors of statistics and probability courses arrange activities during their teaching in such a way that students could comprehend that they can master the topics, develop confidence, perceive the subject easier, and lessen negative attitudes toward statistics and probability. It is further recommended that tutors of statistics and probability courses improve their pedagogical content knowledge in the subject area and apply real-life situations in their teaching. This will help students to better appreciate the importance and real-life applications of statistics and probability, hence make the course interesting to study. Lastly, this study was conducted at the E. P. College of Education, Bimbilla, we therefore recommend that this study be replicated in other Colleges of Education in Ghana in order to help address some of the challenges pre-service teachers encounter in solving problems related to statistics and probability.

REFERENCES

Ashaari, N. S., Judi, H. M., Mohamed, H., Tengku, & Wook, M. T. (2011). Student's attitude towards statistics course. *Procedia - Social and Behavioral Sciences*, *18*, 287-294. https://doi.org/10.1016/j.sbspro.2011.05.041

Auzmendi Escribano, E. (1992). *Las Actitudes Hacia la matemática-Estadística en las Enseñanzas Media y Universitaria* [Attitudes towards Statistical Mathematics in Secondary and University Education]. Mensajero, D.L.

Blueman, A. G. (2009). *Elementary Statistics; A Step-by-Step Approach. 7th Edition*. McGraw Hill.

Bukari, H. I., & Asiedu-Addo, S. (2019). Effect of problem-based learning on Colleges of Education students' achievement in probability and attitude towards solving probability related problems. *African Journal of Educational Studies in Mathematics and Sciences*, *15*(2), 155-168. https://doi.org/10.4314/ajesms.v15i2.13

Chiesi, F., & Primi, C. (2015). Gender differences in attitudes toward statistics: Is there a case for a confidence gap? In CERME 9-Ninth congress of the European society for research in mathematics education.

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research (4th ed.)*. Pearson.

de Oliveira-Júnior, A. P., Zamora, P. R., de Oliveira, L. A., & de Souza, T. C. (2018). Student's attitudes towards probability and statistics and academic achievement on higher education. *Acta Didactica Napocensia, 11*(2), 43-56. https://doi.org/10.24193/adn.11.2.4

Estrada, A., & Batanero, C. (2020). Prospective primary school teachers' attitudes towards probability and its teaching. *International Electronic Journal of Mathematics Education*, *15*(1), em0559. https://doi.org/10.29333/iejme/5941

Estrada, A., Batanero, C., & Díaz, C. (2018). Exploring teachers' attitudes towards probability and Its teaching. In C. Batanero & E. J. Chernoff (Eds.), *Teaching and Learning Stochastics: Advances in Probability Education Research* (pp. 313-332). Springer International Publishing. https://doi.org/10.1007/978-3-319-72871-1_18

Evans, M. J., & Rosenthal, J. S. (2009). *Probability and statistics: The science of uncertainty. Second Edition*. University of Toronto.

Gopal, K., Salim, N. R., & Ayub, A. F. M. (2018). Influence of self-efficacy and attitudes towards statistics on undergraduates' statistics engagement in a Malaysian public university. *Journal of Physics: Conference Series*, *1132*, 012042. https://doi.org/10.1088/1742-6596/1132/1/012042

Lancaster, S. (2008). A study of preservice teachers' attitudes toward their role as students of statistics and implications for future professional development in statistics. In ICMI study 18 and 2008 IASE Round Table Conference.

León-Mantero, C., Casas-Rosal, J. C., Maz-Machado, A., & Rico, M. E. V. (2020). Analysis of attitudinal components towards statistics among students from different academic degrees. *PLoS One*, *15*(1), e0227213. https://doi.org/10.1371/journal.pone.0227213

Maity, R. (2018). Basic concepts of probability and statistics. In *Statistical Methods in Hydrology and Hydroclimatology* (pp. 7-51). Springer Singapore. https://doi.org/10.1007/978-981-10-8779-0_2

Mason, R. D. (1990). *Statistical techniques in business and economics. 7th Edition*. McGraw-Hill Inc.

Mustam, A. A., Adnan, M., Johnny, J., & Setambah, M. A. B. (2020). Attitude towards statistics among pre-service teachers of institute of teacher education. *Journal of Physics: Conference Series*, *1521*(3), 032011. https://doi.org/10.1088/1742-6596/1521/3/032011

Nasser, F. M. (2004). Structural model of the effects of cognitive and affective factors on the achievement of Arabic-speaking pre-service teachers in introductory statistics. *Journal of Statistics Education*, *12*(1), null-null. https://doi.org/10.1080/10691898.2004.11910717

Pale, J. W. (2016). Teacher and student based instructions on probability achievement outcomes and attitudes of secondary school students in Bungoma North, Kenya. *Journal of Education and Practice*, *7*(24), 43-53.

Peiró-Signes, Á., Trull, Ó., Segarra-Oña, M., & García-Díaz, J. C. (2020). Attitudes towards statistics in secondary education: Findings from fsQCA. *Mathematics*, *8*(5), 804. https://doi.org/10.3390/math8050804

Ruz, F., Molina-Portillo, E., Vásquez, C., & Contreras, J. M. (2020). Attitudes towards probability and its teaching in prospective mathematics teachers from Chile and Spain. *Acta Scientiae*, *22*(2), 48-66. https://doi.org/10.17648/acta.scientiae.5489

Tan, C.-K., Harji, M. B., & Lau, S.-H. (2011). Fostering positive attitude in probability learning using graphing calculator. *Computers & Education*, *57*(3), 2011-2024. https://doi.org/10.1016/j.compedu.2011.05.005

Taşgın, A., & Kaya, Y. (2018). The relationship between preservice teachers' attitudes towards statistics and their research anxiety. *International Journal of Assessment Tools in Education*, *5*(4), 731-739. https://doi.org/10.21449/ijate.455177