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The Teaching Methodology and the Behavior of Ordinary Secondary School Students in Learning Mathematics Subject: A case of selected Ordinary Secondary Schools in Mbeya, Tanzania

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ABSTRACT

The study investigated the teaching methodology and the behavior of ordinary secondary school students in learning mathematics. This study sought to find behind the scenes why most students in ordinary secondary schools dislike mathematics, which leads to massive failures. To uncover this gap, the study applied a correlation research design. Systematic sampling technique of the interval 50th was used in which 100 respondents were selected; 20 respondents each from 5 selected secondary schools in Mbeya. Data were collected through a questionnaire. Data were analyzed descriptively and speculatively. The survey found that teaching materials/media were effectively implemented. Also, the findings indicate the non-adoption of informal behavior and non-reflection of mathematics teachings to the learner's natural home environment. Thus, from these discrepancies, the study recommends that mathematics teachers be used to teaching simulation and visual aids/media. It is recommended that mathematics teachers use informal behavior such as courage words, remedial classes, and others for students adapted to mathematics-solving behavior. Lastly, it is suggested that mathematics teachings should be reflexive to students' real-life environment.

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1. INTRODUCTION

Student likes or dislikes a particular subject is an attitude, cognition, and behavior shaped by a teacher's teaching methodology [1]. Different methods and strategies exist to teach different subjects and courses so that students can appropriately follow a lesson and like a subject [2]. Thus, it can be argued that not every method can be applied to teach every subject every time and in every learning environment. Usually, teaching methods are specific though they can be used interchangeably only to observe that learners like and

understand a lesson. Appropriate teaching methods change the emotional feeling of the learner (affect), the way they act towards academic achievement over a given subject (behavior), and the feeling and beliefs of others about a particular subject such as mathematics (cognition) [3]. It is through learning models and formulae that are found to create cognitive domain attributes [4]. Affective behavior of being used and solved to mathematical models was sustained through the appropriate use of teaching aids/simulation, informal behavior when teaching, and reflection on mathematics lessons [5].

Simulation sustained through teaching aids, and media were found to equip a learner with methods and procedures to come to a confined solution given a mathematical problem [6]. The use of media and aids (visual and tangible objects) is reported to help students easily remember the subject matter. This is because visual and natural objects speak millions more words than words [7]. It is by being used in the mathematical set where the said visual aids and media are found that more revealed to enhance learning by doing [8]. Learning by doing is a practicum form of teaching and learning that inspires a student to become a problem solver. In secondary schools in Pakistan, the simulation method of teaching mathematics was found to equip students with stepwise procedures for solving mathematical problems [9]. This indicates that mathematics is a science subject that applies procedures to conclude. 75% agree with responses reported by Farooq and Shah [10] that simulation mathematics teaching methods emphasizing the use of teaching aids and media created an affection for students like mathematics. Simulation teaching methods are revealed to create cognition in a learner and, therefore, a critical thinker.

Literature suggests that using informal behavior when teaching mathematics tends to influence students to like mathematics and solve equations [11]. Informal behavior includes (teacher) being approachable, not arrogant, friendly, use of good language (courageous words), and use of extra time in helping students. Since learning is psychological, encouraging words help students like the subject and perform well in examinations [12]. In Nigeria, informal behavior in teaching mathematics was found to evaluate students in colleges who love mathematics and are used to it [13]. It is through informal behavior, creating rapport, and being friends with students while helping them wherever problems are revealed to create courageous feelings for them used to solve mathematical problems. Being used to solve mathematics had the same paradigm shift effect on social problem solving.

Reflection on mathematics lessons is also reported to enforce mathematics-solving behavior among students [14]. This is because whatever is done at home applies mathematics, as said by Maelah, Amir, Ahmad, and Auzair [15]. Moreover, reflecting mathematics lessons, as reported by Buraerah and Aras [16] found to equip students with the spirit of mathematical problem solving, an affection the ABC model postulated.

From the theoretical and empirical reviews above, none of the studies has reported that teaching and learning mathematics, therefore, need specific behavioral acts. These unique behaviors impose specific ways and methods of teaching/learning for students, like mathematics, and perform well in their examinations. As this study has uncovered, teaching mathematics involves using informative ways such as emphasizing teaching aids,

media, and natural objects, using informal behaviors, and much reflection on mathematics lessons in students' home living environment. Analytics of these three specific ways to be used in teaching mathematics was accompanied by three formulated research objects which were:-to determine the effects of the use of teaching media for students undertake and like mathematics subject; to examine the effects of the use of informal behaviors in teaching/learning mathematics for students like it, and to analyze the effects of mathematics lessons reflection for students understand and like it.

2. METHOD

The study used a quantitative research approach with a correlation research design. The study was conducted in Mbeya City, where five selected ordinary-level secondary schools were involved. The area was chosen representing other areas from four results over mathematics subject is outmost worse in every academic year. This was revealed from the reports published through mass media over form four results in which mathematics frequently appears to be the subject students fail miserably. The same results were with the pilot study conducted with schools such as Lupata Secondary School, and Ibungila Secondary School found in Tukuyu-Mbeya, creating more curiosity for researchers to consider this study topical.

The five (5) selected secondary schools involved in the study were Lyoto, Aggrey, Ulambya, Vanessa, and Samora Machel secondary schools. From 5000 population (students, teachers, heads of schools, and Academic Masters/mistresses), 100 respondents (70 students and 30 teachers, heads of schools, and academic masters/mistresses) were selected through systematic sampling. In the interval of 50th, twenty respondents were selected from each school. The 100 sample size was derived using a margin of error = 0.1.

From the sample frame, data on why most students in ordinary secondary schools dislike and fail mathematics were collected using Likert scale questionnaires. The collected facts were analyzed descriptively (using mean, coefficient of skewness, and measure of kurtosis) and inferentially by employing the product-moment correlation coefficient and HLM Model.

3. RESULTS AND DISCUSSION

3.1. Use of teaching aids and media and behavior of students in learning mathematics

Equations In this aspect, the study aimed to examine the effects of the effective use of teaching aids and media on the behavior of students who like mathematics. The results in Table 1 below summarise the extent to which Mathematics teachers frequently and effectively used teaching means, aids, and media from the field.

Table 1. Correlation Analysis Testing Results

N = 100	1	2	3
Flip charts	1		
Mathematics toolbox	0.13	1	
Natural/Real objects	0.12	0.20	1

Source: Researchers' Computations

As noted by scholars [17], [18], visual media is insisted in teaching. This is one of the indicators of a good teacher because the use of visual aids helps students to recall the material quickly. However, the findings of this study indicated a discrepancy. The use of visual aids (flip charts and mathematics toolbox) was not effective with flip charts given r=0.13 and mathematics toolbox given r=0.20). The mathematics toolbox is a package of a ruler, colored pen, mark pen, white and colored chalks, three-dimensional figures, triangles, rectangles, circles, semi-circle, Bisector, pointer, and calculator, say a scientific one. The mathematical toolbox may also contain four mathematical figures. It is with these tools that teachers can sustain simulation in teaching mathematics. Whatever a student what to solve, she/he has to be used to those instruments. These tools are arguably reflexive to the learner's real-life environment. For instance, historians, fine artisans, architects, and quantity surveyors would like to use mathematics and engineering science tools to determine the angles. The angles obtained using mathematics tools might be depression, elevation, right angle, obtuse angle, an acute angle. For example, Bisector can help determine the $\Theta<90^o$ or $\Theta>90^o$, such as 30^o, 45^o, 60^o, 90^o, 135^o, 180^o, 270^o, and 360^o. It is argued here that using teaching aids creates effective behavior for a student to determine the SinΘ, CosΘ, and tanΘ of a given figure. It is with a piece of paper with which figures such as triangles, rectangles, three-dimensional figures, and ellipses are deduced.

The same results were shown over the variable, i.e., the number of times natural/real objects were adequately ineffectively used, given r = 0.12. For instance, in teaching the Ellipse concept, though this subject matter is not taught in ordinary secondary school (it is used here for the advantage of this review), the teacher is expected to use a folded paper to derive an ellipse. However, most mathematics teachers do not use it; they usually draw on the chalkboard. Arguably, this negatively influences students' attitudes toward learning mathematics, as observed by Blazar and Kraft [19].

To reveal the fact behind r = 0.12 showing ineffective use of natural/real objects teachers committed, a reference to a teacher teaching bookkeeping and accounts subject was taken into account. This revelation revealed that most teachers were not used to natural objects such as petty cash vouchers or cheques; they tended to use Audio or talk as if the documents were with them, while students had never seen those documents.

There are different categories of teaching aids, i.e., printed, Audio, visuals, audio-visual and natural objects [20]. However, visual aids and natural objects are insisted on when teaching Mathematics. These include using flip charts, chalkboards, manila sheets, natural objects, rulers, bisectors, semi-circles, three-dimensional figures, rectangles, triangles, and hexagonal. It is recommended that a teacher should demonstrate before forming group discussion, using the Jig Saw method or asking a student to solve mathematical problems on the chalkboard. The demonstration, which involves teaching aids, reminds students to do the same in groups and individually [21].

3.2. Informal behavior and the actions of students in mathematics learning

In this aspect, the study aimed to determine the positive influence of informal behavior in teaching mathematics. Such a behavioral act was assessed in terms of the

number of times a teacher used courageous words such that "mathematics is simple like other subjects such as civics." The positive relationship between a teacher behaving informally when Zan and Martino [22] also noted teaching and students' attitudes toward liking Mathematics. Other encouraging statement includes "nothing impossible under the sun." Table 2 below summarises whether Mathematics teachers used pleasing language, conducted remedial classes, represented the subject matter, and used extra time helping students in Mathematics.

Table 2. Descriptive Statistics

(N = 100)	Mean ($\bar{X}$)	Skewness	Kurtosis
Use of encouraging words	4.464	0.69	-0.59 (Platy kurtic)
Use of pleasing language	6.01	-4.42	2.04 (Leptokurtic)
Use of extra time	3.45	0.31	-0.35 (Platy kurtic)
Conducting remedial classes	6.47	3.42	1.03 (Leptokurtic)
Representation of the subject matter	4.32	-0.71	-1.25 (Platy kurtic)

Source: Researcher's Computations

With $\lambda = 4.464 < 10$, the acceptable threshold level as it is to measure skewness is $-0.69 < 0.00$ and kurtosis = -0.0.59 (platykurtic) < mesokurtic over the number of frequency teachers used to encourage words like 'mathematics is elementary' indicate non-linearity between the variables. This means mathematics teachings did not effectively use encouraging words but discouraging ones like "Mathematics is difficult. It is not like Kiswahili". Other discouraging words were, "the topic of Logarithm is difficult; even a teacher faced a challenge when he was in Form II." It is argued here that encouraging words give courage to students that everything is possible, only that someone has to put more effort to become effective in whatever is to be done.

Similar results were shown over the number of times teachers used pleasing language given –X = 6.01, coefficient of skewness -4.42 (left-skewed), and measure of kurtosis 2.04. This is to say that since mean (-X) = 10, skewness = 0.00, and kurtosis measure = mesokurtic are recommended levels, suggesting that the two variables did not tally. This indicates that the use of harsh language overrides pleasing language. Teachers used too many corporal punishments than guidance or simply giving students more exercises, assignments, tests, and examinations to adopt mathematical problem solving. This finding is in connection with Brown's [23] study, in which this was one of the reasons students dropouts from mathematics.

Using extra time in teaching mathematics, -X = 3.45, coefficient of skewness 0.31, and measure of kurtosis -0.35 violated the measure of central tendency, normal distributions, and flatness principles [24]. This means that teachers were not used to extra time teaching mathematics. Usually, and as it was found from the field was that after 8 hours and 30 minutes of working time lapse then, all teachers were observed evacuating from the school environment back home. Nevertheless, it was bad enough to find that teachers' residential homes were indeed not around the school environment but far from the school premises; thus, the possibility of turning back for remedial/evening classes was not there.

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The ineffective use of extra time was also shown with the number/frequency teachers use in these studies for helping the so-called slow learners and representation of the lesson. This was from the results -X = 6.47 < 10; coefficient of skewness (Zά) = 3.42 and measure of kurtosis 1.03 for frequency of conducting remedial classes and –X = 4.32, (Zά) = -0.72 and kurtosis -1.25.

3.3. Reflection on lessons and the behavioral act of students in Mathematics learning

In this aspect, the study examined the effects of lessons being reflexive and behavioral acts of students in mathematics teaching and learning. The use of symbols and variables say 'X' and 'Y' move students astray by thinking that the Xs and Ys are not in their living environment. No interpretation of and b's indeed graphs without interpreting them is one of the primary reasons students dislike mathematics because they lack meaning in their natural life. It should be known that "life is Mathematics and Mathematics is life" [25]. Asyoni further reported that "if someone is dull in Mathematics, he became dull even in other life dealings because life is mathematics."

Either it should be further known that whether it is pure or applied Mathematics, both have reflection/impacts on the real life of students. For instance, the logic/sets concepts have an application in Electronics and Electricity (in physics) by taking the case of the operation of logic gates. The (+ve) and (-ve) answers with Quadratic Equations have meaning over Wave motion and alternating current(in physics), which was also depicted by Tahar et al. [26]. Indeed polynomial functions with answers X1, X2, and X3 imply the business cycle, i.e., the business passes several stages, i.e., expansion (increasing), boom(constant), downturn, and depression (trough) or with product life cycle /Venture enterprise cycle the phases include:- introduction, growth, maturity, and decline. The (+) and (-) in quadratic function has implication over resultant forces or Newton's third law of Motion that F = Ma where F = M(V-U) or reaction (KX) and action (T) are equal and opposite. Moreover, the T= KX is also applied in simple harmonic motion (This is Hooke's Law in physics).

Linear algebra, Matrices, and Vector concepts give credit in solving the Serial/Linear relation problems with variables more than two, say, X, Y,…Z or X1, X2, X3,…This concept of Linear algebra is applied in economics/ business for solving general market equilibrium models while those with two variables, say X and Y; X1, X2 as it is with Qd=Qs called partial market equilibrium problem with;

$$Qd = a - bP \quad (1)$$

$$Qs = c + dP \quad (2)$$

Employ the Gauss elimination method two variables model as it is to equations 1(demand function) and 2 (supply function). Furthermore, differentiation (∂Y) and integration $\int(f(x)')$ are used in solving the ∂X.

Marginal productivity and total productivity of the business/economic activity, respectively. Again if the 'a' coefficient is favorable over a quadratic equation, i.e., $aX^2 +bX+C$, then this implies a Cost function, and when the 'a' coefficient is (-ve), i.e., aX^2+bX+C it implies Revenue function.

To reveal whether the Mathematics teachings were reflexive or not then, the HLM Model results in Table 3 post lay:-

Table 3. HLM Model

Predictors	Direct effects	Expected Value	Indirect effects			Total indirect effects	Total effects
			Good Behavioral Students	Attendance	Achievement		
1st cross loading							
Use of reflexive examples	0.23	0.3	0.19	0.21	N/ALL	0.20	0.22
Reflexive presentations	0.21	0.3	0.18	0.19	N/ALL	0.19	0.20
Collaborative teachings	0.22	0.3	0.20	0.17	N/ALL	0.19	0.21
2nd cross loading							
Use of reflexive examples	0.11	0.15	0.13	0.10	N/ALL	0.12	0.12
Reflexive presentations	0.14	0.15	0.12	0.13	N/ALL	0.13	0.14
Collaborative teachings	0.13	0.15	0.14	0.12	N/ALL	0.13	0.13

Source: Researchers' Computations

With HLM values < 0.3 for direct effects and indirect effects (for first cross-loading) and HLM value < 0.15 using the same attributes but for second cross-loading is an indication that teachers in most cases were not used to reflexive teachings. This is, therefore, the reason why the majority of students by HLM (1-0.2) > 0.8 (80%) were found to dislike Mathematics. The nonuse of reflexive examples, formative evaluation, and summative assessment revealed proof of why most students with HLM (1-0.3) > 70% were found to fail mathematics rather than essential simple Mathematics. The nonuse of reflection in the lesson revealed the non-reflexive presentation of subject matter and non-collaborating teachings.

In most cases, what was recognized by most young teachers was to be not used to transformative Mathematics teaching methodology but deposition. Majority of teachers who were more outstanding than (i.e., HLM > 0.7 found to teach or talk on themselves with the chalkboard with much solving. Those solving contained 'X' and 'Y'; P and Q; 'a' 'b' and 'c.' Either those variables lack their physical meaning to the natural living environment of students. This was then found to be the cause of most students being bored and, therefore, the ignition for students disliking Mathematics. This, then, plus the cognition of others dictating that Mathematics is complex, adds another burden.

Non-reflection of Xs and Ys used in mathematics in ordinary secondary schools is the cause of the increase in truancy and absentees, which was reported by Ostagard et al. [27]. The issue of truancy and absenteeism may be caused by others factors such as the harshness of a teacher or even poor learning/school environment, but non-reflection of the lesson is among the factors counting for the knowledge gap underhand. The existence of truancy in the field was proven by the found students from some schools hiding, dodging Mathematics sessions, while in other sessions such as 'Kiswahili,' such students were found to be there. Indeed the absenteeism was revealed by looking over the attendance registry to find that a student seemed to be present from attendance registry but not in class, especially during the Mathematics session.

4. CONCLUSION AND RECOMMENDATION

Mathematics carries a particular model or way of teaching and assessment for students like it. Since Mathematics is compulsory in ordinary secondary schools for every student to take, but if it could be not that, then it could experience none- of the students opt for it. The found behavior of students disliking Mathematics was revealed to be caused by ineffective use of teaching Aids, materials, and media; ineffective adoption of informal behavior and non-reflection of Mathematics subject matter taught.

Thus from this revealed gap, the study recommends That Teachers should be using teaching aids, media, and appropriate technology such that over the use of ICT. Mathematics teachers should be used to simulation. In addition, math teachers should make friends with their students and use bold and polite language. Mathematics teachers should also be strict in their assessments. Additionally, math teachers should spend extra time supporting students. More emphasis should also be put on remedial classes and the representation of subject matters to be part of the life of mathematics teachers. Lastly, mathematics teachers should give students many element exercises, quizzes, take-home assignments, tests (weekly, monthly), and examinations for them used to mathematical problems solving.

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