SURVEY OF COLLEGES OF EDUCATION PRIMARY PRE-SERVICE TEACHERS MATHEMATICAL CREATIVITY ABILITY AND THE LEARNING OF MATHEMATICS

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Abstract
The study investigated primary pre-service teachers' mathematical creativity ability and the learning of Mathematics. The study adopted a descriptive survey research design. The population consisted of all primary pre-service teachers in Emmanuel Alayande College of Education, Oyo. One hundred (100) primary pre-service teachers randomly selected were involved in the study. Two research questions were raised to guide the process of this study. An adapted questionnaire from Balka (1974) tagged "Mathematical Creativity Ability Questionnaire" (MCAQ) was validated by experts with reliability coefficient of 0.82 using Crobach Alpha was used for data collection. Data generated was analysed using descriptive statistics, frequency count, mean score, standard deviation and t-test. The results show that primary pre-service teachers have mathematical creativity ability expected of them. Also, there was a significant difference between the perception of male and female primary pre-service teachers' mathematical creativity ability. It is therefore suggested among other things that Mathematics educators should prepare students to develop their Mathematical Creativity competencies.

Keywords: Mathematics, Creativity, Ability, Primary, Pre-service teachers

Introduction

Mathematics is a compulsory subject in schools, from basic education to higher education and is a subject that contains many concepts and principles that are difficult to understand, besides it involves formulae and calculations. Mathematics is a science of magnitude and number that is very useful virtually in all subject areas. All fields of studies are dependent on Mathematics for problem solving and prediction of outcomes. Mathematics relates to a person's knowledge, beliefs, and other intellectual symbols. Many students are scared of Mathematics and feel intimidated with mathematical ideas because they consider Mathematics as a difficult subject.

Ali & Mohammad (2017) opined that the aim of teaching Mathematics, which should begin from pre-primary ages, is to gain social and psychological value in addition to intellectual development. Acquiring Mathematics skills is not only important for those students planning to attend college but

also for students who are not seeking further education beyond high school. People who resort to learning a trade because of their inability to make the required grade for further studies end up using Mathematics as an important tool for performing their duties in their work places.

Pre-service teacher trainees are the future basic school teachers; they will be expected to teach Mathematics to other young ones and it is necessary to inquire of their confidence levels in solving Mathematics problems. There is need for pre-service teachers to understand and promote teaching and learning activities that can facilitate and enhance learning in the classroom. Bayturan & Kesan (2012) emphasised that students would learn better if they were engaged in significantly appealing activities in Mathematics. Pede & Dennis (2021), submitted that teachers might also incorporate activities into their Mathematics curriculum that demand students to present various clearly defined solutions to improve students' creative potential.

The ability to think creatively is one of the abilities students must possess in learning Mathematics. This creative ability allows students to solve problems with various solutions which influence their achievement. Pre-service programs have to explicitly explore with students what it means to be creative for future teachers to be able to improve their students' mathematical creativity. Primary pre-service teachers are supposed to provide appropriate classroom atmosphere for creativity in Mathematics education, since it is well acknowledged that basics of creative thought are developed at the earlier ages of primary education (Leikin & Pitta-Pantazi, 2013). This is also supported by Ardiansyah, Junaedi & Asikin (2018) that a successful teacher encourage, supports, and assists students in developing their creative thinking and use instructional methods which will enhance students' creative ability. Therefore, pre-service teacher education programs have to be much more explicit in discussing with the prospective teachers what it means to promote pupils' creative ability in Mathematics at primary level of education and in what ways this can be done.

Pre-service teacher mathematical creativity is the ability of primary pre-service teachers to make or bring into existence something new, whether a new solution to a problem, a new method or device or a new artistic object or form that would be: fluent, flexible, original and motivated for creativity to produce ideas that are both novel and valuable. Suyitno (2020) also submitted that to prepare the students future teachers, they need to grow their mathematical creativity competencies. Mathematical creativity is an ability to analyse a given problem from different perspective, and to see patterns, similarities and differences, generate multiple ideas and choose a proper method to

deal with unfamiliar mathematical situations (Idris & Nor, 2010). To be creative in Mathematics, students should be able to pose mathematical questions that extend and deepen the original problem as well as solve the problem in a variety of ways. The ability to think creatively in the field of Mathematics needs to be developed so that learners have high creativity ability in solving mathematical problems, thus Mairing (2016) maintained that creativity ability is a benchmark of the success of learners in learning. In order to enhance creativity in students, teachers should serve more as facilitators, learning partners, inspirers or navigators than as lecturers. Since solving problems is a major feature of Mathematics, the role of creativity in Mathematics could not be denied and Sriraman (2004) claimed that students can be creative if they are engaged in challenging mathematical problems. A creative act in Mathematics could consist of: creating a new fruitful mathematical concept; discovering an unknown relation; and reorganizing the structure of a mathematical theory. In Mathematics, creative ability occurs when students generalise. Generalising involves identifying common properties or patterns across more than one case and communicating a rule (conjecture) to describe the common property, pattern or relationship. In order to generalise, students need to first analyse the problem to notice things that are the same or different, notice things that stay the same and things that change, or order examples to notice patterns and expressing the common property or pattern noticed.

Wahyudi, Stefanus, Rochmad and Hardi, (2018) perceived that the ability to think creatively leads to the acquisition of new insights, new approaches, new perspectives, or new ways of understanding issues that include aspects of fluency, flexibility, originality and elaboration.

Fluency is the ability of students to produce various answers correctly within a short time; it refers to the number of relevant ideas produced in a set period of time. It is students' ability to solve problems in accordance with what is required and the ability to translate the story into Mathematics language and then able to pour many ideas in solving the problem. Flexibility is the ability of students to generate various ideas and approaches to solve problems for each answer. It refers to the range of categories corresponding to ideas generated by a test-taker, students' ability to compile a variety of questions or look at a problem from a different point of view. Originality is the ability of students to use a new, unique, or unusual strategy to solve problems correctly, it refers to the generation of ideas not produced by other test-taker and is based on problem solving ideas that are original ideas of students that are different from others and show their own language style in solving the problem.

Elaboration is the ability of the students to explain sequentially in detail and coherently; based on certain mathematical procedures, answers, or mathematical situations; it refers to details and development depth of ideas generated. It involves students' ability to develop a problem-solving idea in detail, based on agreed concepts.

Pronita (2019), proposed five ways to add creativity in Mathematics: Make problems open-ended by giving students' open-ended problems where multiple solutions are possible, as opposed to the traditional one right answer problems, allow students to experience the first stages of mathematical creativity. Traditional mathematical problems can be converted into open-ended problems relatively easily; by making the problem to have open-ended nature style, the problem allowed students to compute multiple options and use additional strategies in picking their final design. Have students create their own problems by problem finding, or problem posing, in any domain, is considered to be an important and integral aspect of creativity. For this activity, students are asked to come up with as many different problems as they can with a given situation. Mathematical problems that challenge students to think in different ways help build divergent thinking skills. Divergent thinking is often used as a strategy to generate multiple creative ideas, and is regarded as an important component for mathematical creativity by contrasting convergent thinking, which is a technique that organizes structures and various ideas from different participants and attempts to culminate them into one best solution to a question. Overcome fixation is a key aspect of creativity that helps to break free from routine patterns of thinking (flexible thinking). By forcing students to drop their established mind-sets helps them in examining a problem from different perspectives and arriving at better solutions. Encourage analogical thinking is often considered relevant in the scientific domain, it is a cognitive skill that underlies creative ability and is equally relevant in Mathematics and other fields.

According to Rubenstein (2000) creativity has been approached from four dimensions which are: the person or the creator, the process of creating, the product created and the press/ place (environment) in which creation takes place.

The scientific studies of creativity focused on four major characteristics of creative behaviour are the 4P's of creativity identified by Rhodes (1961); which are: Person is study of the creative persons to identify their personal characteristics. They are tested with various personality and intellectual instruments, interest inventories and interviews to identify their characteristics and peak

periods of creative productivity. Process involves phases, theories, steps, procedures, techniques, mechanisms involved in the process of creativity. Product has to do with the creative outcome, such as inventions and discoveries. It focuses on what constitutes a creative idea, how potentials can be measured and what differentiate creativity from intellectual skills and abilities. Press/Place concerns environment which may promote or hinder the development of person or organisation.

Students' creative ability is the capacity to generate original solution to a problem and critical for Mathematics accomplishment, because it enables students to address difficulties encountered in everyday life (Suparmi, Nugraheni, Budiyono, Slamet, Nugraheni, Budiyono, Slamet, Firmasari and Santi, 2017). Ombay & Roble (2020) found that creative ability in Mathematics has a positive effect on the learners, and promotes students' achievement and conceptual understanding. To stimulate mathematical creativity ability in students, then mathematical problems need to be given to students is the problems that have an open ended character and who are relatively more difficult. Bahar & Maker (2011) examined exploring the relationship between mathematical creativity and mathematical achievement and found significant relationships among all the measures of creativity (fluency, OFE, and TMC) and between all the indices of creativity and both the measures of Mathematics achievement.

According to Fonseca & Arezes (2017), with mathematical creativity, a person will have the ability to reason, understand, and be able to make complex choices namely understanding the interconnection between systems, compiling, expressing, analyzing, and solving problems. So, to increase mathematical creativity ability through Mathematics education, students need to be accustomed to solving mathematical problems whose solutions require the ability to reason, understand, and be able to make complex choices namely understanding the interconnection between systems, composing, expressing, analyzing, and solving problems with various alternatives. Creativity ability is critical in Mathematics because creativity is an inherent aspect of Mathematics. According to Habibollah, Rohani, Tengku and Jamaluddin (2010) in a study on relationship between creativity and academic achievement: A study of gender differences reported that aspects of creativity are related to academic achievement for both males and females and therefore canvassed for inclusion of creativity in the schools' curricula. In another view, Surapuramath (2014) conducted study on the relationship between creativity and academic achievement found that there is no significant difference in creativity of students between boys and girls.

This study therefore investigates the influence of mathematical creativity ability of primary pre-service teachers' in learning Mathematics and the perception of mathematical creativity ability of primary pre-service teachers based on gender.

Statement of the Problem

The Mathematics concepts arise from the child's minds during the pre-primary or pre-school period and as one of the most established disciplines that is included in every curriculum worldwide, understanding of Mathematics is competency for accuracy, consistency, develop pupils' computational skills, reasons, ability to think logically, and its knowledge is very essential in everyone's life because it is useful in our day-to-day activity. Despite the great importance of Mathematics in human development, it is the only subject that is most dreaded to learners among all subjects offered in schools. This problem affects the learning of the subjects thus resulting to low level of commitment and poor performance, which therefore call for attention of Mathematics educators. There are literatures on mathematical creative thinking ability, but to the best of the knowledge of the writer, studies exist on mathematical creativity among students but not among the primary pre-service teachers. It is on this basis that this study examined primary pre-service teachers' mathematical creativity ability and the learning of Mathematics.

Research Questions

1. What is the influence of mathematical creativity ability of primary pre-service teachers' in learning Mathematics?
2. Is there any significant difference in the perception of mathematical creativity ability of male and female primary pre-service teachers?

Methodology

The study adopted a descriptive survey research design to investigate the mathematical creativity ability of primary pre-service teachers in learning Mathematics. Primary pre-service teachers in Emmanuel Alayande College of Education, Oyo comprised the population of the study. Through random sampling technique a total of one hundred (100) primary pre-service teachers were selected from the population.

The instrument used in the study was adapted questionnaire from Barka (1974), tend to focus on beliefs about one's creative ability which is Mathematical Creativity Ability Questionnaire (MCAQ). The face and content validity of the instrument were determined by expert from mathematics education. The instrument was trial tested and the data collected were used to compute reliability coefficient using Cronbach Alpha which yielded a reliability coefficient of 0.82. Data collected were analysed using frequency count, mean, standard deviation and t-test statistics at 0.05 level of significant.

Results

Research Question 1: What is the influence of mathematical creativity ability of primary pre-service teachers' in learning Mathematics?

Table 1

Mean and standard deviation of creativity ability levels of primary pre-service Teachers' in Mathematics

Mathematical Creativity Ability	N	Mean	Standard Deviation
Low	25	6.10	1.90
Medium	37	7.34	2.57
High	38	7.47	2.63

Table 1 reveals that low creativity ability students recorded a mean of 6.10 with a standard deviation of 1.90, medium creativity ability groups of student obtained a mean score of 7.34 with a standard deviation of 2.57 and the high creativity ability students had a mean of 7.47 and standard deviation of 2.63. Comparatively, the high creativity ability students had the highest achievement mean score followed by the medium creativity ability students and the last low creativity ability students. The difference in the performance mean scores is an indication that mathematical creativity ability had influence primary pre-service teachers' performance in Mathematics.

Research Question 2: Is there any significant difference in the perception of mathematical creativity ability of male and female primary pre-service teachers?

Table 2:

t-test showing the difference between male and female primary pre-service teachers' in their perception of mathematical creativity ability

Variables	N	Mean	SD	T	df	Sig(p)
Male	37	26.00	3.00	4.16	98	.000
Female	63	23.43	3.58			

Table 2 reveals that male pre-service teachers had a higher mean score in their eight ability. This means that male pre-service teachers viewed that they possessed mathematical creativity ability, but female pre-service teachers do not.

Discussion of Findings

It is evident from the outcome of the finding that majority of the pre-service teachers have mathematical creativity ability expected of them since the mean scores of high mathematical creativity ability students is higher than the mean scores of medium and low mathematical creativity ability students. The findings of the study is in agreement with the findings of Ombay & Roble (2020) who found that creative ability in Mathematics has a positive effect on the learners, and promotes student achievement and conceptual understanding. It is also in consonance with Bahar & Maker (2011) who examined exploring the relationship between mathematical creativity and mathematical achievement and found significant relationships between all the indices of creativity and measures of Mathematics achievement. In Mathematics, the ability to think creatively is the capacity to generate an original solution to a problem, therefore Suparmi, Nugraheni, Budiyono, Slamet, Nugraheni, Budiyono, Slamet, Firmasari & Santi, (2017) in their study reported that students' capacity to think creatively is critical for Mathematics accomplishment because it enables students to address difficulties encountered in everyday life. The capacity to think creatively is one of the keys to success in Mathematics. Mathematics requires a great deal of creativity and is believed to be the ability to think creatively. Hence, students are to be involved in activities that develop critical thinking that facilitates learning of important mathematical concepts and processes. According to Suyitno, (2020), to prepare the students future teachers, they need to grow their Mathematical creativity competencies. Having high mathematical creativity, it is hoped that students can use it to solve problems in their lives since

Mathematics has a relationship with the real world and humans will not be able to master the world if humans do not master Mathematics. To foster mathematical creativity through Mathematics education, students need to be accustomed to solving mathematical problems, whose solutions require the ability to reason, understand, and be able to make complex choices, composing, expressing, analysing, and solving problems with various alternatives.

Also, a significant difference between the perception of male and female primary pre-service teachers was revealed in the study. This implies that gender has significant influence on primary pre-service teachers' perception of mathematical creativity ability. This corroborates the findings of Habibollah, Rohani, Tengku and Jamaluddin (2010) who reported that gender differences aspects of creativity are related to academic achievement for both males and females and therefore canvassed for inclusion of creativity in the schools' curricula. In contrary to the study, the study of Surapuramath (2014) conducted on the relationship between creativity and academic achievement found that there is no significant difference in creativity of students between boys and girls.

Conclusion

From the findings of this study, it could be concluded that primary pre-service teachers have mathematical creativity ability expected of them. The findings also established a significant difference between the perception of male and female primary pre-service teachers. Therefore, mathematical creativity ability is essential to improve primary pre-service teachers learning of Mathematics.

Recommendations

Based on the findings of this study, the writer recommends that courses and curricula in Mathematics learning should provide opportunities for learners to improve their creative ability.

- Mathematics educators should incorporate tasks into the Mathematics curriculum that is capable of developing their creative potentials.
- Educators should prepare students to develop their Mathematical creativity competencies.
- Pre-service primary teachers should be challenge to use their mathematical creativity to solve problems.
- Government should make efforts to restructure Mathematics education programmes to develop mathematical creativity ability of students to be skilled in proving, able to be innovative and have good reasoning.

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