

# Innovations

## **Influence of beginning teachers development of mathematical knowledge for teaching on students achievement in mathematics in Delta State.**

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**Abstract:** *The study investigated the influence of beginning teachers development of mathematical knowledge for teaching on students achievement in mathematics in Delta State. For the course of the study, two research questions were raised and two research hypotheses were formulated. The study employed descriptive research design using three hundred (300) students and ninety (90) beginners teachers make it a total of three hundred and ninety (390) respondents as sample size. The study used both teachers and students questionnaires as well as lesson observation as instrument to collected. Stratified sampling technique was used to chose the respondents. The collected data were analyze using mean/standard deviation and Chi-square statistical test. The mean/standard deviation were used to answer the research questions and Chi-square test were used for testing research hypotheses at 0.05 level of significance. The results of the test revealed that; there was a significant influence of mathematical knowledge needed by teachers beginning teachers and students achievement in mathematics and there was significant influence between teacher development of mathematical knowledge and student achievements in Mathematics. based on these results, the study recommended that; beginning mathematics teachers are encourage to update their mathematical knowledge so that they become effective, knowledgeable, productive and efficient for teaching mathematics to enhance students achievement.*

**Keywords:** *Beginning Mathematics Teachers, Mathematical Knowledge, Teacher Development, Students Achievement*

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## Introduction

The aims of teaching and learning of mathematics focuses on enabling the learners to acquire and develop thinking and ability to solve real problems. Also, the aims of teaching and learning of mathematics is to prepare learners with a sound foundation needed in various professions such as engineering, banking, accounting, as well as scientist, statisticians etc. Therefore, mathematics should be aim at preparing the learners for higher learning in mathematics (MoE, 2013). To achieve these goals for teaching and learning of mathematics, beginner teachers must be must explore various instructional skills, professional development and strategies for teaching mathematics (Ijeh, 2013), so that learners can learn and understand during classroom practices. But, it is unfortunate that beginning teachers are facing many challenges in development mathematical knowledge to achieve the aims of teaching and learning of mathematics. On the account of this, Shulman (1987); Plotz (2007) and Ibeawuchi (2010) noted that there are certain mathematical knowledge that is necessary for beginning teachers in teaching mathematics. Amongst these categories of knowledge are; subject matter content knowledge, curriculum knowledge for teaching, knowledge of relevant instructional strategies, knowledge of learners' conceptions and Knowledge of learners' learning difficulties (Shulman, 1986; Ijeh, 2013).

The term "beginning teacher" means "a teacher in a public or private school who has been teaching less than a total of three complete years. Beginning teachers can also refers to teachers with teaching experience between 0-5 years. Sometimes, beginner teachers felt ill-prepared to cope with all the challenges in and around the classroom. Beginners teacher lacked classrooms management skills and they found it difficult to deal with learners with socio- behavioural problems which lead to weak academic performance. Teacher development and knowledge for beginning teachers has become crucial that teachers acquire the knowledge, skills, and eventually the confidence to work with learners with social behavioural problems (Dorothy & Rouaan, 2021). Beginning teacher's lack of confidence in his /her classroom management skills as knowledge can be a major deterrent to his or her ability to be an effective instructor.

Teachers are expected to play new roles as part of the system reform efforts. For this reason, teachers' development provides opportunities for teachers to explore new roles, develop new instructional techniques, refine their practice and broaden themselves both as educators and as individuals. Teachers' development is that component of any educational system concerned with the education and training of teachers to acquire the necessary competencies and skills in teaching for improvement in the quality of teachers in the school system (Afe, 1995). It is often planned and systemically tailored and applied for the cultivation of those who teach or will teach, particularly but not exclusively in primary and post primary schools (Okafor, 1998). Continuing professional education is therefore conceptualised as a process for development of skills for coping with changing demands of the job through regular exposure to professional update programmes (Miefa, 2004).

Teacher (professional) development involves a continuous process of reflection, learning and action to further a teacher's knowledge and skills, leading to enhanced teaching practices that positively impact on students' learning. Darling-Hammond, Hyler and Garner (2017) teacher professional development refers as structured professional learning that leads to changes in teacher practices and improved student learning outcomes. Teacher development training can help teachers to become better at planning their time and staying organized. Teacher development aims to improve teachers and their practice by adopting a holistic approach to developing the teacher as a professional practitioner. It is an ongoing process that supports continuous development of practice throughout the whole of a teacher's career (Creemers & Kyriakides, 2013). Teacher development can be regarded as the activities and programmes (formal or informal) exposed to teachers to learn about responsibilities, develop required skills and competencies necessary for the attainment of quality education (Awodiji, 2018). The teacher development activities also enhance teachers to grow professionally so as to prepare themselves for advancement in the classroom and beyond (Awodiji, 2018). It is a model of developing teachers' personal and institutional skills, knowledge and abilities which include training, career development, coaching, and mentoring (Awodiji, 2018). Therefore, effective teacher

professional development can positively impact teachers' practice and substantially improve learners achievement.

Knowledge of instructional strategies includes two dimensions in terms of knowledge of subject specific strategies and knowledge of topic specific strategies. Knowledge of subject specific strategies is broader than knowledge of topic specific strategies. Knowledge of subject specific strategies are suitable for science teaching generally; however, knowledge of topic specific strategies represents particular topics in science teaching. Knowledge of subject specific strategies is parallel with "orientations to teaching science". These general instructions serve to realize goals of particular orientations. Best known subject specific strategies are "learning cycle" that is used for discovery, inquiry and conceptual change-oriented instruction. Knowledge of topic specific strategies is another sub-dimension of knowledge of instructional strategies. Knowledge of topic specific strategies also comprehends two subunits with respect to topic specific representations and topic specific activities. Topic specific representations are used to facilitate students' learning on specific concepts or principles. Some of these representations are illustrations, examples, models and analogies. Teachers need to know each representations strengths and limitations during the instruction of topic. Teachers can answer students' questions and use different representation in specific topic with the help of their improved SMK. However, improved SMK doesn't guarantee to develop teacher PCK. Topic specific activities are used for students' better understanding of specific concepts or relationships. Some of these activities are problems, demonstrations, simulations, investigations, and experiments (Magnusson et al., 2019).

The content knowledge is the core knowledge of teacher in particular subject and specific content area. For many years, some researchers focused on the discussion that teachers' content knowledge impacts students' achievement. Those studies found that the lack of teachers' knowledge should find the difficulties of the teaching-learning process (Washburn, et al, 2020). Darling Hammond stated that teachers' content knowledge is the fundamental requirement for an effective teaching (Darling-Hammond, 2018). Furthermore, content knowledge of teachers influences the teaching-learning process, and it makes the substantial effect for learners' achievement.

The curriculum knowledge consists of knowledge of different programs and corresponding materials available for teaching the given content. It goes beyond an awareness of the different programs and materials to also include knowledge of the effectiveness and implications of programs and materials for given contexts. It entails knowledge of content and corresponding materials in other subject areas of students and consists of knowledge of how topics are developed across a given program (Shulman, 1986). Knowledge of curriculum consists of two different categories in terms of mandated goals and objectives, and specific curricular programs and materials. Knowledge of goals and objectives shows a teacher's knowledge of objectives about selected topic for students placed in curriculum. In addition, teachers are supposed to know previous years related objectives and goals about selected topic and following years' objectives for particular grade. This curricular knowledge is vertical dimension of knowledge of goals and orientation. Next, knowledge of specific curricular programs consists of different kinds of curricular programs and materials that are compatible for teaching specific topic like textbooks, articles, lab materials, internet etc. (Magnusson et al., 2019). The teacher must know what the curriculum required that is materials and strategies for effective teaching and learning process.

Pedagogical knowledge includes knowledge of teaching procedures such as effective strategies for planning, classroom routines, behavior management techniques, classroom organizational procedures, and motivational techniques. Pedagogical Knowledge (PK): Pedagogical knowledge (PK) is another element inside PCK. The knowledge is related to the ability of teachers in delivering the effective teaching and learning atmosphere for all learners. Shulman says that pedagogical knowledge is the knowledge, theory, and belief about the act of teaching and the process of learning, which it figures the teacher's approaches in delivering a subject in the classroom. The learning process also provides all activities from developing the materials, classroom management, learning habit, problem-solving, methodology, strategy, and assessment (Hudson,

2017). The successful of these events determines the improvement of students learning outcomes. The experience in teaching would be a factor for teachers in developing the aptitude of PK. For instance, Gatbonton has tried to compare between experience and novice teachers in their pedagogical knowledge. He found that the pedagogical knowledge between the two groups is similar. However, the experience teachers have the more detailed pedagogical knowledge, especially in recognizing students' attitudes and behaviours (Gatbonton, 2018). It means that teachers' educational background provide the development of teachers knowledge in teaching a subject. Further, the experience will strengthen the knowledge to make teachers more professional in their field.

The knowledge of learners' conceptions is also needed by beginners teacher to improve students achievement as well as their teacher professions. Learners concept of learning is refers to learners ideas and beliefs about learning.

Knowledge of learners' learning difficulties is another component of mathematical knowledge and development of teacher. According to Penso (2002), learners consider their learning difficulties to be due to conditions prior to the process of teaching and those existing in the course of teaching. While the aspect of lesson content relates to the level of difficulty and abstraction of the topic, the teaching, lesson preparation and implementation aspects are concerned with the structure and presentation of the lesson (Cazorla, 2006). Negative lesson structure conditions include overloading content and unsatisfactory sequences in the lesson. Negative lesson presentation conditions include inappropriate instructional strategies for presentation, and not contributing to the process of learning. Negative cognitive and affective characteristics entail lack of prior knowledge about a topic that would enable learners to cope with the lesson in a meaningful way, preconceptions developed by the learners because of previous experiences, partial and inconsistent thinking, and lack of motivation and concentration. These negative cognitive and affective characteristics may result in learning difficulties in a teaching and learning situation if the teacher does not have adequate prior content knowledge of the topic. Penso (2002) findings showed that learning difficulties could be identified and described during teaching and by observing lessons. Penso (2002) claimed that these difficulties may originate from the way the lessons are taught, which involves the content of the lesson, lesson preparation and implementation, and the learning atmosphere. Other factors include the misconceptions that the learners and the teachers have about the topic, and the cognitive and affective characteristics of the learners. Cazorla (2006) researched the way mathematics teachers teach statistics in elementary and secondary schools and teacher training colleges, and reported that mathematics teachers seemed to encounter some difficulties during teaching. According to this author, misconceptions and the way mathematics lessons are taught are among the factors that contribute to learners' learning difficulties in statistics. In addition, most statistics teachers do not have adequate knowledge of the curriculum and the necessary approaches to the teaching and learning of statistics. This leads to poor content delivery in the classroom, and consequently affects learners' performance. To this effect, this seek to investigate the influence of beginning teachers development of mathematical knowledge for teaching on students achievement in mathematics in Delta State.

### **Statement of the Problem**

Despite the importance of education to the society and economic growth of national development, mathematics students are in greater risk of poor academic achievement in internal and external examinations. Despite all the efforts made to ensure effective teaching and learning of mathematics at the secondary school level in Nigeria, the problem of students' poor achievement in mathematics in internal and external examination have remained unsolved due to inexperience (beginners) mathematics teachers. Report from chief examiner on the overall performance of mathematics students in Nigeria, is still pointing out their weakness and failure. This weakness or decline of students' performance is evidence in WASSC results released between the years 2016 to 2020. Examining these results enables science educators to understand how students are doing well or bad in the subject area. To improve on the performance of mathematics students and achieve the laudable objectives of teaching and learning of mathematics, there is a need to

provide professional development for mathematics teachers to improve their level of teaching for effectiveness thereby enhancing students' achievement.

In light of the above issues the outstanding and relevant question is; what is the Influence of beginning teachers development of mathematical knowledge for teaching on students achievement in mathematics in Delta State.

**Research questions**

- What are the mathematical knowledge needed by teachers beginning teachers?
- Does teacher development of mathematical knowledge influence student achievements in Mathematics?

**Research Hypotheses**

**H<sub>01</sub>:** There is no significant influence of mathematical knowledge needed by teachers beginning teachers and students achievement in mathematics

**H<sub>02</sub>:** There is no significant influence between teacher development of mathematical knowledge and student achievements in Mathematics.

**Purpose of the Study**

- To find out the mathematical knowledge needed by teachers beginning teachers for teaching.
- To find out if teacher development of mathematical knowledge influence student achievements in Mathematics.

**Methodology of the Study**

**Design of the study**

The study employed descriptive survey research design because it is suitable to this study using questionnaire on the Influence of beginning teachers development of mathematical knowledge for teaching on students achievement in mathematics in Delta State.

**Population of the Study**

The population of the study covers all senior secondary school two (SSS II) that offering mathematics in Delta State. There are about five thousand (5,000) students in the area of the study.

**Sample and Sampling Technique**

The sample size of the study was three hundred and ninety (390) mathematics students using stratified sampling technique. The study sample were consists of ninety (90) beginners mathematics teachers and three hundred (300) SSS II mathematics students. This stratified sampling techniques method was used to choose three senatorial Districts in Delta State; Delta North, Delta South and Delta Central. Furthermore, this method were used to select thirty beginners mathematics teacher and one hundred students from each senatorial districts. Also, thirty (30) secondary schools were chosen from each Senatorial Districts in Delta State. Furthermore, hundred and ninety (190) respondents were selected from each Senatorial District of Delta State. The summary of the sample size is given below:

S/N	Senatorial District	Beginners Mathematics Teacher	Mathematics Teacher
1	Delta Central	30	100
2	Delta South	30	100
3	Delta North	30	100
	Total	<b>390</b>	

### **Research Instrument**

The instruments that will be used in this study are part A: beginners mathematics teachers, part B: mathematics students questionnaires and part C: lesson observation. The part A which is Beginners Mathematics teachers questionnaire is divided into two major sections, A and B. Section A seeks demographic information of the respondents while section B contains research items regards to mathematical knowledge and teacher's development whose options will be rated in four-point degree of responses as follows; Strongly agree (SA) - 4 points, Agree (A) - 3 points, Strongly Disagree (SD) - 2 point, Disagree (D) - 1. The Part B which is the mathematics students questionnaire were made of section C and D. Section C is to obtained students information while Section D is for description of research items rated with 4-Likert scaling point. Finally, part C is for lesson observation.

### **Validity of Research Instrument**

The face validity of the questionnaire was ensured by expert judgment of a panel of three experts made up of one experienced mathematics teacher, one from science education and one from Measurement and Evaluation. They examined the face validity of the instrument by critically examining the clarity and appropriateness of the test items. Thereafter, their corrections and suggestions was effected in the instrument. The panel's approval of the test items as being able to measure what it intended to measure led to the use of the instrument for the study.

### **Reliability of the Instrument**

To ascertain the reliability of the instrument, The teacher and students questionnaires will be given to 10 mathematics teachers and 30 mathematics students in the area of the study to answer and their scores will be used using Kuder-Richardson 21 formula method to determine the reliability of the instrument. A reliability coefficient of 0.71 and 0.70 was obtained for mathematics teachers and students, hence the instrument was adjudged reliable.

### **Method of Data Collection**

In order to get access and co-operation from the respondents, the researcher will visit the sampled school and explained to the principals the purpose of the research. The researcher presented the letter to the principals of the schools and a copy of the questionnaire attached. The researcher will give the questionnaires to the teachers and students to fill it. Moreover, 300 copies of the questionnaire will be distributed to respondents and the researcher make collected the filled questionnaire back at the spot immediately after they are responded to.

### **Method of Data Analysis**

The method of data analysis that will be used to answer the research questions is mean and standard deviation while null hypotheses will be tested using Chi-square statistical method of analysis at 0.05 alpha level.

## **Results**

**Research Question 1:** What are the mathematical knowledge needed by teachers beginning teachers?



**Table 1: Mean and Standard Deviation of mathematical knowledge**

S/N	Item Description	SA	A	SD	D	Total	$\bar{X}$	SD
1	Subject matter knowledge	150	125	50	65	390	1.34	0.11
2	Curriculum knowledge	156	130	46	58	390	1.27	0.11
3	Knowledge of learners conception	140	151	66	33	390	1.30	0.91
4	Pedagogical knowledge	170	120	48	55	390	1.31	0.31
5	Knowledge of learners learning difficulties	128	159	73	30	390	1.28	0.12

From the data presented above in table 1, the calculated arithmetic mean values of items 1-5 is greater than 1.25, which means that all items were accepted. This shows that beginning teachers need mathematical knowledge for teaching mathematics in secondary school.

**Hypothesis 1:** There is no significant influence of mathematical knowledge needed by teachers beginning teachers and students achievement in mathematics.

**Table 2: Chi-square Analysis of Mathematical Knowledge needed by Beginning teachers**

Responses	Total	Df	X <sup>2</sup> -cal.	X <sup>2</sup> -crit.	Level of sig.	Decision
SA	744	12	26.40	19.83	0.05	Rejected
A	685					
SD	283					
D	241					

Chi-square analysis presented in table 2 revealed that the calculated value 26.40 is greater than the critical value 19.83 at 0.05 level of significance, hence this hypothesis is rejected. This implies that there is a significant influence of beginning teachers mathematical knowledge on students achievement.

**Research Question 2:** Does teacher development of mathematical knowledge influence students achievement in mathematics.

**Table 3: Mean and Standard Deviation of teacher development of mathematical knowledge influence students achievement in mathematics**

S/N	Item Description	SA	A	SD	D	Total	$\bar{X}$	SD
6	Learn better ways to teach	131	161	78	70	139	1.35	0.92
7	Develop educational skills to teach	126	146	43	75	139	1.28	0.19
8	Teachers gain knowledge	140	120	81	49	139	1.26	0.12
9	Teachers learn new method of teaching	135	116	84	54	139	1.31	0.71
10	Teachers expand their knowledge of teaching	128	109	61	92	139	1.33	0.56

From the data presented above in table 3, the calculated arithmetic mean values of items 6-10 is greater than 1.25, which means that all items were accepted. This shows that teacher development of mathematical knowledge influence students achievement in mathematics.

**Hypothesis H<sub>02</sub>:** There is no significant influence of mathematical knowledge needed by teachers beginning teachers and students achievement in mathematics.

**Table 4: Chi-square Analysis of Teacher Development of Mathematical Knowledge**

Responses	Total	Df	X <sup>2</sup> -cal.	X <sup>2</sup> -crit.	Level of sig.	Decision
SA	660	12	31.11	19.83	0.05	Rejected
A	652					
SD	347					
D	340					

The summary Chi-square analysis presented in table 4 revealed that the calculated value 31.11 is greater than the critical value 19.83 at 0.05 level of significance, hence hypothesis two is hereby rejected. This implies that there is a significant influence of mathematical knowledge needed by teachers beginning teachers on students achievement in mathematics.

**Discussion of Results**

The testing of hypothesis one revealed there was a significant influence of mathematical knowledge needed by teachers beginning teachers and students achievement in mathematics. This finding is in collaboration with Shulman (1987) Plotz (2007), Ijeh (2013) and Ibeawuchi (2010) that the necessary mathematical knowledge needed by beginning teachers are; subject matter content knowledge, curriculum knowledge for teaching, knowledge of relevant instructional strategies, knowledge of learners’ conceptions and Knowledge of learners’ learning difficulties to influence students achievement in mathematics.

The testing of hypothesis two revealed that was significant influence between teacher development of mathematical knowledge and student achievements in Mathematics. This finding is agreed with Awodiji (2018), which stressed that teacher development can be regarded as the activities and programmes (formal or informal) exposed to to teachers to learn about responsibilities, develop required skills and competencies necessary for the attainment of quality education. The teacher development activities also enhance teachers to grow professionally so as to prepare themselves for advancement in the classroom and beyond. It is a model of developing teachers’ personal and institutional skills, knowledge and abilities which include training, career development, coaching, and mentoring.

**Conclusion and Recommendations**

Based on the analysis and results presented above in this study, it is concluded that there was a significant influence of mathematical knowledge needed by teachers beginning teachers and students achievement in mathematics and there was significant influence between teacher development of mathematical knowledge and student achievements in Mathematics. Based on the above discussion, it is clear that the increase on students achievement depends on teacher’s development and mathematical knowledge they are acquired. In this regards, the following recommendations could play an important role.

- Beginning mathematics teachers are encourage to update their mathematical knowledge so that they become effective, knowledgeable, productive and efficient for teaching mathematics to enhance students achievement.
- Beginning mathematics teachers are encourage to develop mathematical knowledge by engaging teacher education programme to influence students achievement positively.
- Government should train in-service beginning teachers by offering them scholarship.
- Mathematics students on their own, work harder to achieve their educational goals.



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