PRE-SERVICE TEACHERS' CONCEPTIONS OF MATHEMATICS

Rukevwe Jerome EKPAMAKU

EDU1602551

FACULTY OF EDUCATION,
UNIVERSITY OF BENIN,
BENIN CITY.

JULY, 2020

PRE-SERVICE TEACHERS' CONCEPTIONS OF MATHEMATICS

Rukevwe Jerome EKPAMAKU

EDU1602551

A RESEARCH PROJECT PRESENTED TO THE DEPARTMENT OF CURRICUUM AND INSTRUCTIONAL TECHNOLOGY, FACULTY OF EDUCATION, UNIVERSITY OF BENIN, BENIN CITY, EDO STATE. IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF SCIENCE IN EDUCATION B.SC (ED.) MATHEMATICS.

JULY, 2020

CERTIFICATION

We, the undersigned, certify that the project was carried out by Rukevwe Jerome EKPAMAKU with matriculation number EDU1602551, in the Department of Curriculum and Instructional Technology, Faculty of Education, University of Benin, Benin City. In partial fulfillment of the requirement for the award of Bachelor of Science in Education B.SC. (Ed.) in mathematics Education.

_____ _____

DR. F. O. IDEHEN **Date**
Project Supervisor

_____ _____

Dr. (Mrs.) F. N. Ofuani **Date**
Project Coordinator

_____

Prof. E. O. S. Iyamu
Dean, Faculty of Education

_____

Date

DEDICATION

This research work is dedicated to God Almighty, my greatest deliverer, who is forever faithful and answers the prayers of his children even before they make the request and to my late elder brother, Mr. OgagaOghene Ekpamaku for the degree he couldn't get before death took him away. Rest on brother.

ACKNOWLEDGEMENT

This project work would not have been a success without the support of the researcher's project supervisor Dr. F. O. Idehen for spending time and energy to ensure that the researcher is well groomed and appropriately guided in the course of this research, may God bless him richly.

The researcher will not fail to acknowledge the Dean, Faculty of Education, Prof. E.O.S Iyamu, the Head of Department of Curriculum and Instructional Technology, Dr. (Mrs.) R. J. Musa, Dr. (Mrs.) I. K. Oteze, Mr. Frank Egbenoma. For spending time and energy to ensure that the researcher is well groomed as far as academic activities are concerned, may God bless them richly.

Special appreciation to my parents; Late Mr. Paul Ekpamaku, my wonderful mother, Mrs. Mary Ekpamaku and to my siblings; Mrs. Ufuoma Emakpo, Mr. Ejiro Ekpamaku, Mr. OgheneOchuko Ekpamaku, Mr. Oghenequeke Ekpamaku and Miss Oghenetejiri Ekpamaku, for their trust in me, financial support, motivation, prayers, love and choosing to starve just to see me further my education, may the good Lord in His infinite goodness not make all your efforts to see me become somebody in life futile in Jesus name Amen.

The researcher equally appreciates the efforts of Dr. Mrs. Omere P. O who was his course adviser in 100level, 200level and 300level, for her motherly advised.

The researcher also wishes to appreciate his friends and colleagues, our able course representative, Mr. Sunday Ogedengbe, Mr. Odje Okiemute, and to all my course mates for their support and scholarly contributions to the success of this research work.

ABSTRACT

This study was undertaken to examine pre-service teachers' conception of mathematics, University of Benin, Benin City, Edo State. One hundred and twenty mathematics students were randomly selected from the faculty of Education and the faculty of physical sciences, University of Benin, Edo State out of a population of 550 mathematics students in both faculties.

To guide this study, four (4) research questions were raised. Nineteen (19) questionnaire items were generated for the research questions raised to guide the study.

The data collected for the research questions were using frequency count and mean. The results gotten from the analysis revealed that majority of the Pre-service teachers have negative conception towards the learning of mathematics.

Based on the findings, it was recommended that; Lecture method of teaching mathematics be replaced with problem solving method as this will enable students to develop good study habits and reasoning powers, stimulates their thinking, helps improve and apply their knowledge and experience to real life situations, mathematics teachers should put on good behaviour in class as this helps to motivates students to listen attentively, periods of teaching mathematics should be fixed in the morning as this will enable students to understand mathematics better, mathematics teachers should make use of good instructional materials as this will help students to understand mathematics better, and lastly, parents should monitor their children's progress, buy good textbooks and other learning materials that are relevant to their studies.

TABLE OF CONTENTS

CHAPTER ONE

INTRODUCTION

Background to the Study

A conception is a combination of knowledge and beliefs and for mathematics; it is combination of knowledge and beliefs about mathematics itself. There are two conceptions of mathematics; relational and instrumental conceptions. An instrumental conception is a procedural view of mathematics, whereas a relational conception describes a network of understanding allowing for the creation of multiple solution paths.

Mathematics is a branch of science that deals with numbers and their operations. It involves calculation, solving of problems etc.

Mathematics is a major aspect of our educational system since its application cuts across all areas of human endeavor. For instance, from social or economics perspective mathematics is a key element in our day-to-day living that every human being practices in one form or the other. Teaching as seen is an activity which enables pupils or learners to learn and acquire the described knowledge, skills and disposition necessary for becoming functional members of the society. Bidwell (2016) viewed teaching as a series of interaction between the teacher and the learners with the explicit goal of changing one or more of the learner's cognitive or

effective states. Therefore, mathematics teaching can be seen as the interaction between the teacher and the learners to acquire the described mathematical knowledge, skills, and ideas necessary for becoming functional members of the society.

Pre-service teachers' conception plays a significant role in the teaching and learning of Mathematics in the secondary schools. Mathematics is conceived as the most difficult subjects by both students and teachers due to the way it was handled and presented. There are many factors responsible to this general conception.

The learning of Mathematics depends greatly on the way it is presented to the student. Teachers' conception towards teaching and learning of Mathematics has a significant impact in shaping the attitude of students towards learning of Mathematics. Students' positive attitude can be enhanced by the teacher positive attitude towards teaching of Mathematics and this can be done through teachers' helpful behavior, resourcefulness, enthusiasms, good method of presentation, concern for students and teacher knowledge of the subject matter. It is recommended that teachers should regularly develop positive attitude towards the teaching of Mathematics since they are the role model. The responsibility of the Mathematics teacher ends when he has taught his students to understand

the concepts and how to apply them in a variety of ways in solving daily mathematical problems.

Finally, seminars/workshops on positive teachers' disposition while teaching should be addressed by all education stakeholders as important and urgent.

Teachers hold varied conceptions pertaining to students, including students 'potential for success, cultural backgrounds, strengths and weaknesses, and future placement in society. High expectations are lauded as a key to successful teaching of students often underserved by schooling (Lipman, 2015; Zeichner, 2014). Zeichner, (2014) argued that high expectations are a necessary attribute of classrooms that have the potential to narrow the achievement gap in urban schools. The research literature contains a growing consensus about what teachers need to be like, to know, and to be able to do in order to teach all students to high academic standards. This vision rests on teachers believing that all students can learn and taking the responsibility for this task regardless of students 'economic circumstance or skin color. The belief that all children can learn and advocate for high expectations has become part of mainstream educational rhetoric.

Historically, mathematics has been a subject that many students struggle with. Young learners often utter the words, "I'm never going to use this

stuff!" as they are struggling to solve some algebra or calculus problems. For many parents and teachers, the utterance of this phrase (or ones like it) is too often a common occurrence in the classroom. Most people will respond to the students by saying that they may need it or a future job or that it improves the critical thinking ability of the brain. While these responses are good, and well-intended, they don't serve the practical and immediate needs of the child. Nigeria recruitment process contributes to some students' neglect of mathematics degree. An average Nigerian knows that "anyone with any class of degree and any discipline can work anywhere in Nigeria provided that the right connections are conserved". Corruption has discouraged many mathematics students as it seems the degree is not necessarily needed in the country.

Statement of the Problem

Mathematics has been one of the subjects which Nigerian students especially at secondary schools level develop dislike for and likewise perform poorly (Odili, 2006) as cited by Mark (2018). However, students and people frequently ask these questions; How can the teaching and learning of mathematics be improved in our secondary schools as a tool for self-reliance? It is an indisputable fact that individuals are differently endowed. As a result the way and manner they perceive issues are of

course different. Teachers' conception plays a significant role in the teaching and learning of Mathematics in the secondary schools. Mathematics is conceived as the most difficult subjects by both students and teachers due to the way it was handled and presented. There are many factors that are responsible to this general conception.

Conceptions are subjective and idiosyncratic but they can provide teachers useful information that may affect planning of lessons and decision making in the classroom. Therefore the problem confronting this research is to investigate pre-service teachers' conception of mathematics.

Research Questions

1. What are students' conceptions towards the learning of mathematics?

2. What are the learning factors affecting the influence of pre-service teachers of mathematics?

3. What are the environmental factors affecting the learning of mathematics at home?

4. What are the environmental factors affecting the learning of mathematics at school?

Purpose of the Study

The purpose of this study is to:

1. Discover students' conceptions towards the learning of mathematics.

2. Examine the learning factors affecting the influence of pre-service teachers' conception of mathematics.
3. Determine the environmental factors affecting the learning of mathematics at home.
4. Determine the environmental factors affecting the learning of mathematics in school.

Significance of the Study

The study shall provide a framework of consideration for the need to re-address issues affecting both poor desirability and teaching of mathematics by Students and Teachers. It shall also serve as a good source of information to Teachers, students, and Education experts.

Scope of the Study

The study focuses on the pre-service teachers' conception of mathematics in the University of Benin, Benin City.

Operational Definition of Terms

The under listed terms are operationally defined as used in the study.

Mathematics: Mathematics is a branch of knowledge that seeks to improve on human perception of himself and his immediate environment by using clear, logical precise and exact thinking processes". Mathematics is

autonomous science that springs up on define basis and develop in any direction based on the unfolding of knowledge.

Conception: The power or faculty of apprehending of forming an idea in the mind; the power of recalling a past sensation or perception; the ability to form mental abstractions. Or the way in which something is perceived or regarded.

Mathematics Learning: It is broadly defined as the acquisition of new knowledge, skills, and affects that are related to quantity, space, and structure.

Pre-service teachers – Students studying any course in the Collage of Education or in the faculty of Education in the University.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Introduction

Related literature was reviewed under the following sub-headings:

- Students conceptions of learning mathematics
- Factors affecting pre-service teachers conception of mathematics
- Environmental factors and learning mathematics at home
- Environmental factors and learning mathematics at school

Students Conceptions of Learning Mathematics

Because mathematical activity does not occur entirely within the cognitive realm, it is important to consider what beliefs students hold about mathematics and mathematical activity and how those beliefs influence mathematical experiences. The data regarding students' beliefs about mathematics comes from various sources, but almost all of it seems to indicate that students' beliefs about mathematics may be part of the reason why mathematical achievement is not as great as it could be. There is a growing body of research that supports the view that a person's conception of what is important in mathematics influences how he or she approaches mathematical situations.

A student's beliefs about mathematics are stable and thus are hard to change (McLeod, 1992) as cited by Orbed (2017). Data from the 1992 National Assessment of Educational Progress (NAEP) (Kenney & Silver, 1997) suggest that students in the United States generally believe that mathematics is important, difficult, and involves memorizing and following rules. On the 2015 NAEP, a large percentage (41%) of the twelfth grade students agreed that learning mathematics involves mostly memorizing facts. Only 64% of the students indicated that they understood what happened in their mathematics class and only 50% of them had confidence in their ability to do mathematics. Despite the finding that students do not understand math and associate memorizing with learning mathematics, they seem to believe that mathematics is useful for solving everyday problems (71%) and that most people use mathematics in their jobs (74%). The above findings indicate that students probably do not hold beliefs that are the most productive to developing a robust understanding of mathematics. Schoenfeld (1985) as cited by James (2016) explored how students' self-reported beliefs were reflected in the mathematical work they were engaged in.

In a study that included interviewing students and observing them while working on problem-solving tasks, he found that students' beliefs about

mathematics might weaken their ability to solve non-routine problems. Schoenfeld found that high school geometry students held strong beliefs about the nature of mathematics that influenced their performance in at least four ways. First, the students operated with a belief in the empirical nature of mathematics and this belief influenced how they acted in problem-solving situations.

They did not see proof as a way to help them validate their geometric constructions. Rather they believed that proof should be used to confirm something that is intuitively obvious or to verify something that they were told was true. On the other hand, mathematicians participating in Schoenfeld's study saw discovery and deduction as flip sides of the same coin. Secondly, he found that students often believed that the form of a solution or proof was as important as the deductive reasoning involved in the proof.

The third belief that Schoenfeld identified was that the students believed that problems should be able to be solved in a short period. The fourth belief identified by Schoenfeld is that students saw mathematics as a passive endeavor: one in which they needed to be able to use the mathematics but not to understand why. They became "passive consumers of 'black box' procedures" (Schoenfeld, 2017 p. 373).

In an effort to conceptualize a framework for analyzing student conceptions of mathematics, Grouws, Howald, and Colangelo (1996) as cited by Brooke (2018) developed and tested the Conceptions of Mathematics Inventory. This inventory categorizes a student's conceptions of mathematics in seven different dimensions:

- composition of mathematical knowledge
- structure of mathematical knowledge
- status of mathematical knowledge
- what it means to do mathematics
- validating ideas in mathematics
- learning mathematics and
- the usefulness of mathematics.

Because they thought that a student's conceptions of mathematics might be a factor in overall achievement, they administered the inventory to groups of mathematically talented students and to groups of typical algebra students. On several dimensions the data indicated no differences between the two groups of students.

In agreement with the 1992 NAEP data, both groups of students believed that mathematics was useful in their personal lives both in and out of school and would continue to be important in the future. Both groups of

students thought that the field of mathematics was always growing and changing. However, in interviews with individual students it became apparent that some students were focused on the changing methods for teaching mathematics and the increased use of technology in doing mathematics rather than on how mathematics as a field of study might be changing.

Both groups of students also indicated a view of mathematics that balances the role of constructing knowledge and developing understanding with that of memorizing. However, the relative importance of these two approaches varied between the two groups. Over 75% of the algebra students believed that mathematics was mostly memorizing, while only 50% of the mathematically talented students held this belief about learning mathematics. As would be expected, a greater percentage of the mathematically talented students (over 75%) than algebra students (40%) felt that they could learn mathematics by independently trying to solve problems.

There were also differences between the conceptions held by the two groups of students. The mathematically talented students believed that mathematics was more about concepts than rules, that mathematics should make sense, that problem solving was more important than applying

formulas, that different areas of mathematics were related to each other and that they could validate their own mathematical thinking. The typical algebra student's responses indicated that for them mathematics was about both rules and concepts, that different areas of mathematics were not strongly connected, that being able to correctly use formulas was enough to be successful and understand mathematics, and that they needed a teacher to tell them if they were doing things correctly.

In summarizing the students' responses, Grouws et al. concluded that mathematically talented students differed from typical algebra students in their views of what constitutes mathematical knowledge and what it means to do mathematics. But they held similar views about what constitutes learning mathematics. The existence of differences between these groups of students' conceptions about mathematics raises the question about how classroom experiences might help shape and maintain a person's conceptions of mathematics. This research also indicates that a person's conceptions about mathematics may be related to how he or she approaches learning and doing mathematics both in and out of school and that this is an important area for further investigation.

The preceding research was concerned with determining and describing the beliefs that secondary school students hold about mathematics. An

additional body of research indicates that the beliefs of college students are not much different than the beliefs of secondary school students and that the mathematical beliefs of college students also seem to be related to their mathematical achievement.

Conceptions of College Students

The majority of the research regarding college students' conceptions of mathematics has been about the conceptions of mathematics held by college students who are in remedial courses. Oaks (1987) as cited by Lukeman (2017) explored how college students' conceptions of mathematics are related to their success or lack thereof in remedial college mathematics courses. She found that students who did not pass remedial college mathematics courses tended to have a conception of mathematics as rote manipulation of symbols. This view of mathematics focused the students' learning efforts on memorization rather than working for conceptual understanding.

Stage and Kloostermen (2015) examined remedial college mathematics students' beliefs about themselves as learners of mathematics and about the nature of mathematics and the relationship of these beliefs to student achievement. They used the Indiana Mathematics Beliefs Scales

(Kloosterman and Stage, 2016) to measure student beliefs. The dimensions measured by the Indiana Mathematics Beliefs Scales are:

- perception of one's own ability to complete difficult problems
- Perception that some mathematics problems cannot be solved simply by following steps
- Perceptions of the importance of conceptual understanding in comparison to rote computational skill, and
- Perception of the importance of word problems in mathematics.

In a study involving 68 remedial college mathematics students, Stage and Kloostermen found that the students had limited self-confidence in solving time consuming problems, slightly disagreed with the notion that not all word problems could be solved simply by following steps, generally agreed that understanding concepts was important in mathematics, and slightly disagreed with the idea that word problems were important in mathematics.

They further found that for the 40 women in their study, the scores on dimensions (a), (b) and (c) above were significantly and positively correlated with final course grade. The beliefs of the 26 men in this study were not significantly correlated with final course grades. This difference in the findings for men and women supports Fennema and Peterson's (198S)

claim that beliefs may influence achievement more for females than for males.

Carlson, Buskirk, and Halloun (in press) assessed the views about mathematics held by pre-calculus and third semester calculus students. In particular their study classified student beliefs about mathematics with regard to the structure of mathematical knowledge, the methods of mathematics, the validity of mathematics, the learnability of mathematics, the role of reflective thinking, and the personal relevance of mathematics. The study showed that the beliefs held by third semester calculus students differ from those held by pre-calculus students.

A higher proportion of calculus students believed that doing mathematics is more a result of effort than teacher explanation (43% vs. 34%), that mathematics was related to everyday life (75% vs. 65%), that mathematical formulas express meaningful relationships rather than provide ways to get numerical answers to problems (45% vs. 23%), and that solving mathematics problems involves more general problem solving techniques than imitating the solution to a similar problem (71% vs. 53%).

They also found that students who did well in pre-calculus had views that were closer to those of mathematicians than did students who did not do well in pre-calculus. The study also considered the impact of a moderately

reformed pre-calculus course on the views held by the pre-calculus students. They found that the reform environment did not have a significant impact on the beliefs of the pre-calculus students.

Carlson (in press) assessed the views about mathematics held by graduate level mathematics students. She found that they believed that persistence and individual effort are necessary attributes for mathematical success. They also indicated that they enjoyed mathematical problem solving and that students should expect to "sort out" information on their own. In problem solving situations, Carlson observed that the graduate students did persist but often did not correctly sort out the necessary information and considers a variety of solution paths.

This indicated that although the beliefs of the graduate students are closer to those of mathematicians than those of undergraduates, they still do not seem to be fully integrated with their work in mathematical situations.

The research studies described above provide information about the conceptions of mathematics that students hold and provide evidence that these conceptions may influence an individual's actions in mathematical situations. They also point to the fact that the conceptions that many students have may be contributing to the lack of overall mathematical achievement of students in the world.

This, in turn, raises the question about what experiences might contribute to changing students' conceptions about mathematics and to future development of students' conceptions that are more congruent with a robust understanding of mathematics.

In an effort to determine how a curriculum influences beliefs, Hirschhom (1993) administered a 25-item student opinion survey to students who had completed four years of the University of Chicago School Mathematics Project (UCSMP) mathematics curriculum and to match comparison groups of students who had completed a more traditional course of study. He found that the use of the UCSMP curriculum did not affect students' beliefs towards mathematics but that the use of a calculator over the four years did affect students' beliefs towards calculator use.

He concludes that there is no evidence that just learning different content will change student beliefs about mathematics. He did however find a positive correlation between the belief that mathematics is useful and higher performance on the standardized achievement instruments that he used to measure mathematical achievement. This study leaves open the question of whether changing the manner in which students engage with mathematical ideas would have an effect on the conceptions of mathematics that the students hold.

The CPMP curriculum introduces students to a wider variety of content and the students are interacting with the mathematics in ways that previously were not commonly found in the mathematics classroom. Data gathered from the field test of the CPMP curriculum indicates that a significantly higher percentage of students who studied mathematics using the CPMP curriculum than students in a traditional mathematics curriculum believed that mathematical ideas should make sense (Schoen & Pritchett, 1998). Of the 221 CPMP students surveyed, 64.7% of them agreed that their mathematics course helped them to see that mathematical ideas make sense.

Only 51.1% of the 134 students in the comparison group indicated agreement with the same statement. Possible reasons given for this difference in beliefs are that the CPMP curriculum includes contextualized entry points into the mathematics, collaborative learning groups, and an emphasis on mathematical communication.

In summary, this part of the literature review suggests that the beliefs that students hold about the nature of mathematics and mathematical activity are important to study. In spite of this fact there is a paucity of research on conceptions of mathematics held by students in non-remedial college-level mathematics courses.

What research does exist indicates that students often hold beliefs that are counterproductive to developing deep understanding of mathematical topics and thus influence their overall mathematical achievement. There is also some evidence that changing the approach to learning mathematics may help students develop more accurate and productive beliefs about mathematics and mathematical learning.

Factors affecting pre-service teachers' Conception of Mathematics

Teachers' knowledge about teaching and learning has been cited as the most important predictor of students' success (Greenwald, Hedges & Laine, 1996). Furthermore, teacher's conceptual understanding of mathematics and their ideologies influence students' mathematical learning and values, which permit students to engage or not to engage in a mathematics course (Bishop, Clarke, Corrigan & Gunstone, 2006).

It is important to consider how teachers' 58 International Electronic Journal of Mathematics Education / Vol.4 No.2, July 2009 mathematical knowledge (i.e., "knowledge of mathematical concepts and procedures") and values (i.e., "mathematical conceptions and ideologies") influence students' mathematical knowledge and learning (Ambrose, 2016).

Improving pre-service teachers' conceptual mathematical knowledge before they begin their classroom practice enhances the mathematical

knowledge and values that these teachers will initially bring to the classroom (Boyd, 1994: Kajander, 2005; Sowder, 2007) as cited by Kevin (2016).

Previous work (Kajander, 2007) and empirical teaching observations suggest that some pre-service teachers embrace and demonstrate conceptual change to a much greater extent than others.

This study investigated factors such as: pre-service teachers' initial capacity (initial levels of conceptual and procedural mathematical knowledge and values, academic background and number of mathematics courses taking at high school and university) that may affect their growth in conceptual mathematical knowledge during a teacher certification program, which included a 36- hour mathematics methods course. The course was designed to promote the concepts of mathematics reform as described by the National Council of Teachers of Mathematics (NCTM) (NCTM, 2000).

Teachers' Mathematical Knowledge

Teachers' knowledge of mathematics has become an area of concern in the last two decades. There has been an implicit disagreement over the knowledge of mathematics that teachers need to know in order to teach with deep conceptual understanding. Some researchers argue that teachers'

capabilities in higher level mathematics are the most important attributes (Hill & Ball, 2004) as cited by Farman (2018).

Others believe that higher level mathematics ability is not sufficient to teach, and believe that teachers must have knowledge about how to teach mathematics to students (Ma, 1999; Ambrose, 2004; Schommer-Aikins, Duell & Hutter, 2005).

Hence, teaching mathematics to students should be treated as a system of interacting features to minimize the gap between teaching and students' mathematical learning (Hiebert, Stigler, Givvin, Garnier, Smith, Zerpa, Kajander and Van Barneveld 59 Hollingsworth, Manaster, Wearne & Gallimore, 2005).

This system of interacting features, such as:

- the knowledge and values that teachers and students bring to the lesson
- tasks presented in the classroom,
- teaching strategies,
- students' discourse and participation,
- the assessments and the physical materials available for teaching is what define the learning conditions for the students (Ibid).

Once the definitions of these learning conditions are established, then what matters is how these features together are enacted with students to help them achieve their goals.

Teaching mathematics is a complex enterprise that entails making the content accessible, interpreting students' questions and ideas, and being able to explain concepts and procedures in different ways (Hill, Sleep, Lewis & Ball, 2007) as cited by Terry (2017). Teachers need to have deep conceptual understanding of the mathematics they are teaching to their students and be able to illustrate to their students why mathematical algorithms work and how these algorithms may be used to solve problems in real life situations (Ibid). Hence, the skills required for teaching mathematics are multidimensional; this means that this capacity does not relate to one general factor such as mathematical ability or teaching ability but rather, it relates to a system of features that interact with one another to help teachers transfer mathematical knowledge to their students.

Mathematical Values

In this system of interacting features for teaching mathematics to students, teachers may opt to use a reform-based model for teaching mathematics, in which students may actively contribute to the construction of their mathematical knowledge rather than being passive recipients of

information (Johnson & Munakata, 2005). Therefore, it is important to realize that teachers' beliefs about mathematics may influence students' perceptions of mathematical concepts and procedures. We define values as deeply held beliefs about what is important in mathematics learning.

These values have a powerful impact on teaching (Ernest, 2018). In some cases, these values can encourage students to apply, or discourage them from applying, their mathematical knowledge to real life situations or other situations outside the classroom structure (Boaler, 1999). Classroom experiences together with teachers' mathematical values develop students' conceptions of mathematics.

Accordingly, some students develop the conception that mathematics is just made of numerous rules, formulas and equations that they must memorize; but in other cases, students may come to believe that mathematics is about interacting with the problem, being creative and finding a solution without following a fixed procedure (Ernest, 1989). Students who subsequently choose to become pre-service teachers also 60 International Electronic Journal of Mathematics Education / Vol.4 No.2, July 2009 tend to arrive at teacher preparation programs with varying experiences and values (Kajander, 2007), and we were interested in the impact of these on subsequent growth.

Teachers' Mathematical Development

One way to facilitate teachers' mathematical development is by deepening their mathematical understanding and changing their epistemological beliefs via professional development experiences (Hill & Ball, 2004; Kajander, Keene, Siddo & Zerpa, 2006). Kajander et al. (2006) conducted a study of 40 in-service grade 7 teachers from urban and rural areas. She surveyed teachers before and after an eight-month intervention in order to examine mathematical understanding as well as beliefs about mathematics. She provided volunteer teachers with 62 International Electronic Journal of Mathematics Education / Vol.4 No.2, July 2009 professional development experiences that emphasized conceptual understanding of fundamental mathematics, appropriate use of manipulative, use of representations and differentiated instruction.

This included three days of professionally delivered in-service training on number and operation, as well as online courses for some of the participants. The researchers found that measureable changes in mathematical knowledge were possible even in such a short time. In addition, teachers' beliefs about the need to focus specifically on procedural learning decreased, which was indicative of a shift towards a more reformed based conception (Kajander, 2005).

If conceptual aspects of learning also promote procedural learning with a less specific focus on procedural skills (NCTM, 2007), a diminished emphasis on procedural values which tends to be accompanied by an increase in conceptual values, may be an indicative of a shift to a more reform-based conception (Kajander, 2005).

Other researchers (Ahmed, 1987; Ingvarson et al., 2005; Mundry, 2005) have however argued that longer time periods are needed for change. Ball (1996) also found that the use of professional development experiences can change teachers' traditional ways of mathematical thinking.

A deep conceptual re-examination of the mathematics itself can shape teachers' understanding of mathematical concepts and help them be more flexible when listening to students' new ideas and innovations. Teachers need experience linking concrete ideas and mathematical models to new generalizations and procedures, and such mathematics may be highly specific to teaching. Ball concludes that the lack of critical discussion and reflection during professional development experiences may cause teachers to formulate their own interpretation and implementations, making common standards difficult to establish.

Professional development experiences should include a vision that requires teachers to shift their mathematical thinking and values in order to deepen

students' mathematical knowledge (Sowder, 2007). This shift in teachers' mathematical thinking and values should occur during their pre-service training experiences. The current study has focused on examining factors that may impact pre-service teachers' change in conceptual mathematical knowledge during a one year (36 hour) mathematics methods course.

Environmental factors and learning mathematics at home

Various environmental factors affecting the learning of mathematics at home are known to be related to mathematics achievement, socio-economic status, and parents' educational level, among others are factors that have been analyzed in this study as predictors of math achievement.

Parents' Educational Level

Parents' educational level has been shown to be a factor in academic achievement. Parents serve as a role model and a guide in encouraging their children to pursue high educational goals and desires by establishing the educational resources on hand in the home and holding particular attitudes and values towards their children's learning. In this case, the educational attainment of parents serve as an indicator of attitudes and

values which parents use to create a home environment that can affect children's learning and achievement.

A number of studies indicated that student achievement is correlated highly with the educational attainment of parents (Coleman, 1966). For instance, students whose parents had less than high school education obtained lower grades in mathematics than those whose parents had higher levels of education (Campbell, Hombo, & Mazzeo, 2000). Research has shown that parents' educational level not only impact student attitudes toward learning but also impact their math achievement scores.

Socio-Economic Status

Socio-economic status is determined to be a predictor of mathematics achievement. Studies repeatedly discovered that the parents' annual level of income is correlated with students' math achievement scores (Eamon, 2005; Jeynes, 2002; Hochschild, 2003; McNeal, 2001). Socio-economic status was found significant in primary math and science achievement scores (Ma & Klinger, 2000). Another study found poor academic achievement of Canadian students to be attributable to their low socio-economic status (Hull, 1990). Socio-economic status was examined and found to be one of the four most important predictors of discrepancy in academic achievement of Canadian students (aged 15) in reading,

mathematics, and science by the Program for International Student Assessment (Human Resources Development Canada, Statistics Canada, & Council of Ministers of Education Canada, 2001) as cited by Kenny (2018).

A number of studies showed that parents with higher socio-economic status are more involved in their children's education than parents of lower socio-economic status. This greater involvement results in development of positive attitudes of children toward school, classes, and enhancement of academic achievement (Epstein, 1987; Lareau, 1987; Stevenson & Baker, 1987) as cited by Uwa (2016). It is believed that low socio-economic status negatively influences academic achievement, in part, because it prevents students from accessing various educational materials and resources, and creates a distressing atmosphere at home (possible disruptions in parenting or an increased likelihood family conflicts) (Majoribank, 1996; Jeynes, 2002). For these reasons, socio-economic status of a student is a common factor that determines academic achievement.

Self-Directed Learning

Self-directed learning could be a factor in students' math achievement. Mathematics learning requires a deep understanding of mathematical concepts, the ability to make connections between them, and produce effective solutions to ill-structured domains. There is no perfect,

well-structured, planned or prescribed system that lets students think and act mathematically. This can be done if, and only if, students play their assigned roles in their learning progress. Self-directed learning has an important place in successful math learning. Self-directed students can take the initiative in their learning by diagnosing their needs, formulating goals, identifying resources for learning, and evaluating or monitoring learning outcomes (Knowles 1975). The teacher's role is to engage students by helping to organize and assist them as they take the initiative in their own self-directed explorations, instead of directing their learning autocratically (Strommen & Lincoln, 1992).

Environmental factors and learning mathematics at school

Some of the environmental factors affecting the learning of mathematics at school are:

Instructional Strategies and Methods

Being successful in math involves the ability to understanding one's current state of knowledge, build on it, improve it, and make changes or decisions in the face of conflicts. To do this requires problem solving, abstracting, inventing, and proving (Romberg, 2018). These are fundamental cognitive operations that students need to develop and use it in math classes.

Therefore, instructional strategies and methods that provide students with learning situations where they can develop and apply higher-order operations are critical for mathematics achievement.

In the literature, it is pointed out that for students to accomplish learning, teachers should provide meaningful and authentic learning activities to enable students to construct their understanding and knowledge of this subject domain (Wilson, 2016). In addition, it is emphasized that instructional strategies where students actively participate in their own learning is critical for success (Bloom, B. 1976). Instructional strategies shape the progress of students' learning and accomplishment.

Teacher Competency in Math Education

Many studies report that what teachers know and believe about mathematics is directly connected to their instructional choices and procedures (Brophy, 1990; Brown, 1985; National Council of Teachers of Mathematics, 1989; Thompson, 1992; Wilson, 1990a, b). Geliert (1999) also reported that "in mathematics education research, it seems to be undisputed that the teacher's philosophy of mathematics has a significant influence on the structure of mathematics classes" (p. 24). Teachers need to have skills and knowledge to apply their philosophy of teaching and instructional decisions.

In the 21st century, one shifting paradigm in education is about teachers' roles and competencies. Findings from research on teacher competency point out that

If teachers are to prepare an ever more diverse group of students for much more challenging work--for framing problems; finding, integrating and synthesizing information; creating new solutions; learning on their own; and working cooperatively--they will need substantially more knowledge and radically different skills than most now have and most schools of education now develop (Darling-Hammond, 1997, p. 154).

Teachers not only need knowledge of a particular subject matter but also need to have pedagogical knowledge and knowledge of their students (Bransford et al., 2000). Teacher competency in these areas is closely linked to student thinking, understanding and learning in math education. There is no doubt that student achievement in math education requires teachers to have a firm understanding of the subject domain and the epistemology that guides math education (Ball, 1993; Grossman et al., 1989; Rosebery et al., 1992) as well as an equally meticulous understanding of different kinds of instructional activities that promote student achievement. Competent math teachers provide a roadmap to guide students to an organized

understanding of mathematical concepts, to reflective learning, to critical thinking, and ultimately to mathematical achievement.

School Context and Facilities

School context and its facilities could be an important factor in student achievement. In fact, identifying factors related to the school environment has become a research focus among educational practitioners. For instance, research suggests that student achievement is associated with a safe and orderly school climate (Reyonds et al., 1996). Researchers also found a negative impact on student achievement where deficiencies of school features or components such as temperature, lighting, and age exist. In a study by Harner (1974), temperatures above 23° C (74° F) adversely affected mathematics skills. In terms of the condition of school building, Cash (1993) found student achievement scores in standard buildings to be lower than the scores of students in above standard buildings. In addition, Rivera-Batiz and Marti (1995) conducted multiple regression statistical analysis to examine the relationship between overcrowded school buildings and student achievement. The findings indicated that a high population of students had a negative effect on student achievement.

Teachers Role in Students' Motivation

Mathematics education requires highly motivated students because it requires reasoning, making interpretations, and solving problems, mathematical issues, and concepts. The challenges of mathematics learning for today's education are that it requires disciplined study, concentration and motivation. To meet these challenges, learners must be focused and motivated to progress. Broussard and Garrison (2004) examined the relationship between classroom motivation and academic achievement in elementary-school-aged children (122-first grade and 129-third grade participants). Consistent with previous studies, they found that for a higher level of mastery, motivation was related to higher math grades.

The teacher's role in students' motivation to learn should not be underestimated. In helping students become motivated learners and producers of mathematical knowledge successfully, the teacher's main instructional task is to create a learning environment where students can engage in mathematical thinking activities and see mathematics as something requiring "exploration, conjecture, representation, generalization, verification, and reflection" (Carr, 1996, p.58).

CHAPTER THREE

METHODOLOGY

Introduction

The methodology of the study was examined under the following sub-headings:

- Design of the study
- Population of the Study
- Sample and Sampling Techniques
- Research Instrument
- Validation of Instrument
- Method of Data Collection
- Method of Data Analysis

Design of the study

The design used was a descriptive survey design which includes the use of questionnaire. This method involves the collection of extensive data for the purpose of analyzing, describing and interpreting the questions raised on the pre-service teachers' conceptions of mathematics in the University of Benin.

Population of the Study

The target population consists of 550 mathematics students both in the faculty of education and the faculty of physical sciences, University of Benin, Benin City.

Sample and Sampling Techniques

Simple Random Sampling technique was used to select the respondents. A total number of one hundred and twenty (120) respondents were randomly chosen out of 550 students studying Mathematics at Faculty of Education and the faculty of physical sciences, University of Benin, Benin City.

Research Instrument

The instrument used for data collection for the study was questionnaire. A close ended questionnaire was designed based on the stated research questions. It is divided into section A and B. Section A elicited personal information about the respondents while section B dealt with statements related to the variables under study. The questionnaire is a four Likert Scale ranging from strongly agree to strongly disagree with a total number of 19 items.

Validation of the Instrument

To determine the validity of the instrument, the questionnaire designed was given to the researcher's supervisor and one other expert in the

Department of Curriculum and Instructional technology, Faculty of Education, University of Benin. Their corrections were taken into cognizance for the final draft of the instrument.

Method of Data Collection

The researcher administered the instruments to the respondents with the help of the course representatives of each level. A total of one hundred and twenty questionnaires were distributed. After explaining the purpose of the study, students were assisted in filing the questionnaire and this method ensured a hundred percent return rate of the questionnaire and the elimination of unnecessary influence.

Method of Data Analysis

The tools for data analysis employed in the analysis of data would be descriptive and inferential statistics tool. The descriptive statistics tools are mean and standard deviation.

CHAPTER FOUR

PRESENTATION OF RESULTS AND DISCUSSION OF FINDINGS

This chapter deals with the results obtained after data analysis. The data analysis is presented and findings discussed below.

Research Question 1: What are students' conceptions towards the learning of mathematics?

TABLE 1: Mean scores responses of students on students' conceptions towards the learning of mathematics.

S/N	ITEM	SA	A	D	SD	MEAN	STD D.	DECISION
1	Learning of mathematics is very easy	23	38	35	24	2.50	1.021	Accept
2	Learning of mathematics is difficult	25	40	34	21	2.58	1.010	accept
3	Mathematics is fun and interesting to learn	27	47	27	19	2.68	0.996	accept
4	Mathematics is boring and tiring to learn	28	31	45	16	2.59	0.992	accept
	Grand Mean					**2.59**		**accept**

Cut off Mean = 2.5

From table 1, items such as learning of mathematics is very easy, learning of mathematics is very difficult, mathematics is brothering and tiring to learn among others were accepted by the majority of the students as the students' conceptions towards the learning of mathematics since the means are above the criterion mean of 2.5.

The grand mean is 2.59, which shows that students' conceptions towards the learning of mathematics listed in items which are to 4 are accepted by majority of the students as the conceptions of students towards the learning of mathematics.

Research Question 2: What are the learning factors affecting the influence of pre-service teachers' conception of mathematics?

TABLE 2: Mean scores responses of students on learning factors affecting the influence of pre-service teachers' conception of mathematics.

S/N	ITEM	SA	A	D	SD	MEAN	STD D.	DECISION
5	Lecture method of teaching mathematics is effective.	21	38	32	29	2.43	1.042	Reject
6	The curriculum is too bulky therefore it is difficult to comprehend.	20	47	44	9	2.65	0.847	accept
7	The environment for learning mathematics is conducive.	18	36	53	13	2.49	0.879	reject
8	The use of good instructional materials helps me to understand mathematics better.	51	59	7	3	3.32	0.698	accept
9	Learning mathematics in the morning helps me to understand better.	50	48	19	3	3.21	0.798	accept
	Grand Mean					**2.82**		**accept**

Cut off Mean = 2.5

From table 2, items such as lecture method is effective, curriculum is too bulky, learning mathematics in the morning helps student to understand better among others were accepted because the means are above the criterion mean, while items 5 and 7 were rejected because the means are below the criterion mean.

The grand mean is 2.82, which shows that the learning factors listed in items 5-9 are accepted to influence pre-service teachers' conception of mathematics.

Research Question 3: What are the environmental factors affecting the learning of mathematics at home?

Table 3: Mean scores responses on environmental factors affecting the learning of mathematics at home.

S/N	ITEM	SA	A	D	SD	MEAN	STD D.	DECISION
10	I have too many house chores to do therefore I cannot do my assignment.	23	32	42	23	2.46	1.012	Reject
11	My parents do not assist me in learning mathematics.	26	42	34	18	2.63	0.987	Accept
12	I have mathematics teacher at home that helps me with my assignment.	12	34	47	27	2.26	0.921	Reject
13	My house is very noisy to learn mathematics therefore I cannot concentrate.	26	38	42	14	2.63	0.952	Accept
14	I don't have enough sleep at home therefore I can't study.	20	35	49	16	2.49	0.926	Reject
15	I eat balance diet therefore I can study effectively	25	49	33	13	2.72	0.918	Accept
	Grand Mean					**2.53**		**Accept**

Cut off Mean = 2.5

From table 3, items such having to many chores to do at home, parent do not assist me in learning mathematics, house is too noisy to learn mathematics among other were accepted because the means are above the criterion mean of 2.5, while items 10, 12, and 14 were rejected because means were below the criterion mean of 2.5.

The grand mean is 2.53 which show that the environmental factors listed in item 10 – 15 are accepted to affect the learning of mathematics at home.

Research Question 4: What are the environmental factors affecting the learning of mathematics at school?

TABLE 4: Mean scores responses on environmental factors affecting the learning of mathematics at school.

S/N	ITEM	SA	A	D	SD	MEAN	STD D.	DECISION
16	My classroom is very conducive to learn mathematics.	30	40	36	14	2.72	0.972	Accept
17	The teacher's personality motivates me to listen attentively in class.	53	41	17	9	3.15	0.932	Accept
18	The duration and time mathematics is taught is enough to cover all the contents	27	39	36	18	2.63	0.996	Accept
19	Mathematics textbooks help me to understand mathematics contents and do assignment with ease.	38	53	21	8	3.01	0.874	Accept
	GRAND Mean					**2.78**		**Accept**

Cut off Mean = 2.5

From table 4, items such as teacher personality the duration of teaching among other were accepted because the means are above the criterion mean of 2.5. No item was rejected because all the means were above the criterion mean of 2.5.

The grand mean is 2.78 which show that the factors listed in items 16 to 19 are accepted to influence the learning of mathematics at school.

Discussion of Findings

The study examined the Pre-service teachers' Conception of Mathematics in the University of Benin, Benin City, Edo State. The respondents were assessed based on four variables such as students' conception; pre-service teachers' conception, environmental factors affecting the influence of learning of mathematics both at home and in school.

From research question one, some students' conception towards the learning of mathematics such as; learning of mathematics is very easy, learning of mathematics is very difficult, mathematics is boring and tiring to learn, among others were listed and students were allowed to tick based on their ideas about the learning of mathematics. From the responses in each of the items, it was observed that majority of the students have negative conception towards the learning of mathematics, although a few numbers of them have positive conception towards the learning of mathematics.

For research question two, the grand mean was accepted and this shows that the majority of the learning factors listed such as, lecture method is effective, curriculum is too bulky, learning mathematics in the morning

helps students to understand better, among others influence pre-service teachers conception of mathematics.

Research question three examined the environmental factors influencing the learning of mathematics at home. Majority of the pre-service teachers accepted that the factors listed such as having too many chores to do at home, my parents do not assist in learning of mathematics, house is too noisy to learn mathematics, among others affect the learning of mathematics at home.

For research question four examined the environmental factors influencing the learning of mathematics at school. Majority of the pre-service teachers of mathematics accepted that the factors listed such as; teachers' personality, the duration of teaching, among others affect the learning of mathematics at school.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

This chapter presents the summary of findings, conclusion and recommendations made.

SUMMARY

Over the years, the conception of per-service teachers of mathematics and that of individuals towards the learning of mathematics has been poor. This is because they see mathematics as a difficult subject to learn. This has made many individuals to have little or no interest in learning mathematics. This research seeks to assess the conceptions of per-service teachers of mathematics in the Faculty of Education, University of Benin.

In order to do this, the following research questions were raised;

1. What are students' conceptions towards the learning of Mathematics?
2. What are the learning factors affecting the influence of pre-service teachers' conception of Mathematics?
3. What are the environmental factors affecting the learning of Mathematics at home?

4. What are the environmental factors affecting the learning of Mathematics at school?

A Survey Research Design was adopted for the study and questionnaire made up of two sections (A) and (B) was used to elicit responses from the respondents. The total populations of mathematics students in the University of Benin 2019/2020 are 550 which comprise the entire mathematics students in the Faculty of Education and the Faculty of Physical Sciences. A simple random technique was used and a total of 120 students were used for the investigation.

The Likert Scale of Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD) was scored 4, 3, 2, 1 respectively was used in mean ratio to the responds gathered.

The instrument was validated by my Project Supervisor and one other expert in the field of Mathematics Education before administering.

The following were the findings:

- The grand mean of 2.59 shows that the students conceptions towards the learning of mathematics listed such as; learning of mathematics is very easy, learning of mathematics is difficult,, mathematics is fun and boring to learn, and mathematics is boring

and tiring to learn were accepted by majority of the students as the conceptions of students towards the learning of mathematics.

- The grand mean of 2.82 shows that the learning factors listed such as; lecture method of teaching mathematics, the curriculum is too bulky, the environment for learning mathematics is conducive, and the use of good instructional materials were accepted by majority of the pre-service teachers' of mathematics.
- The grand mean is 2.53 which show that the environmental home factors listed such as; having too many chores to do, parents not assisting with learning of mathematics, having mathematics teachers at home, among others were accepted to influence the learning of mathematics by majority of the students.
- The grand mean 2.78 is accepted and implies that the majority of the students agreed to the factors listed such as; classroom not conducive, teachers personality, among others.

CONCLUSION

Based on the findings, the following conclusions were reached:

1. Lecture method of teaching mathematics is not effective because it only requires the lecturers to introduce the topic while the students have to study hard to understand the topic on their own.
2. Teachers' personality plays a great role in motivating students to listen attentively in class.
3. Learning mathematics in the morning helps students to understand mathematics better.
4. The use of good instructional materials helps students to understand mathematics better.
5. Most parents do not assist their children in learning mathematics at home.

Recommendations

Based on the findings, the researcher made the following recommendations;

1. Lecture method of teaching mathematics should be replaced with problem solving method as this will enable students to develop good study habits and reasoning powers, stimulates their thinking, helps improve and apply their knowledge and experience to real life situations.
2. Mathematics teachers should put on good behaviour in class as this helps to motivates students to listen attentively.
3. Periods of teaching mathematics should be fixed in the morning as this will enable students to understand mathematics better.
4. Mathematics teachers should make use of good instructional materials as this will help students to understand mathematics better.
5. Parents should monitor the progress of their children in mathematics, buy good mathematics textbooks, and hire mathematics teacher for them at home.

REFERENCES

Ball, D.L. (1993). With an eye on the mathematical horizon: Dilemmas of teaching elementary school mathematics. *Elementary School Journal 9,* p. 373-397.

Getahun, D. A., Adamu, G., Andargie, A., & Mebrat, J. D. (2016). Predicting mathematics performance from anxiety, enjoyment, value, and efficacy beliefs towards mathematics among engineering majors. Bahir Dar j educ, 16(1). Retrieved from https://www.researchgate.net/ publication/309703947

National Teachers' Institute (2004). Sociology of Education: A course book on Sociology of Education, Kaduna: NTA.

Beaton, A. E., Mullis, I. V., S., Martin, M. O., Gonzalez, E. J., Kelly, D. L., & Smith, T. A. (1996). *Mathematics achievement in the middle school years: IEA's Third International Mathematics and Science Study*. Chestnut Hill, MA: Boston College.

Beaton, A. E., & O'Dwyer, L., M. (2002). Separating school, classroom and student variances and their relationship to socioeconomic status. In D. F. Robitaille & A. E. Beaton (Eds.), Secondary analysisofthe TIMSS data (pp.2 11-231). Boston, MA: Kluwer Academic Publishers.

Bloom, B. (1976). *Human Characteristics and School Learning*. New York: McGraw Hill, Inc.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How People Learn: Brain, Mind, Experience, and School: Expanded Edition*. Washington, D.C.: National Academy Press.

Brophy, J.E. (1990). Teaching social studies for understanding and higher-order applications. *Elementary School Journal, 90* (351-417).

Broussard, S. C., and Garrison, M. E. B. (2004). The relationship between classroom motivation and academic achievement in elementary-school-aged children. *Family and Consumer Sciences Research Journal, 33*(2), 106-120.

Brown, C. A. (1985). A study of the socialization to teaching of a beginning secondary mathematics teacher. Unpublished doctoral dissertation. University of Georgia.

Brown, A.L., and Campione, J.C. (1994). Guided discovery in a community of learners. Pp. 229-270 in *Classroom Lessons: Integrating Cognitive Theory and Classroom Practice*, K. McGilly, ed. Cambridge, MA: MIT Press.

Carr, M. (1996). *Motivation in Mathematics*. New York: Hampton Press, Inc.

Cash, C. S. (1993). *Building condition and student achievement and behavior*. Unpublished doctoral dissertation. Virginia Polytechnic Institute and State University.

Campbell, P. B. (1995). Redefiningthe"girlproblem"in mathematics. In W. G. Secada, E. Fennema, & L. B. Adjian (Eds.), Newdirectionsforequity in mathematics education (pp. 225-241). Cambridge: Cambridge University Press.

Campbell, J.R.; & Beaudry, J.S. (1998). “Gender gap linked to differential socialization for high-achieving senior mathematics.” *Journal of educational research* 91, 140-147.

Campbell, J. R., Hombo, C. M., & Mazzeo, J. (2000). *NAEP 1999 trends in academic progress:Three decades of student performance.* Washington, DC: National Center for Education Statistics.

Cobb, P., Yackel, E., & Wood, T. (1992). A constructivist alternative to the representational view of mind in mathematics education. *Journal for Research in Mathematics Education 19*, 99-114.

Colakoglu, O., & Akdemir, O. (2008). *Motivational Measure of the Instruction Compared: Instruction Based on the ARCS Motivation Theory versus Traditional Instruction in Blended Courses.* Paper presented at the World Conference on Educational Multimedia, Hypermedia and Telecommunications 2008, Chesapeake, VA.

Coleman, J. S. (1966). *Equality of educational opportunity*. Washington, DC: U.S. Government Printing Office.

Darling-Hammond, L. (1997). School reform at the crossroads: Confronting the central issues of teaching. *Educational Policy 11*(2), 151-166.

Dursun, S. & Dede, Y. (2004). The Factors Affecting Students Success in Mathematics: Mathematics Teachers Perspectives. *Journal of Gazi Educational Faculty 24*(2), 217-230.

Epstein, J. L. (1987). Parent involvement: What research says to administrators. *Education and Urban Society, 19*, 119-136.

Epstein, J. L. (1991). Effects on student achievement of teachers' practices of parent involvement. In S.B. Silvern (Ed.), *Advances in readings/language research* (5th ed., pp. 261-276). Greenwich, CT: JAI Press.

Fennema, E., & Peterson, P. (1985). Autonomous learning behavior: A possible explanation of gender-related differences in mathematics. In L. C. Wilkinson & C. B. Marrett (Eds.), *Gender influences in classroom interaction* (pp. 17-35). New York: Academic Press.

Fennema, E., & Sherman, J. (1976, 1986). Fennema-Sherman mathematics attitudes scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. *JSAS Catalog of Selected Documents in Psychology, 6*(31).

Fluty, D. (1997). Single parenting in relation to adolescents' achievement scores. *Research Center for Families and Children, 6*, 4-8.

Gellert, U. (1999). Prospective elementary teachers' comprehension of mathematics instruction. *Educational Studies in Mathematics, 37*, 23-43.

Gray, M. (1996). Gender and mathematics: Mythology and misogyny. In G. Hanna (Ed.), Towards gender equity in mathematics education: An ICMI study (pp. 27-38). Boston, MA: Kluwer Academic Publishers.

Grossman, P.L., Wilson, S.M., & Shulman, L.S., (1989). Teachers of substance: Subject matter for teaching. Pp. 23-36 in *Knowledge Base for the Beginning Teacher*, M.C. Reynolds, ed. New York: Pergamon Press.

Harner, D. P. (1974). Effects of thermal environment on learning skills. *CEFP Journal (12),* 4-8.

Hopkins, K. B., McGillicuddy-De Lisi, A. V., & De Lisi, R. (1997). Student gender and teaching methods as sources of variability in children's

computational arithmetic performance. *The Journal of Genetic Psychology, 158*, 333-345.

Hull, J. (1990). Socioeconomic status and native education. *Canadian Journal of Native Education, 17*, 1-14.

Human Resources Development Canada, Statistics Canada, & Council of Ministers of Education Canada (2001). *Measuring up: The performance of Canada's youth in reading, mathematics and science*. Ottawa: Authors.

Hyde, J. S., Fennema, E. H., and Lamon, S. J. (1990). Gender Differences in Mathematics Performance: A Meta-Analysis. *Psychological Bulletin 107*, 139-55.

Hyde, J. S., Fennema, E., Ryan, M., Frost, L. A., & Hopp, C. (1990). Gender comparisons of mathematics attitudes and affect: A meta-analysis. *Psychology of women quarterly 14(3)*, 299-324.

Israel, G.D., Beaulieu, L.J., & Hartless, G. (2001). The Influence of Family and Community Social Capital on Educational Achievement. *Rural Sociology, 66 (1)*, 43-68.

Jensen, B. and Seltzer, A. (2000). Neighborhood and Family Effects in Educational Progress. *The Australian Economic Review, 33 (1)*, 17-31

Jeynes, W. H. (2002). Examining the Effects of Parental Absence on the Academic Achievement of Adolescents: The Challenge of Controlling for Family Income. *Journal of Family and Economic Issues, 23* (2), 189-210.

Kaeley, G. S., (1983). Explaining mathematics achievement of mature internal and external students at the University of Papua New Guinea. *Educational Studies in Mathematics, 25*(3), 251-260.

Kellaghan, T., & Madaus, G. F. (2002). Teachers' sources and uses of assessment information. In D. F.Robitaille & A. E. Beaton (Eds.), *Secondary analysis of the TIMSS data*. Boston, MA: Kluwer Academic Publishers.

Kifer, E. W. (2002). Students' attitudes and perceptions. In D. F. Robitaille & A. E. Beaton (Eds.), *Secondary analysis of the TIMSS data*. Boston: Kluwer Academic Publishers.

Kimball, M. M. (1989). A New Perspective on Women's Math Achievement. *Psychological Bulletin 105*, 198-214.

Knowles, M. (1975). *Self-Directed Learning: A Guide for Learners and Teachers*. New York: Association Press.

Lareau, A. (1987). Social class differences in family-school relationships: The importance of Cultural capital. *Sociology of Education, 60*, 73-85.

Lehrer, R., and Chazan, D. (1998). *Designing learning environments for developing understanding of geometry and space*. Mahwah, NJ: Erlbaum.

Libienski, S. T. & Gutierrez, R. (2008). *Bridging the Gaps in perspectives on Equity in Mathematics Education*. Journal for Research in Mathematics Education*, 39 (4)*, 365-371.

Lockheed, M.E., Thorpe, M., Brooks- Gunn, J., Casserly, P., & McAloon, A. (1985). *Sex and Ethnic Differences in Middle School Mathematics,*

Science and Computer Science: What Do We Know? Princeton, NJ: Educational Testing Service

Ma, X., & Klinger, D. A. (2000). Hierarchical linear modelling of student and school effects on academic achievement. *Canadian Journal of Education, 25*, 41–55.

Marjoribanks, K. (1996). Family learning environment and students‘ outcomes : A review. *Journal of Comparative Family Studies, 27*, 373-394.

Mills, C. J. (1997). *Gender differences in math/science achievement: The role of personality variables.* Paper presented at the 20th Annual Conference of the Eastern Educational Association, Feb. 1997, Hilton Head, South Carolina.

Mullis, I. V. S., Martin, M. O., Beaton, A., E., Gonzalez, E., J., Kelly, D., L., & Smith, T. A. (1997). *Mathematics achievement in the primary school years: IEAs Third International and Mathematics and ScienceStudy*. ChestnutHill,MA: BostonCollege.

Meece, J.L., Wigfield, A., & Eccles, J.S. (1990). Predictors of math anxiety and its influence on young adolescent’s course enrollment intentions and performance in mathematics. *Journal of Educational Psychology 82 (1)*, 60-70.

Mullis, I. V. S., Martin, M. O., Fierros, E. G., Goldberg, A. L., & Stemler, S. E. (2000). *Gender differences in achievement: IEA's Third International Mathematics and Science Study.* Chestnut Hill, MA: Boston College.

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

Oakes, J (1990). Opportunities, Achievement, and Choice: Women and Minority Students in Science and Mathematics. *Review of Research in Education 16*,153-222.

Rasmussen, C. & Marrongelle, K. (2006). Pedagogical Content Tools: Integrating Student Reasoning and Mathematics in Instruction. Journal for Research in Mathematics Education*, 37 (5)*, 388-420.

Reigeluth, C., M. (1983). *Instructional-Design Theories and Models: An Overview of Their Current Status*. Lawrence Erlbaum Associates: New Jersey

Reyonds, D., Bollen, R., Creemers, B., Hopkins, D., Stoll, L., & Lagerweij, L. (1996). *Making good schools: Linking effectiveness and school improvement.* London: Routledge.

Rivera-Batiz, F. L. and Marti, L. (1995). *A school system at risk: A study of the consequences of overcrowding in New York City public schools.* New York: Institute for Urban and Minority Education, Teachers College, Columbia University.

Romberg, T.A. (1983). A common curriculum for mathematics. Pp. 121-159 in *Individual Differences and the Common Curriculum: Eighty-second Yearbook of the National Society for the Study of Education, Part I*. G.D. Fenstermacher and J.I. Goodlad, eds. Chicago: University of Chicago Press.

Rosebery, A.S., Warren, B., & Conant, F.R. (1992). Appropriating scientific discourse: Findings from language minority classrooms. *The Journal of the Learning Sciences* 2(1), 61-94.

Saritas, M. (2004). Instructional Design in Distance Education (IDDE): Understanding the Strategies, Applications, and Implications. In C. Crawford et al. (Eds.), *Proceedings of Society for Information Technology and Teacher Education International Conference 2004* (pp. 681-688). Chesapeake, VA: AACE.

Schauble, L., Glaser, R., Duschl, R., Schultz, S., & John, J. (1995). Students' understanding of the objectives and procedures of experimentation in the science classroom. *The Journal of the Learning Sciences, 4*(2), 131-166.

Scheffler, I. (1975). Basic mathematical skills: Some philosophical and practical remarks. In *National Institute of Education Conference on Basic Mathematical Skills and Learning, Vol. 1*. Euclid, OH: National Institute of Education.

Schiefele, U. & Csikszentmihalyi, M. (1995). Motivation and ability as factors in mathematics experience and achievement. *Journal of Research in Mathematics Education, 26*(2), 163-181.

Stevenson, D. L., & Baker, D. P. (1987). The family-school relation and the child's school Performance. *Child Development, 58*, 1348-1357.

Strommen, E., F., & Lincoln, B. (1992). *Constructivism, Technology, and The Future of Classroom Learning.* Children's Television Workshop.

Thompson, A. G. (1992). Teachers' beliefs and conceptions: A synthesis of the research. Pp. 127-146 in *Handbook of Research in Mathematics Teaching and Learning,* D.A. Grouws, ed. New York: Macmillan.

Warren, B., & Rosebery, A (1996). This question is just too, too easy: Perspectives from the classroom on accountability in science. Pp. 97-125 in the *Contributions of Instructional Innovation to Understanding Learning*, L. Schauble and R. Glaser, eds. Mahwah, NJ: Erlbaum.

Wilson, M. (1990a). Investigation of structured problem solving items. Pp. 137-203 in *Assessing Higher Order Thinking in Mathematics,* G. Kulm, ed. Washington, DC: American Association for the Advancement of Science.

Wilson, M. (1990b). Measuring a van Hiele geometry sequence: A reanalysis. *Journal for Research in Mathematics Education 21,* 230-237.

Wilson, B. G. (Ed.). (1996). *Constructivist learning environments: Case studies in instructional design*. Englewood Cliffs, NJ: Educational Technology Publication.

APPENDIX

DEPARTMENT OF CURRICULUM AND INSTRUCTIONAL TECHNOLOGY,
FACULTY OF EDUCATION,
UNIVERSITY OF BENIN, BENIN CITY.

Dear Respondent,

This questionnaire is designed to elicit information about pre-service teachers' conceptions of Mathematics. Please, your cooperation is humbly requested in responding to the questions and note that your responses will be treated with utmost confidentiality and only for research purposes.

Yours faithfully,

Rukevwe Jerome Ekpamaku

SECTION A: DEMOGRAPHIC DATA

Instruction: Please, kindly tick the appropriate options in the box below.

Sex: Male ( ) Female ( )

SECTION B:
Keys: SA: Strongly Agree, A: Agree, D: Disagree, SD: Strongly Disagree

S/N	ITEMS	SA	A	D	SD
	What are students' Conceptions towards the learning of Mathematics?				
1.	Learning of mathematics is very easy.				
2.	Learning mathematics is difficult.				
3.	Mathematics is fun and interesting to learn.				
4.	Mathematics is boring and tiring to learn.				

	What are the learning factors affecting the influence of pre-service teachers' conception of Mathematics?				
5.	Lecture method of teaching mathematics is effective.				
6.	The curriculum is too bulky therefore It is difficult to comprehend.				
7.	The environment for learning mathematics is conducive.				
8.	The use of good instructional materials helps me to understand mathematics better.				
9.	Learning mathematics in the morning helps me to understand better.				
	What are the environmental factors affecting the learning of Mathematics at home?				
10.	I have too many house chores to do therefore I cannot do my assignment.				
11.	My parents do not assist me in learning mathematics.				
12.	I have a mathematics teacher at home that helps me with my assignment.				
13.	My house is very noisy to learn mathematics therefore I cannot concentrate.				
14.	I don't have enough sleep at home therefore I can't study.				
15.	I eat balance diet therefore I can study effectively.				
	What are the environmental factors affecting the learning of Mathematics at school?				
16.	My classroom is very conducive to learn mathematics.				
17.	The teacher's personality motivates me to listen attentively in class.				
18.	The duration and time mathematics is taught is enough to cover all the contents.				
19.	Mathematics textbooks help me to understand mathematics contents and do assignment with ease.				