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FACTORS INFLUENCING THE EFFECTIVENESS OF MATHEMATICS TEACHING AND LEARNING IN HIGH SCHOOLS IN MARYLAND COUNTY SOUTHEAST LIBERIA

Maria Fe Dumlao Gueta [1*], Emmanuel Olagunju [2], Daniel Katu[3], Fallah Nyuamah[4], Gwendolyn Hedd – Williams[5].
William V.S Tubman University[1,2,3,4,5], Liberia.
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Abstract

Teaching and learning mathematics in junior and senior schools in Liberia has being a huge challenge which over time has resulted in limited progress in science, innovation, and economic advancement. However, in other to find practical solutions to this problem led to this research work wham's sole objective is to examine and elucidate the factors that influence Mathematics education in high schools and reveals how to effectively teach the subject in a developing country like Liberia. The research Investigation was done from the perspective of the school administrator, Mathematics teacher, and the students. The method adopted for data collection were open interview and semi-structured questionnaire, which was conducted and administered to a total of 11 administrators, 13 teachers and 160 students in the 8 educational districts in Maryland county. The findings of this work reveal that teachers are mostly responsible for ensuring that Mathematics education is effective in schools. Nevertheless, results also show that some major factors such as unavailability of qualified mathematics teachers in schools and negative perception of mathematics as a subject by the students hamper effectiveness in Mathematics teaching and learning. All educational shareholders must be aware of these factors in other to help increase the effectiveness of Mathematics education.

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INTRODUCTION

Mathematics is the foundation of science but unfortunately, students fear it (Yadav 2017). Mathematics deals with the study of shapes, numbers, space, and rate of change. Over centuries, the definition of mathematics has evolved; it is seen as a tool to seek out patterns and to formulate new conjectures Ziegler (2017); Abramovich et al (2019). Development of mathematical structures and concepts are good models of real phenomena, mathematical reasoning, provide insight or predictions about nature. With abstraction and logic, mathematics developed from counting, calculation, measurement, and the systematic study of the shapes and motions of physical objects (Umeodinka and Nnubia 2016). However, it is imperative to develop logical, technical, numerical, and intellectual competence capable of driving a modern society effectively and efficiently, this could be realized by building a solid foundation for mathematics teaching and learning (Kaushik 2019).

In recent times, teaching and learning mathematics has become major academic impalement in the educational environment in Liberia. Years back, students were more or like interested in mathematics. Based on that, teaching and learning mathematics in high schools needs the necessary attention and investment to have a solid bedrock in science, innovation, and technology. This study critically investigated, examined and outlined the factors influencing strategies of effective teaching and learning and how government policies, school administrative systems, teacher's practices of mathematics, their qualifications, professional development, and personal experiences could impact students' knowledge, beliefs, perception, and learning outcomes in mathematics during their high school years. Isack (2015) stated that to achieve effectiveness in teaching, teachers attribute and practice is major factors such as displaying fairness, having a positive outlook, being prepared, using a personal touch, possessing a sense of humor, possessing creativity, admitting mistakes, being forgiving, respecting students, maintaining high expectations, showing compassion, and developing a sense of belonging for students. Achieving effective teaching in mathematics is a core objective in education (Seah, 2007). An effective teacher development usually enhances student interest which will eventually have a lasting effect on the student learning approach to any mathematical-orientated field.

However, Maduabum (2009) recognized that some mathematics teachers might be more effective than others through their approach and pathological skills but they share certain similar traits in teaching mathematics. In recent years, much attention should be given to identify these unique traits on how mathematics instructions are delivered, in other to encourage mathematics teachers to adduct these traits. The effectiveness in the school system is solely based on teacher effectiveness (Jones et al., 2017). Teacher effectiveness is underlined by a variety of meanings based on the student's perspectives. According to Stanford (2001), teacher effectiveness is the degree to which a teacher achieves desired effects upon students. Oliver (2007) described the effectiveness of a teacher in terms of students' focus, performance, teacher behavior, and the classroom procedures that could be implemented well, to better the outcomes of the student. Oliver (2007) simply put that the degree of teacher's effectiveness could explain how well students develop their competence, resilience, and perseverance while facing adversity in learning. To promote students' interest and deep understanding of mathematics, best practices

must be ensured and adopted a strategy of teaching.

Four main factors determine the level of student's effectiveness in learning mathematics as theorized by Ingvarson et al., (2004), and outlined in Ismail et al (2015). These are:

(a) The school environment - conditions in the school where the students are located

(b) The teachers capacity - teachers' experiences and professional developments

(c) The teacher intellectualism - the knowledge, beliefs, and understanding of teachers;

(d) The teacher instruction skill - what teachers do in their classroom

Three of the factors that enhance learning ability in students are center on the teacher's characteristics and abilities to deliver to the learner. Goe et al., (2008) identified characteristics of effective teachers, where he mentioned that effective teachers always do the following; go an extra mile to add value to students, enhance self-efficacy and cooperative behavior, diverse use of resources and materials to make learning fruitful, good communication skills and enhance good classroom climate.

Effective Mathematics teachers should help develop their students' attitudes and perceptions, be sensitive to their student's feelings, valuing every student's contribution, recognizing student's needs for success, by involving students in the process of learning, and making Mathematics interesting. In recent years, studies were carried out to determine the factors that influence the effectiveness of teaching mathematics. Studies such as Tukur et al., (2013), Dauda et al., (2016), Anthony and Walshaw (2007), Habtamu (2017), Du Preez (2018), This research study seek particularly address how to effectively teach mathematics in a developing society

RESEARCH METHOD

Research Sample

This study involved eight Government secondary schools from the eight educational administrative districts in Maryland County. The school administrators (including principals, vice-principal, and headteacher), Mathematics teachers, and students of these schools participated in the study. A total of 184 respondents including 13 administrators, 11 Mathematics teachers, and 160 students participated in the survey. A minimum of 3 and a maximum of 5 students were each sampled from grades 7 to 12, ranging from ages 13 to 25.

Research Instruments

The data were mostly qualitative in nature. The primary data were gathered through questionnaires surveys, interviews, and observation. Questionnaires were administered to School administrators, Mathematics teachers, and students. The questionnaires were developed in line with the group research from the Australian Council of Educational Research (ACER), which developed three different sets of questionnaires to gather information about effective Mathematics teaching and learning in Australian secondary schools (Ingvarson et al., 2004). This format was also adopted by Ismail et al., (2015) to determine factors contributing to effective mathematics teaching in secondary schools in Brunei Darussalam. Some of the content of these were reviewed and accepted to suit the peculiarities of the Liberian society and also serve as a guide to ensure the reliability and validity of the data needed for this study.

A questionnaire titled 'administrative questionnaire' which consisted of 44- item inventory was designed to extract perceived factors that could influence the effectiveness of teaching and learning mathematics in secondary schools from grades 7 - 12. Interviews were also conducted for the administrator to confirm and gather consistent information about the nature and context of mathematics teaching and learning situations within the school environment.

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Teacher questionnaires and interviews were administered and conducted respectively in other to acquire relevant information about the situation they face in teaching mathematics and provide practical solutions on how challenges limiting effective learning can be overcome. The teacher questionnaire was designed based on the work of Cohen and Hill (2000). This design was later adopted by the American National Board of Professional Teaching Standards (2002). Due to the significant role the teacher plays in the teaching and learning process, comprehensive information of mathematics teachers were collected such as level of their education, period of experience in teaching, years of experience in teaching mathematics, level of professional teacher training, area of initial teachers training, the context in which they taught, and their teaching activities, practices and strategies, frequent rate of professional development and how regularly they attend a workshop on mathematics education.

The response of students to learning mathematics was covered in the students' questionnaire which seeks to acquire information of the perception and mental state of students while learning mathematics. The guideline used for the student questionnaire was developed by the Victorian Quality Schools project (Ingvarson et al. 2004), This instrument provided information about the students' classroom teacher, about the attitudes of students to their Mathematics learning, about the significance of learning to their future and about how they informally evaluate their teachers. A maximum of 5 students was chosen at random from each grade of grades 7 - 12 across each school in the 8 education administration district with ages of the students ranging from 13 to 25 years. Meanwhile, a series of small groups discussion sessions was set up for students in each of the schools to share ideas on how to improve their learning. Students were able to freely discuss and highlight the factors responsible for their poor performance, lack of interest, and sources and causes of their mathematics anxiety.

FINDINGS AND DISCUSSION

Response of School Administrators

Based on the response provided through the administered questionnaires and interview the school administrators sincerely believe that Mathematics teachers play a major role in the effectiveness of Mathematics teaching. The basic function of the school administrator is to provide a well-organized environment suitable for both the teacher and students to ensure knowledge is been transferred efficiently. However, in other to ensure that there is effective Mathematics learning, teachers should be well trained and well qualified. In other words, they need to specialize in mathematics or be trained experts in the methods of teaching mathematics. Mathematics teachers must be passionate about the subject and be willing to adapt their teaching practices and take on new approaches to teaching in other to cater to student's numerical weaknesses and needs. The teachers believe that to attain their highest possible level of effectiveness in teaching they have to be given significant welfare packages such as an increase in salaries and special allowance because they put in additional time and effort in improving the numerical competence of their students. Teachers also consistently request professional development such as training, workshops, and seminars in other to improve their knowledge and classroom practices. The teachers also demand support from all educational stakeholders in and out of Liberia and increased cooperation between mathematics teachers and other subject teachers is encouraged. Observation has been made in recent years that 60% of mathematics teachers are volunteer teachers (teachers awaiting employment), government must review and reform the procedure and process of employing teachers to absorb volunteer teachers as so as possible to secure the future of Mathematics education.

Based on the data analysis, it was discovered that some factors exist that negatively influence mathematics teachers' effectiveness

and some of these factors are caused by the school administrators. Firstly, there is no proper and standard students' placement procedure. Most times students are placed in classes that are above their intellectual level. Secondly, teachers find it difficult to obtain the updated curriculum of instruction and instructional resources from their schools. Thirdly, teachers lack the required time in structuring the lesson plan to cover the required topics in the curriculum within the allocated time which is majorly due to a large number of subjects and classes the teacher is assigned to teach. Lastly, lack of mathematics teachers mostly in the rural/community schools,

Possible solutions to overcome these challenges were put forward by some administrators. On behalf of the administration, for the first issue, one of the vice principals suggested that " [A government-approved uniform test be conducted for every student intake to determine students intellectual competence and suitable class placement]" The second issue discussed above was addressed by one of the principals who said "[There is insufficient school material supplied to us can such as individual subject curriculum and other instructional materials or teaching aids which may be due to poor supply chain of the Ministry of Education(MOE) because most community/rural schools are so deeply remote that they can be barely accessed. To solve this problem the MOE should effectively distribute and decentralize all teaching aids and instructional materials to each educational district in the country at the beginning of each academic year to ensure route/community schools easy access to these materials]" On the Third issue raised, one of the headteachers stated that "[most of the time excess school extracurricular activities and school holidays could significantly impact on the teachers contact time with students and suggested that school administrators should remove all unnecessary of such activities to create more time for Mathematics teaching and learning]" Lastly, one of the principals explained that "[there is a general unwillingness by teachers to stay in the rural communities due to various reasons, but it's important that the government adopt lucrative policies to ensure qualified teachers stay at rural schools]"

These outlined challenges directly or indirectly create more workload for the few available mathematics teachers, which will automatically reduce their effectiveness. To overcome some of these challenges, teachers will need support in various forms in a combined approach from the school administrators, Liberia Teachers Association (LTA), and the Ministry of Education (MOE).

The school administrators highlighted what must be done to ensure high effectiveness in teachers: (1) Continuous support programs on training teachers in mathematics and effective methods of teaching must be put in place. The curriculum must also be made available and regularly revised to reflect students' peculiarities and the need of society, while teachers must be properly monitored and supervised. (2) There is an urgent need for the recruitment of more mathematics teachers to solve the problem of teacher's overload, when more teachers are in schools it will take the excess workload from existing teachers and improve teacher's efficiency in instructing an adequate amount of classes. Special bonuses or allowance should be provided for teachers assigned to rural/remote communities. (3) Government should build more schools across the country in other to solve the problem of overpopulation experienced in urban schools through reducing massive enrollment. A headteacher of a school said "[the rate at which teachers retire is faster than their replacement and suggested that teachers retirement age should be increased, also due to the facts that experience gained by older teacher contribute to their level of

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effectiveness]". Most of the administrators categorically stated "[that due to the poor foundation of students in mathematics, the subject must be taught to students daily]". Suggestions were also made that government must look into the issue of school locations because most schools are located in commercial, religious, and entertainment areas, the activates of these areas negatively influence the teaching and learning process.

However, other negative factors that influence effectiveness in mathematics teaching and learning are the perception problem of the teacher and the students. Some Mathematics teachers are unable to clearly understand the problems of students in understanding mathematics. This may be because the student could be a slow learner and may see mathematics as an abstract concept; this could be as a result student's poor foundation or lack of prior mathematics knowledge. Some students also had negative attitudes and a lack of interest in Mathematics as a compulsory subject due to the societal misconceptions that "Mathematics is difficult". Moreover, lack of constructive parental and family support to achieve competency in mathematics could have hindered them in achieving positive learning outcomes. As was explained by one of the vice principals who said "[majority of this student came from a disadvantaged home where they face lack of continuity in schooling (due to lack of sponsorship or early age pregnancy). This must-have contributed to poor command of English as they are used to communicating with street English called' Colloquial' ', this makes it difficult for them easily understanding various Mathematics concepts, such as problem-solving, word problems, especially weaker students]' The aim where the student is getting an education has to be properly outlined and integrated into the national developmental plan so all stakeholders especially the student will understand why it's important to be in school.

Response of School Teachers

Teacher's questionnaires were administered to all available high school Mathematics teachers in the selected schools. They were 13 teachers respondent and they were all male, generally, the percentage of female mathematics teachers is very low in Liberia. The main issue raised by teachers is the recruitment of support teachers, improved teachers' welfare, and professional development (PD). The majority of the teachers stated that there is no structured professional development scheme for training and updating methods of teaching mathematics effectively based on the peculiarities of the society. 75% of the teachers in this study indicated that they had not attended any PD program in the last 5 years, which had resulted from lack of innovation in their teaching skills. Most of the teachers were able o give reasons for the urgent need for PD, a teacher y one teachers "Professional development improve the teaching ills, through studying and sharing knowledge. Gaining new ideas and collaborating with other mathematics teachers could help improve teaching skills" another said. It improves teaching skills by giving new knowledge and enhance the effectiveness and efficiency of the subject story. Changes teachers teaching approach towards student teaching-learning teaching-learning process students centered and help identify the strength and weaknesses of the student" PD must be given a major priority in n other to have an adequate amount of qualified mathematics teachers in schools. This study reveals that due to the unavailability of qualified mathematics teachers in rural and remote communities, high school graduates with no form of mathematics teaching training are recruited as teachers. These teachers are also victims of the same poor mathematics school background, which creates a cycle of ineptness in mathematics competency in students. The main problem students

encounter in learning Mathematics is a general lack of interest in the subject which is caused by poor background and societal negative perception. The majority of the teacher said, “in other to install interest in students they result to use varieties of methods such as motivation, direct instruction, encouragement, demonstration and explanation, visualized teaching”. Some teachers did not hesitate to point out some specific mathematics topics such as Trigonometry, Logarithm, and Pythagorean theory as the most difficult aspects of mathematics for high school students to understand. Student's poor performance in these topics is occasionally addressed by giving more attention to student’s individual needs through organizing extra classes, creating small learning groups, and enforcing this consistent practice of Mathematics. One individual commented that he believes that large students population in classes is a major reason for teachers’ ineffectiveness in the classroom, stating that “it takes much energy and effort to effectively manage overpopulated classes and reveals that students in overpopulated classes easily lose concentration in class due to class distraction by other students and they are unable to regain concentration, mostly because they would be too afraid to ask the teacher question in a large class”. Another possible explanation for this may be that students were unable to cope with these high-order thinking tasks as they were already accustomed to being ‘spoon–fed’ by their teachers for as long as they could remember. This is also in line with the findings of Ismail et al.,(2015). Experience has shown that many students simply want the teacher to provide a shortcut to learning mathematics and also want teachers to provide the solution to the problem without even trying, in an attempt to avoid failures.

Response of Students

The student's response to this study critically addressed student's perceptions, believes, and attitudes towards Mathematics teaching and learning. The majority of the students are motivated to learn Mathematics and are determined to do well in Mathematics because they deeply believe that it would be useful and relevant for them in their future endeavors but the students agree that they are not good in mathematics. They also expressed, that learning Mathematics is not fun for them but strongly believe that under the right educational condition they can enjoy learning Mathematics. However, students have confidence in their school teachers and strongly rely on them to improve their Mathematics competencies.

There were only three major widely held negative concerns by the students towards their mathematics teachers. Firstly, that their teachers don’t put extra effort into explanation and don't give them regular practice questions, during and after Mathematics classes. The majority of the students always find it difficult to grab the concept of what the teacher had taught. Secondly, most teachers barely have the mastery of the subject. Which often result in a very poor presentation of topics, lack of detailed explanations, and discouragement of students from asking questions in class. Thirdly, most teachers don’t motivate students to persist in learning mathematics. Some teachers have made students consider mathematics as a subject for unique students, this negative perception discourages students from making any serious attempt to learn and creates Mathematics anxiety in them. The possible reason for the first issue may be due to teacher’s lack of quality time to spend with students due to heavy workload and tight school activities series. Most schools due to shortage of teachers, mandates mathematics teachers to teach 2 or 3 other subjects, this will result in teachers overload and eventually reduce the teaching effectiveness and diminish student's interest in learning. The second and third issues involving lack of teacher subject mastery and teacher's inability to motivate students, result from the fact that the majority of the teachers in high schools,

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teaching mathematics are not core-trained mathematics teachers and are yet to undergo any formal training in teaching methods.

Classroom Effectiveness

During the cause of this study, the principals were asked to disclose their most effective mathematics teachers, and specific questions were asked from them about class management, student-centered teaching, their most effective techniques in teaching, and why students' performance in their classes is better. It was noticed that the most effective teachers in these schools are masters in classroom effectiveness and consistently do five things very well, which are 1. Develop a structured lesson plan in a way that covers topics at the allocated time. 2. They have deep knowledge of what they teach. 3. They communicate and connect excellently 4. They understand the mathematical language and student's facial expressions 5. They have ethically care about students and constantly evaluate students' progress.

Factors Responsible for effective Mathematics Teaching

The major factors responsible for the effective teaching of mathematics in high schools in Liberia mainly result from the teachers themselves. Although the Government of Liberia and the school administrators influence teacher's degree of effectiveness through the provision of required educational recourses and proper utilization of these resources respectively. To achieve effective mathematics teaching, the teacher must ensure that deep mathematics concepts are well understood and aptitude to use different teaching mathematical techniques to impact knowledge. These findings are consistent with numerous studies such as Abramovich et al.,.(2019). He explains that teachers should use group problem-solving to stimulate students to apply their mathematical thinking skills and also kindle students to interact in ways that both support and challenge one another's strategic thinking. Other works that are in line with the result of this study are Hill et al., (2008), Jones and Pepin, (2016), and Pepin et al., (2017). Finding from students in this study as earlier stated reveal that their teachers have been their primary source of learning. The effectiveness in mathematics learning is solely dependent on how efficiently the teacher can monster all resources such as instructional, administrative, personal and relational to bring out the desired learning outcome from the students.

CONCLUSION

In the quest to develop a self-reliant and technological-driven nation. Effective teaching of a technical subject such as Mathematics is imperative. Therefore, it is a matter of national interest that schools ensure effectiveness in teaching. In doing so, some challenges were encountered; most principals said that lack of educational materials, poor rate of Mathematics teacher's recruitment, and lack of structured professional development programs were the major factors limiting teacher's effectiveness. However, the Majority of the teachers clearly stated that students show little or no interest in learning Mathematics, this is mainly due to virtually no or very weak foundation in the subject. This study also discloses that the teacher is the most influential variable in the teaching and learning process. Hence it is necessary that Mathematics teachers in Liberia have to be well–prepared, well–versed, and thoroughly supported to enact changes in the curriculum and instructional strategies towards expanding student's capacity to learn. Nearly, all students accept they are poor in mathematics but they solely believe that it their mathematics teacher's failure to motivate them, make teaching student-centered, and put in the required extra effort to upset their poor foundation in mathematics, which has greatly contributed to the loss of interest in the subject. To ensure effective teaching of Mathematics, teachers are expected to serve as role models to students and put in sufficient effort in all activities related to teaching

which can influence and stimulate desirable learning outcomes in the students..

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