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Time-on-Task as Correlate of Slow Learners Achievement in Modular Arithmetic in Senior Secondary School Mathematics

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Abstract

The study investigated the relationship between time-on-task and academic achievement of slow learners in modular arithmetic in senior secondary school mathematics in Orumba South Local Government Area of Anambra State. Two specific purposes and two research questions guided the study. The study adopted a correlational research design. The population of the study was all the 726 senior secondary school one (SS1) students in Orumba South Local Government Area in Anambra State of which 361 are males and 365 are females. The sample size was 127 slow learners made up of 59 males and 68 females. Simple random sampling technique was used in choosing the schools that were used for the study while purposive sampling technique was used in selecting the slow learners. The instruments used for data collection were, Modular arithmetic Time-on-task Rating Scale (MTRS), and Modular Arithmetic Achievement Test (MAAT). A reliability index of 0.891and 0.75 were obtained for MTRS and MAAT respectively. Data collected were analyzed using SPSS version 20 in which Regression Analysis was used in answering all the research questions and Analysis of Variance Regression Analysis was used for testing the formulated hypotheses at 0.05 levels of significance. The findings of the study revealed a significant high positive relationship between time-on-task and slow learners' academic achievement in modular arithmetic. It was also found that gender has no significant relationship between time-on-task and slow learners' academic achievement in modular arithmetic in secondary school Mathematics. Based on the findings of the study it was recommended among others that time-on-task teaching strategy should be used in teaching the slow learners because it emphasizes that enough useful time be allotted to learning for students to master a concept well.

Keywords: *Time-on-Task, Correlate, Slow Learners, Academic Achievement and Modular Arithmetic.*

INTRODUCTION

Mathematics is one of the very important and compulsory subject in both the primary and secondary education in Nigeria. Mathematics is the science that deals with the logic of shape, quantity and arrangement (Hom, 2013). Hom continued by saying that Mathematics is all round us, in everything we do; it is the building block for everything in our daily lives, including mobile devices, architecture (ancient and modern), art, money, engineering and even sports. Hom added that since the beginning of recorded history, mathematics discovery has been at the forefront of every civilized society and in use in even the most primitive cultures. The needs of mathematics arose based on the wants of society. The more complex a society, the more complex the mathematical needs. Primitive tribes needed little more than the ability

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to count, but also relied on Mathematics to calculate the position of the sun and the physics of hunting.

Mathematics is a methodical application of matter. It is so because the subject makes a man methodical or systematic. Mathematics makes our life orderly and prevents chaos. Certain qualities that are nurtured by Mathematics are power of reasoning, creativity, abstract or spatial thinking, critical thinking, problem-solving ability and even effective communication skill (Guwahati News, 2015). Guwahati continued by saying that mathematics is the cradle of all creations, without which the world cannot move an inch, be it a cook, or a farmer, a carpenter or a mechanic, a shopkeeper or a doctor, an engineer or a scientist, a musician, everyone needs Mathematics in their day-to-day life. Mathematics is the key to the national development. It is described as an indispensable subject, without which no nation could contemplate progress or development (Ambali, 2014). Mathematics is important in shaping our everyday life and development. The subject (mathematics) is critical to the survival of the world today and the future generations (Agwagah, 2014). Agwagah further said that Mathematics is an indispensable knowledge and is described as the "builder of modern civilization" and also maintained that mathematical education would enhance citizen's capacity to tackle national challenges, urging members of Mathematical Association of Nigeria (MAN) to make useful contributions in the course.

The importance of mathematics as a requirement for scientific and technological development of any nation cannot be over-emphasized. For any nation to grow or develop in science and technology, the teaching and learning of Mathematics becomes inevitable. There is no science subject which does not have an atom of Mathematics in it. Mathematics serves as the rudiment in which a child's horizon of reasoning and manipulation is expanded.

Despite the acknowledged importance of Mathematics in National development and in our everyday life, some students hate this subject because of the confusing agglomeration of numbers the teachers seem to conjure when they are teaching (Wahab, 2018). Wahab also said that the phobia for mathematics among students is a universal phenomenon and this perhaps is the reason it is almost universally believed that this subject is very difficult and the hatred that some students have for this subject is attributable to their poor foundations in the subject. Many researchers have attempted finding out the causes of students' poor achievement in Mathematics. They include the following as found out by many authors: poor teaching methods applied to teach mathematics, inadequate instructional materials, students' misconception of mathematics as a difficult subject, Mathematics teachers' attitude towards teaching this subject, poor teaching skills/strategies and lack of participation by the students, among others could be responsible for students' poor achievement in the subject (Sa'ad et al., 2014). Therefore, it is clear that the causes of poor achievement in mathematics among secondary school students are many and varied but they fall under school-based causes, teachers' and students' personal causes. This shows that mathematics education at secondary school level is problematic resulting to poor students' achievement especially as it concerns the newly introduced concepts in General Mathematics among which is Modular arithmetic. Modular arithmetic is among the concepts that were introduced by National Education Research and Development Council (NERDC) in 2007 along with other concepts like: Matrices and determinants, Differentiation and integration of simple algebraic functions and Logical reasoning.

Modular arithmetic is a system of arithmetic for integers which considers the remainders. According to Odogwu et al. (2015), modular arithmetic is operation which gives remainder when an integer is divided by a fixed non-zero integer. When one divides an integer by 7, all

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the possible remainders are, 0, 1, 2, 3, 4, 5 and 6. These values become the elements of modulo 6. The set of z of integers is shown as$z = \{0, 1, 2, 3, 4, 5, 6\}$. The divisor is modulus, and the process is arithmetic modulo of 7. The operations involving addition, subtraction, multiplication and division can be carried out using modulo arithmetic. Examples; sum up 8 and 13 in modulo 6. Now, when 8 and 13 are added together, we get 21 and 21 is written as 3 x 6 rem 3. The solution is 3 (mod) 6. We follow the same process in subtraction, division and multiplication.

In Modular arithmetic, numbers "wrap around" upon reaching a given fixed quantity, which is known as modulus (which would be 12 in the case of hours on a clock, or 60 in the case of minutes or seconds on a clock). Modular arithmetic is also referred to as arithmetic of congruencies, sometimes known informally as clock arithmetic (Insall & Weisstein, 2019). Modular arithmetic is concerned with congruent relations. Before stating what congruence, relation involves, recall that given a positive integer K, it would divide an integer b resulting in an integer n and another integer r usually called the remainder that is b $\equiv n \times k + r$.

Whenever the condition stated above is satisfied by b, K and r, we say that b is in congruence relation with r relative to (or with respect to) the integer K. Examples, $6 \equiv 2 \times 3 + 0,\ 12 \equiv 4 \times 3 + 0$. Therefore 6 and 12 are in congruence relation with respect to 3. Whenever 'b' and 'r' are in congruence relation, we also state that 'b' is congruent to 'r' with respect to 'K'. In the relation described, 'r' is called the residue and 'K' is the modulus of congruence relation. Therefore two integers are congruent to each other with respect to a modulus, if on dividing each by the modulus, the same residue (remainder) is generated (Mathematical Association of Nigeria (MAN), 2012). This topic in mathematics called modular arithmetic is one of the concepts of mathematics newly introduce into the curriculum in the year 2007 by the Federal Ministry of Education (FME), senior secondary National Education Research and Development Council (NERDC). The importance of modular arithmetic to students and society are many and these include: time keeping as in module 12 arithmetic, the algorithm that determines a market day in the community as in module 5 arithmetic, the algorithm that determines the day of the week for a given date as in module 7, the modular operation as implemented in programming language and calculations and others (Awodeyi, 2017). It is because of this importance of modular arithmetic that it is included in the curriculum.

Despite the acknowledged importance of this Modular arithmetic, there is evidence of students' poor achievement in this concept at secondary school level. There are evidences that many students have low achievement in Modular arithmetic as contained in 2011 and 2013 chief examiners' report from West African Examinations Council. The poor achievement in Modular arithmetic may also be a reason for the overall poor achievement of students in Mathematics in general as can be seen in the annual result analyses of most public secondary schools in Orumba South Local Government Area of Anambra State.

Due to all these importance of Modular arithmetic, Mathematics teachers therefore have the professional responsibility to help, develop and boost the achievement of all the students especially the slow learners who may not learn at the same pace with other students in this all-important useful concept – modular arithmetic.

Slow learners tend to perform at their ability level, which is below average. A slow learner is one who has the ability to learn necessary academic skills but at a rate and depth below average of the same age peers (Suranjana et al., 2015). The students whose cognitive

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structures are low are referred to as slow learners (Vasudevan, 2017). Being a slow learner is a life-long problem. A slow learner is generally considered as a student who achieves a full scale score between 70 and 85 (or 89) on formal Intelligent quotient (IQ) testing (Block, 2014). Intelligence quotient (IQ) is a number meant to measure peoples' cognitive abilities (intelligence) in relation to their age group (Brain, 2018). Brain further said that an IQ between 90 and 110 is considered average, over 120, superior. Roughly 68% of the population has an IQ between 85 and 115. The average between 70 and 130 represents about 95% of the population. A score below 70 may indicate problems in understanding the IQ questions or some type of learning disability, and a score above 130 may indicate intellectual giftedness. According to Block (2014), slow learners intelligence level is between 71 and 89, this range of IQ is thus considered as a borderline intellectual disability (Cognitive impairment) or low average intellectual capability. These IQ scores are not low enough (less than 70) to place them in the mild cognitive impairment group (old term = mild mental retardation). Nor is there usually enough discrepancy between their IQ and academic ability to place them in the learning-disabled group, as well. Surprisingly, this group of children may represent about 23% of the entire student population, compared with a rate of 5% to 10% for remediable learning disabilities in the population.

The worrisome aspect of being a slow learner is the fact that they usually will not qualify for any special services, special education, or even a helpful Individualized Educational Plan (IEP). In the typical classroom setting, most teachers aim their academic course work for the average learner, who has a mean IQ of 90 and 110. These slow learner children are destined to struggle here (Block, 2014). The slow learners need more efforts to understand a concept that has been mastered by the majority of students in the class. This is in accordance with Novitasari et al. (2018) who reveals that the slow learners have below average cognitive abilities of the age mates and who struggle to cope with the traditional academic demands of the regular classroom. However, Chauchan (2011) argues that the slow learners have Intelligence Quotient (IQ) between 76 and 89. Their level of intelligence is high to be considered a child with mental retardation and it is too low to be considered an average learner of their age mate. The slow learners can also exhibit some characteristics with which one can use to identify them. According to Suranjana et al. (2015), the slow learners exhibit the following characteristics: Low self-esteem, poor concentration skills, inattention in class, poor grades, procrastination in submitting assignments and their preference to work with their hands rather than theoretical learning.

However, slow learners must receive education because education is the right of every citizen, no exception, including children who have other learning difficulties whose thinking skills are below average than other normal students in his/her age. This is a big challenge for teachers to help slow learners build their understanding of learning mathematics in general class especially in learning modular arithmetic because even average students generally find it difficult and make errors in solving problems in it. Mathematics teachers therefore have the professional responsibility to help, develop and boost the achievement of all the students especially the slow learners who may not learn at the same pace with other students in this all important useful concept – modular arithmetic by employing good instructional strategies that will make their course deliveries more meaningful, effective, productive and understandable in modular arithmetic. Among those strategies that can be tried out, according to Bates (2012) are; pair work, repetition, time-on-task, manipulation of tools, motivation, mathematics games and others. The present researcher picks time-on-task as instructional strategies that can be employed and hence investigate if it can help the slow learners to achieve higher.

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Time-on-task is counted among the most important factors affecting learning and achievement. Time-on-task is defined as the amount of time a class spends in quality instruction (Mitchell, 2013). In the words of Johnson and Johnson (2009), time-on-task refers to the amount of time students spend attending to school related tasks such as following directions and engaging in learning activities. Time-on-task is engaged time on particular learning task. Johnson also added that the concept is not synonymous with engaged time because it deals with engagement in planned learning experiences. A student may be deeply engaged in mathematics homework or reading a comic book during a time period allocated to science, but that is not time on the desired task.

Time is an essential resource for all human action-learning and studying also take place within the framework of time, the relation between time and learning is one of the most perplexing questions in teaching something which is probably every teacher has contemplated on. Workload is appropriate when the students are provided with enough time for completing learning tasks and learner's capacity is taken into account. A too tight schedule does not enable effective learning. Slow learners may need more time to figure things out than the average learners to get the content. Time-on-task is one of the teaching strategies that emphasizes on enough useful time allotted for learning for the students to understand the concept well. Slow learners need more time to figure things out or to understand a new concept because their reasoning skills are typically delayed which makes new concepts difficult to learn. The use of Time-on-task as a teaching strategy can be of help to them in the sense that when enough time is given to their individual needs, they will learn. Modular arithmetic being a new concept needs enough explanation for the learners to get a deep knowledge of the concept especially as it concerns the slow learners who are pace disabled. The amount of time needed to figure things out may differ according to the gender of the slow learner students as both male and female student slow learners may not work at the same pace. Therefore, another variable of interest in the present study is gender and its influence on the achievement of students (slow learners inclusive) in Modular arithmetic.

Gender refers to the socially constructed characteristics of women and men, such as norms, roles, and relationships of and between groups of women and men. It varies from society to society and can be changed (WHO, 2019). This is against sex which tends to relate to biological differences. For instance, male and female genitalia, both internal and external are different. Similarly, the levels and types of hormones present in male and female bodies are different. So, it is only genetic factors that define the sex of an individual.

Most of the researchers are showing that there exists no gender difference among their studies so far but one still wonders why the under-representation of women at the highest level of mathematics, physical sciences and engineering as noted by Asante (2010).This study will therefore investigate gender differences in slow learners' achievement in Modular arithmetic. This is because of the varying reports on studies in gender differences in students' achievements in mathematics. It is against this inconclusive background that the present study aims at investigating the influence of gender on slow learners' achievement in modular arithmetic. In a bid to attest to the above belief and support existing finding by aforementioned researchers, this present study is geared towards investigating how time-on-tasks correlate with slow learners' achievement in modular arithmetic.

It is heartbreaking experience for students to be in the class day after day but fail to keep up with what the teacher is teaching especially not because they have not been making effort to cope but simply because their minds work that way. This does not concern the affected

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students alone but the teachers and parents as well. Considering mathematics and its importance in National development, it is a well-known fact that, the subject (mathematics) is used in all aspects of human life as the social, scientific and technological aspects of man are centered on numbers. So students' (especially slow learner's among them) achievement in Mathematics needs to be given more serious attention.

The slow learners who are seen as pace disabled find it difficult to learn with the average students in the class. Some researchers point fingers to the teaching strategies used in teaching the new concept-modular arithmetic as part of the causes of the difficulties of the slow learners in understanding the concept. So strategies that can help the slow learners to easily understand mathematics concepts are demanded. This prompted the researchers to search for alternative teaching strategies for these secondary school slow learners to clear the desperate and sad looks on their faces when they are unable to follow the lessons being taught which may invariably affect their achievements. Therefore, there is need to explore alternative teaching strategies and then their relationship with slow learners' achievement in modular arithmetic. Hence, the problem of this study put in question form is; what is the relationship between time-on-task and slow learners' academic achievement in senior secondary school modular arithmetic? The purpose of this study is to determine the relationship between time-on-task and academic achievement of secondary school slow learners in modular arithmetic. In specific terms, the study addressed the following issues;

1. What is the relationship between time-on-tasks and slow learners' academic achievement in modular arithmetic in senior secondary school mathematics?
2. What is the relationship between time-on-tasks and slow learners academic achievement in modular arithmetic in senior secondary school mathematics as moderated by gender?

METHODS

The study adopted a correlational survey research design. A correlational research is a type of non-experimental research method in which a researcher measures two variables, understand and assess the statistical relationship between them with no influence from any extraneous variables (Bhat, 2019). Also, according to Nworgu (2015), correlational survey study is the type of study that seeks to establish the nature of relationship that exists between two or more variables. The design was considered appropriate for the study because the study will establish the nature of relationship that exist between the criterion variable (slow learners' achievement in modular arithmetic) and the predictor variable (time-on-task).

The population for this study comprised of all the Seven hundred and twenty-six (726) Senior Secondary one (SSI) students in Orumba South Local Government Area for 2020/2021 session. The students that made up the population also consist of Three hundred and sixty-one (361) boys (male) and Three hundred and sixty-five (365) girls (female). The population was gotten from the fourteen (14) public secondary schools in Orumba South Local Government Area. The sample size for this study was all the identified slow learners in the intact class from the schools that were used in Orumba south local government area of Aguata education zone Seven (7) out of the fourteen (14) public secondary schools in Orumba South were chosen for the study using simple random sampling technique. Two instruments were used to collect the pertinent data for this study. They are: Modular Arithmetic Time-on-task Rating Scale (MTRS) and Modular Arithmetic Achievement Test (MAAT). MTRS is a twenty-seven (27) item

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questionnaire to determine the involvement of the slow learners when Time-on-task is used as a teaching strategy. The instrument (MTRS) has two sections: Section A and B. Section A is a personal data of the respondent and section B which consists of twenty seven (27) item scales will measure the involvement of slow learners when Time-on-task is used as a teaching strategy.

The MTRS is rated on a four point rating scale of Strongly Agree (SA) - 4points, Agree (A) - 3points, Disagree (D) - 2points and Strongly Disagree (SD) - 1point for positively cued items. In the reverse order, the negatively cued items are rated. The instrument was adapted from Astute-hoot (2019) original instrument. The original instrument was reframed to suit the purpose of the research. Each item statement was either partially or entirely reframed.

MAAT is a forty (40) item multiple-choice question with four options ranging from A to D and was constructed to cover the three (3) taxonomy of learning objectives (Cognitive, Affective and Psychomotor domains). The instrument was developed by the researcher in order to assess the level of acquisition of the concept-Modular arithmetic by the slow learning students. It covered the following topics: (Revision of Addition, Division, Multiplication and Subtraction of Integers; Concept of Modular arithmetic; Addition, Division, Multiplication and Subtraction in Modular arithmetic; Application to Real-life Situation) in Modular arithmetic taught in SSI first term for the school year. In preparing the test items, a well prepared table of specification or test blue print was used. Each correct response attracted one (1) mark while a wrong response was scored zero (0).

The instruments (MTRS and MAAT) were face validated by three experts in Department of Science Education (Measurement and Evaluation and Mathematics Education unit) Faculty of Education, University of Nigeria, Nsukka. The experts' comments, correction and suggestions helped in modifying the items to suit the problem under investigation. Also, to ascertain the content validity of MAAT, a well prepared table of specification was used in the construction of the test items. A reliability index of 0.891 and 0.75 were obtained for MTRS and MAAT respectively making the instruments suitable for the study.

The researchers with the help of research assistants administered the copies of the instruments (MTRS and MAAT) to the intact class of the sampled schools. All the copies of the instrument administered were collected back on the spot. The students' responses were scored and the data generated were used for statistical analysis. The data collected was analyzed using regression analysis in answering all the research questions and analysis of variance was used to test the hypotheses at0.05 levels of significance.

RESULTS

The result in Table 1 shows that the correlation coefficient between time-on-tasks and slow learners' academic achievement in modular arithmetic in senior secondary school Mathematics was 0.62. This means that, there exist a high positive relationship between time-on-tasks and slow learners' academic achievement in modular arithmetic in senior secondary school Mathematics.

Table 1 also revealed that, the coefficient of determination (R^2) associated with the correlation coefficient of 0.62 was 0.39. This coefficient of determination (R^2) indicates that, 39% of variation in slow learners' academic achievement in modular arithmetic is attributed to time-on-tasks. This is an indication that 61% of the variation in slow learners' academic achievement in modular arithmetic is attributed to other factors other than time-on-tasks.

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Table 1: Regression analysis of time-on-tasks and slow learners' academic achievement in modular arithmetic in senior secondary school Mathematics

Variables	r	R^2
Time-on-tasks and slow learners' academic achievement in modular arithmetic	0.62	0.39
(R^2) = Coefficient of Determination		

The result in Table 2 shows that an F-ratio of .541 with associated exact probability value of 0.00 was obtained. This probability value of 0.00 was compared with 0.05 set as level of significance for testing the hypothesis and it was found to be significant because 0.00 is less than 0.05.

Thus, the null hypothesis of no significant relationship between time-on-tasks and slow learners' academic achievement in modular arithmetic in senior secondary school Mathematics was rejected. The researcher therefore, concludes that there is a significant relationship between time-on-tasks and slow learners' academic achievement in modular arithmetic in senior secondary school Mathematics.

Table 2: Regression Analysis of relationship between time-on-tasks and slow learners' academic achievement in modular arithmetic in senior secondary school Mathematics

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11.010	1	11.010	.541	.000a
	Residual	2544.345	125	20.355		
	Total	2555.354	126			

Result in Table 3 reveals that the correlation coefficients (r) of .59 and .65 with associated coefficients of determinant (r^2) of .35 and .43 were obtained for male and female slow learners respectively between their time-on-task and academic achievement in modular arithmetic. The obtained coefficients of determinant of .35 and .43 indicate that 35% and 43% variation in slow learners' academic achievement in modular arithmetic in senior secondary school mathematics is attributed to time-on-task for male and female slow learners' respectively.

The difference in the variation of male and female slow learners as predicted by time-on-task is jointly 6% in favour of the female slow learners. Hence, gender moderated 6% of the variation in slow learners' academic achievement in modular arithmetic in favour of the females than their male counterparts.

Table 3: Regression analysis of relationship between time-on-task and slow learners' academic achievement in modular arithmetic in senior secondary school Mathematics as moderated by gender

Model	Gender	N	r	R^2	z-value	Sig
1	Male	59	.59	.35	-.54	.59
2	Female	68	.65	.43		

Result in Table 3 was also used to test significant relationship between time-on-task and slow learners' academic achievement in modular arithmetic in senior secondary school Mathematics as moderated by gender. The result revealed that z-value of .54 with associated probability value of .59 was obtained. Thus, the null hypothesis of no significant relationship was accepted since the p-value of .59 is greater than 0.05 level of significant. The researcher therefore, concludes that, there is no significant relationship between time-on-task and slow learners' academic achievement in modular arithmetic in senior secondary school Mathematics as moderated by gender.

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DISCUSSION

The results of the study revealed a significant high positive relationship between Time-on-task and slow learners' academic achievement in modular arithmetic in senior secondary school mathematics. This implies that slow learners' academic achievement is associated with Time-on-task in modular arithmetic.

The results have clearly shown that the slow learners when taught with Time-on-task teaching strategy tend to achieve higher in their academics. The above result of the study is in agreement with the findings of Waweru and Nyagosia (2013) that schools performing well in national examinations were putting more emphasis on Time-on-task.

The result of the study is also in consonance with the findings of Ayodele (2014), which showed that the instructional time, engaged time and numerical ability when taken together, accounted for 63.9% of the total variance ($R = 0.639$, $p < 0.05$). Also, student numerical ability and students' engaged time contributed significantly to the prediction. It was concluded that it is not the length of instructional time that results in learning but rather the time the students themselves are engaged in learning activities.

The study further revealed the variation of male and female slow learners as predicted by time-on-task in favour of the female slow learners. Hence, gender moderated 6% of the variation in slow learners' academic achievement in modular arithmetic in favour of the females than their male counterparts.

The percentage difference is insignificant and therefore there is no significant relationship between time-on-task and slow learners' academic achievement in modular arithmetic in senior secondary school Mathematics as moderated by gender. This is in line with the study carried out by Marissa (2019) on the relationship between gender and time-on-task that there exists no significant relationship between gender and average time spent on a task or percentage of time spent on-task. This shows that both male and female slow learners will spend same useful time on a given task.

CONCLUSIONS

Based on the findings of this study that a significant positive high relationship exited between time-on-task and slow learners' academic achievement in modular arithmetic in senior secondary school Mathematics, it was concluded that the slow learners when taught with Time-on-task as a teaching strategy achieve higher in mathematics, modular arithmetic in particular. Also, the finding that gender moderated 6% of the variation in slow learners' academic achievement in modular arithmetic revealed that there is no significant relationship between time-on-task and slow learners' academic achievement in modular arithmetic in senior secondary school Mathematics as moderated by gender. So, it can be concluded that gender is not a factor of slow learner's achievement in modular arithmetic.

Teachers should understand that slow learners take more time to understand a concept, for that, they should employ special teaching techniques like time-on-task to teach them. Teachers should also adopt the use of time-on-task in teaching their students for this will not only make them achieve higher but will help them to reduce the slowness in the students. School counselor should be provided in all schools to help in identifying this group of students called slow learners and also help in solving other problems that students face during academic life. Teachers should employ strategies that supports both genders' achievement in mathematics like TIME-ON-TASK.

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