Low Academic Performance in Mathematics amongst Learners with Visual Impairment; A Case of Two Colleges of Education in Zambia.

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ABSTRACT

This study is focused on the academic performance of the students with visual impairment in mathematics at colleges of education. The main objectives of the study were, to establish challenges encountered in learning mathematics by learners with visual impairment and to establish the best practices for students with visual impairment in terms of their academic performance in Mathematics. The study was conducted at Malcom Moffat and Mansa colleges of education because the institutions had students with visual –impairment and were taking mathematics.

This study used qualitative research paradigm and case study as a research design. Data was collected using qualitative method. Thus the instruments for data collection included the focused group discussion for lecturers, structured interview schedule for students with visual impairment and observation checklist for both students and the lecturers.

The study discovered that students with visual impairment performed poorly in mathematics in class activities. The challenges being faced with were that of not understanding mathematics concepts being taught due to the teaching methods being used which were not multisensory approaches, of using materials which were not tactile in nature or adaptive, materials being not user friendly, of their needs not being met, negative attitude such as not having a good relationship with their lecturers and that of depending on their sighted peers. The best practice with regard to instructional materials in teaching mathematics were established such as the need for the lecturers to use adaptive instruction materials, teaching and learning materials which involve the sense of touch combined with the remaining senses other than sight. The best practices established for the instructional approaches to be used were such as, multisensory approach, individual teaching, modified teaching approaches according to the needs of the students and the use of recorded lessons. The established best practice in terms of the lecturers' attitude towards students with visual impairment in learning mathematics were that of showing positive attitude, attention, love and care, not neglecting learners, building students' self-esteem and motivating them through words of encouragements.

Keywords: Students with visual impairment, mathematics, lecturers, attitude, academic performance, teaching materials and methods

INTRODUCTION

Students with visual impairment have not been performing well in the course of Mathematics. There has been a lot of support towards learners with visual impairment at international level. For example, the

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American Foundation for the Blind (2008) has supported learners with visual loss by removing barriers and creating possibilities so that leaners with visual loss can achieve their full potential. However, the academic performance of visually impaired students in Mathematics remains poor. For instance Megan (2012) carried out a research in Michigan in the United States of America on "students with visual impairment and math: 'impact of practice on achievement and attitude". The researcher reveals that the achievement in mathematics among blind and severely visually impaired persons is, and always has been extraordinarily low" compared to students with sight

In Africa learners with visual impairment are also supported in a number of ways. For instance, the South African National Council for the Blind (2018) supports students with visual impairment by training them at colleges. Nevertheless, the issue of failing Mathematics in colleges by students with visual impairment still stand. For example Mbulaheni (2015) carried out a research in Gauteng and Pioneer in Western Cape in South Africa and the research was based on 'teaching science and mathematics to students with visual impairments: Reflections of a visually impaired technician'. The study tells us that blind and partially sighted learners find it difficult to pursue mathematics because the resources are limited and teachers are not prepared to do their best to resolve the problems they encounter in putting the subject matter across to their learners.

In Zambia learners with visual impairment receive various kind of support. For example, McCall (2015) states that the Zambian inclusive education programs aim at improving quality education for the blind and low vision students. Nevertheless students still fail to perform well in mathematics. For example Akakandelwa and Munsanje (2012) conducted a research on the provision of learning and teaching materials for pupils with visual impairment: Results from a National Survey in Zambia. The researchers discovered that most children with visual impairment appeared to perform poorly in their studies. This study was only conducted at secondary school and not the college of education.

There has been support of various ways from the international, in Africa and at national level. The gap is that despite the support being given to the students with visual impairment at college of education the issue of failing Mathematics still remains and has not been investigated. Therefore this study researched on the failing of Mathematics by the students with visual impairment in two colleges of education in Zambia.

Statement of the problem

Students with visual impairment at college level who have been taking Mathematics have not been performing well. This is supported by Lynn (2012) who stated that students who took Mathematics at college level did not perform well because the pass rate indicated that only four percent passed the subject and ninety-six percent did not pass. There has not been any study to investigate the issue of failing Mathematics by students with visual impairment in a Zmbian context at college of education level and the issue remained unknown. Hence this study investigated the issue of failing Mathematics by the students with visual impairment in two colleges of education namely: Mansa and Malcom Moffat Colleges of Education.

Objectives

The study was guided by the following objectives:

1. To establish challenges encountered in learning mathematics by learners with visual impairment at colleges of Education.

2. To establish best practices for students with visual impairment in terms of their academic performance in Mathematics.

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FINDINGS

In order to establish challenges encountered in learning mathematics by learners with visual impairment at the two colleges of education under study, the researcher used interviews, focused group discussions and observation checklist. Data was obtained from the students with visual impairment, Heads of department (HODs mathematics), Heads of section as well as from the lecturers with special education background handling these students. Data was presented using the subthemes namely, instructional materials and instructional approaches in teaching mathematics and the lecturers' attitudes towards students with visual impairment. Before establishing the challenges the researchers embarked on establishing the participants' awareness concerning the students' performance in mathematics.

When the researchers asked ten students with visual impairment during an interview about whether they performed well or poorly in mathematics, the findings indicated that all the students with visual impairment gave common responses and agreed that they performed poorly in mathematics during classroom activities as well during public examinations. This was indicated in their responses. For example, student "A" with visual impairment from College of education [A] indicated that *'I have not scored above 40% in all the mathematics tests I have written so far.'* Student "B" from College of education [A] said that *'I don't perform well in mathematics.' S*tudent "C" from College of education [A] added that *'I perform poorly in mathematics during both class exercises and tests or national examinations.*' Student "D" from College of education [A] indicated that '*passing mathematics is my dream which I have never achieved to pass ever since I came into this college.'* Student "A" from College of education [B] narrated that *'I cannot remember the time I passed a test in mathematics from the time I was enrolled into this college.' S*tudent "B" from College of education [B] stated that *"I pass mathematics tests with marks not exceeding 41%.'* Student "C" from College of education [B] indicated that *"my results in mathematics are bad I only pass through markup tests and assignment.'* Student "D" from College of education [B] added that *'I don't think the blind students and those without proper sight can pass mathematics.'*

During focused group discussions with Heads of department of mathematics section as well as lecturers handling students with visual impairment, the question was posed to find out if the students with visual impairment performed well or poorly in mathematics. The two lecturers, "A" and "C" from college A and "A" and "B" from college B mentioned that students with visual impairment performed poorly in mathematics. Lecturer "A" from College of education [A] further said; *'the performance of students with visual impairment cannot be compared to their sighted peers because they don't see anything during mathematics lessons and this is the reason they are experiencing poor academic performance.'* Lecturer "B" from College of education [A] also said that *'students with visual impairment in my class don't perform well in mathematics.'* HOS "A" from college A and HOS "B" from college B said that learners with visual impairment do not performed well in mathematics. For example Head of section "A" from College of education [A] said that '*these students cannot perform well because they cannot see and mathematics demands the use of eyes.*'.

In order to find out whether the students with visual impairment performed well in mathematics or not, the researchers had to observe classroom activity where the class with visual impairment at College of education [A] were learning 'sub sets'. The lecturer started the lesson by making a recap of what the students talked about in the previous lesson. The recap was in form of question and answer technique. The sighted students provided correct answer to all the questions asked by the lecturer.

Afterwards, the lecturer introduced a new topic 'subsets' and wrote it on the chalk board. The lecturer explained that 'a subset is a set within another set.' The lecturer gave examples of some common subsets. It was explained that College of education [A] was a subset of colleges of education in Zambia and Zambia

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was a subset of countries in Africa. Furthermore the lecturer displayed a chart which had some examples of sets and the students were required to form subsets individually.

It was observed that no sighted students had challenges when making subsets. However, a student with partial visual impairment had to struggle to copy the work from the chart especially that the chart was in small prints and the two students who were totally blind did not even copy. The lecturer and the researchers went round to check what the students were doing. It was discovered that only one student with partial visual impairment out of the three who were in that class formed the correct sets but the two totally blind could not. When it was time to conclude the lesson, the lecturer confirmed that mangoes, oranges, apples and lemons were a subset of fruits while cat, dog, goat and sheep were a subset of domestic animals.

During class exercise, the lecturer took another chart which had jumbled words and students were asked to sort the words into their main sets. The student with partial visual impairment struggled to copy the work on the chart into the exercise books because the chart was in small prints and the words were clustered. The exercise was to be done in thirty minutes and it appeared the work was very simple to the sighted students because they completed the work within ten minutes. However, the student partial with visual impairment took time to complete the task and with help from their sighted peers. After marking, student with partial visual impairment got one out three while the other two student with visual impairment did not write anything. It was also observed that the lecturer did not mind about the condition and needs of the students with visual impairment but concentrated much on the sighted students. It was observed that the lecturer's attitude towards the students with visual impairment was not good.

CHALLENGES ENCOUNTERED IN LEARNING MATHEMATICS BY LEARNERS WITH VISUAL IMPAIRMENT AT COLLEGES OF EDUCATION.

Instructional Materials

In order to ascertain the challenges concerning the instructional materials which were used when teaching mathematics to the students with visual impairment and how it affected their academic performance, a question was posed to the students with visual impairment and responses given were found in the following statements. For example, *S*tudent "A" from college of education [A] said that '*the instructional materials used are not of great help to me during mathematics lessons and they make learning of mathematics difficult because they are not in tactile form'*

*S*tudent "B" from college of education [A] said that '*the use of teaching and learning materials which involve the use of sense of sight are not helping in experiencing the real learning of mathematics concepts.' S*tudent "C" from college of education [A] maintained that '*instructional materials used at this college have very small prints and I can't manage to read them from the charts and because of that learning of mathematics is becoming very challenging to me.*

*S*tudent "D" from college of education [A] echoed that "*for me to learn mathematics with learning materials which are not in Braille which is being used here becomes a challenge and is a sheer waste of time because I totally can't see anything. S*tudent "A" from college of education [B] narrated that "*learning mathematics has become difficult because the instructional materials used are sighted oriented.*' *S*tudent "B" from college of education [B]' said that *"learning of mathematics at this college is a challenge to me because using the sense of sight combined with the sense of hearing is not very helpful for me and I am failing to use materials while learning mathematics.*

The heads of department, heads of section and lecturers handling students with visual impairment were asked during a focused group discussion about the instructional materials used during mathematics lessons

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VI June 2024

and how they affected the academic performance of the students with visual impairment. The responses of these participants were shown in the following statements. For instance, Lecturer "A" from College of education [A] stated that "*there is need to use instructional materials that can suit the students with visual impairment because the materials used are not user friendly because they are not tactile and they don't stimulate learning among the students with visual impairment."* Lecturer "B" from College of education [A] mentioned that "*the use of instructional materials which involve the use of sight are not beneficial and possess a challenge to the students with visual impairment especially that some of them are not able to see anything.*

The head of section from college of education [A] stated that *'the instructional materials used in mathematics lessons pose a challenge to students with visual impairment because they are neither in Braille nor large prints.* Lecturer "A" from College of education [B] explained that '*the instructional materials we are using don't make any sense to the students with visual impairment because they do not involve 'touch' and this makes them lose truck during mathematics.* Lecturer "B" from College of education [B] said that *'the best instructional materials for the students with visual impairment are those which involve the use of 'touch' but the instructional materials we use in mathematics lack this component and as such students fail to learn mathematics effectively.'*

The lecturers' Attitudes

In order to find out from the respondents about their experience on the attitudes the lecturers had on the students with visual impairment and how it affected or helped the performance of the students with visual impairment and learning of mathematics at colleges of education, the researcher used, interviews and focused group discussion.

During an interview with students with visual impairment at college of education [A], a question was posed about the lecturers' attitudes towards the students with visual impairment and how it helped or affected the academic performance or learning of mathematics. The responses concerning the lecturers' attitudes were in the following statements.

For instance, student "A" from college of education [A] stated that **"**lecturers *don't look at us as people who can learn mathematics and as such we feel like we are second class citizens in our learning this to me is a challenge when I am learning mathematics.'* Student "B" from college of education [A] confirmed that *'the lectures have no regard for us and all they do is to concentrate on our sighted friends in mathematics lesson to me this is a challenge when I am learning mathematics and it consequently make me miss out a lot.* Student "C" from college of education [A] said that *'I would personally say that the lecturers don't consider me as an active member of the class just because I don't answer oral questions and I am really neglected this is a great challenge to me.'* "Student "D" from college of education [A] mentioned that *'I can just say that the lecturers have no love for the students with visual impairment and this is challenge leading to the reason why we cannot perform very well in mathematics but we need to be loved and be treated equally as our sighted peers.'*

Student "A" from college of education [B] said that *"I don't learn mathematics properly because our lecturer has negative attitudes towards me and I am rated to be a person who cannot learn mathematics and this is a big challenge to me."* Student "B" from college of education [B] said that *'the relationship which lecturers have developed with students with visual impairment is not good and is really a challenge when I am learning mathematics because it doesn't promote learning.'* Student "C" from college of education [B reported that "*as students with visual impairment, we are not well accommodated in the classrooms and our individual needs are neglected and is a challenge.*

On the other hand, when lecturers handling students with visual impairment were asked about the lecturers'

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VI June 2024

attitudes towards the students with visual impairment and it affected or helped the students to learn mathematics. Lecturer "A" from College of education [A] reported that *"the students with visual impairment are not treated well by most of the lecturers which demoralize them from learning mathematics and this is a big challenge to them."* Lecturer "B" from College of education [A] echoed that *'these students would waste much of my time because they find it difficult to learn it is a challenge teaching them.* Lecturer "C" from College of education [A] said that *'these students cannot learn mathematics well because we heavily depend on the sighted friends who might not be there at certain times.''* The head of department from college of education [A] further explained that *'lecturers become irritated when students with visual impairment are enrolled in their classrooms because they feel that these learners impose more problems on the lecturers.*

Lecturer "B" from College of education [B] *said that 'the student with visual impairment can only learn mathematics with partial vision.'* Head of department from college of education [B] added that '*these students cannot learn mathematics because they are not encouraged and motivated by their lecturers.*

INSTRUCTIONAL APPROACHES USED IN TEACHING AND LEARNING MATHEMATICS

In order to find out from the respondents about the instructional approaches the lecturers used and how it affected or helped the performance of the students with visual impairment and learning of mathematics at colleges of education, the researcher used, interviews and focused group discussion and observed two lessons.

Concerning the challenges students encountered the lecturers responded in the following ways; Lecturer "A" from College of education [A] narrated that *"I am aware that some of the challenges such as failing to understand mathematical concepts which these students face while learning mathematics are coming from the learning instructional approaches which I use such as demonstration method but I have no skills to handle these students efficiently"*. One head of section from college [A] who is also handling students with visual impairment mentioned that "*I use the demonstration method when teaching students with visual impairment and this is a challenge to learners with visual impairment because they cannot see what I am demonstrating."*

Lecturer "D" from College of education [B] echoed that "*the students are subjected to the four learning instructional approaches namely exposition, demonstration, question and answer and class/group discussion without bringing in the multisensory approaches, this is a great challenge to them because they need individual teaching approach"*

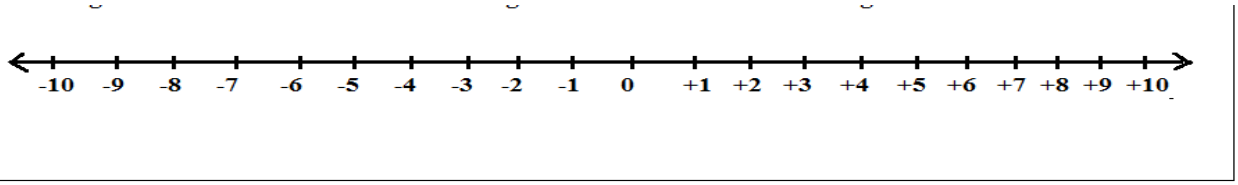
Student "A" from college of education [A] stated that 'our lecturers are fond of explaining the concepts for so long without using the methods which can allow us to use other senses and we are challenged. Student "B" from college of education [A] explained that '*the instructional approaches our lecturers use does not involve the use of other senses other than the use of sense of sight.'* Student "A" from college of education [B] explained that 'the methods used during mathematics lessons are depended on demonstration and as such we fail to grasp mathematical concepts.'

Some of the lecturers' and students' responses were confirmed in a mathematics lesson observed at college of education [A] on a topic 'Addition of integers." The lesson was presented to a class of second year students pursuing primary teachers' diploma and the class had two students with visual impairment. The lecturer started by introducing the topic "integers". The lecturer told the students that the term integer refers to the negative and positive numbers including zero. The lecturer further explained that these numbers are put on the number line and zero is in between the positive and negative numbers. The lecturer explained that

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VI June 2024

despite a bigger value of a negative integer, it is smaller than zero or positive one. Thereafter, the lecturer demonstrated to the students how to add integers and was writing whatever he was talking about on the white marker board. Unfortunately the students with visual impairment were not able to see what the lecturer was demonstrating. Further the lecturer took a chart where the number line was drawn and he was referring to it when demonstrating the concepts about addition of integers. Figure 1: shows the number line which was used by the lecturer.

Figure 1: The number line used during the lesson observation on integers



After demonstration, the lecturer assigned one student to find the answer for the question -6 + (-3) on the board using the number line. The student also demonstrated how to find the answer to the given question but the two students with visual impairment were not able to grasp any concept from their sighted peer who was demonstrating on the board. After a demonstration from a student the lecturer created five groups of six students and two groups had one student with visual impairment each. The group assignments were as follows;

Group 1. -5+ (-1+5) + (+5) = Group 2. -9 + (-1) + (-7+12) = Group 3. +4 + (-3) + (-4) =

Group 4. -2 + (-7+5) + (- 6) = Group 5. +3 + (-4 + 3) + (5) =

To do this work, the students were given five minutes and after five minutes, group representatives were called to do the reporting and from the six students who came in front, there was no student with visual impairment. Each group representative had to show how the group arrived at the answer and all the working was to be shown on the board. The following answers were given by respective groups:

Group 1. -5+ (-1+5) + (+5) = **+9** Group 2. -9 + (-1) + (-7+12) = – **5**

Group 3. +4 + (-3) + (-4) = –**7** Group 4. -2 + (-7+5) + (- 6) = –**6**

Group 5. +3 + (-4 + 3) + (+5) = **+7**

The lecturer concluded the lesson by asking the students oral questions and it was observed that none of the two students with visual impairment participated in answering oral questions. Some students in class kept on laughing at the 2 students with visual impairment who were not participating and the lecturer interjected by saying that ‘let’s take our books and write our exercise. A class activity was given to the students and the lecturer went round as the students were writing their exercise. The lecturer kept on marking each student as they raised up their hands to indicate that they had completed the class exercise. Most of the sighted students did very well, except for the students with visual impairment who had challenges in using the number line to find their answers.

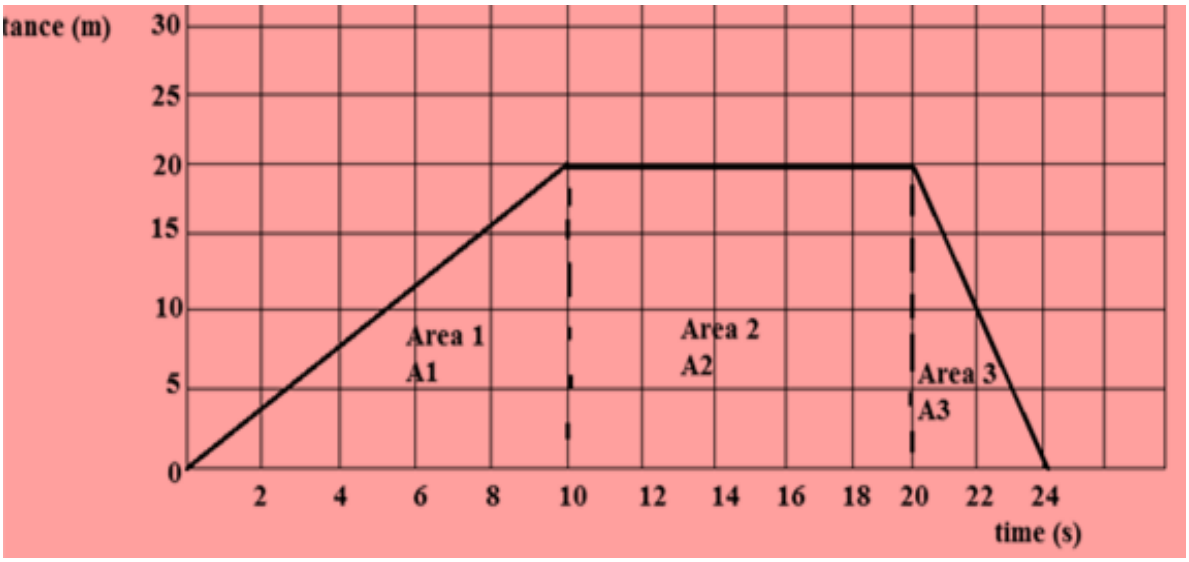
The researchers observed students with visual impairment facing the challenge of not understanding the concepts of using number line and adding using number line.

The responses from the lecturers and students with visual impairment were also confirmed during a lesson

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VI June 2024

observation made at college of education [B] on the topic 'distance-time graphs.' This lesson was presented to 35 students of which 3 were students with visual impairment. It was noted that the lecturer used the following instructional approaches and these were exposition, question and answer, demonstrations and group discussion. The lecturer introduced the topic by referring to a car ascending a hill. The lecturer later explained that the total distance covered by a car can be calculated using the area around the graph. The lecturer further took a graph which was drawn on a piece of Manila paper and demonstrates how total distance can be calculated using the area of a rectangle as well as the area of a right-angled triangle. Figure 2 showed the graph used by the lecturer to explain how the distance covered by a car could be calculated.

Figure 2: Calculating the total distance under a graph



The lecturer explained that the total distance covered by the car could be calculated by summing up the values of area 1, area 2 and area 3. The lecturer explained that area 1 could be calculated using the formula of triangle such as; area = half base X height; $A = \frac{1}{2}bh$

The lecturer further stated that the area of a rectangle could be calculated by using the formula; Area = length X breadth (A= LB). As the lecturer was explaining this, was also pointing at the areas 1, 2 and 3. The lecturer explained that A_1 and A_2 could be calculated using the same formula $A = \frac{1}{2}bh$. Unfortunately the students with visual impairment were not able to see the areas 1, 2 and 3 which the lecturer was pointing at. Furthermore the lecturer combined exposition with demonstration and demonstrated how to calculate area 1. Using question and answer, the following information for area 1 ($A_{1)}$ was obtained from the students;

Base = 10 Height = 20 Area = x (unknown)

The following calculations were done by the lecturer using data which was obtained by the members of the class.

$$A1 = \frac{1}{2}bh = \frac{1}{2}X\ 10\ X\ 20 = 100m$$

After a demonstration, the lecturer divided the class into seven groups comprising five members each and 3 groups had a student with visual impairment each. When group discussion was effected in the lesson, the three students with visual impairment were observed not contributed their ideas to the discussion thus they remained passive or not actively involved.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VI June 2024

The students started writing their class exercise the lecturer gave them and those with visual impairment faced the challenge of copying the questions which were in small print. The lecturer went through to check those who completed the question. Surprisingly, no student with visual impairment completed the question and the lecturer concluded the lesson by confirming the answer through this calculation

Area 2 = L x B

= 20m x 10m

= <u>200m</u>

Area 3 = $\frac{1}{2}$bh = $\frac{1}{2}$X 4m X 20m = 80m

Total distance = Area 1 + Area 2 + Area 3

= 100m + 200m + 80m

= <u>380m</u>

It was observed by the researchers during the lesson that, the three students with visual impairment faced challenges of not understanding the concept of distance-time graph due to the methods being used and as a result they did not participate in the discussion. Besides, the students with visual impairment were not able to see what was written on the Manila paper and on the board and this also contributed to the issue of not understand the mathematical concept they were learning during the lesson. It was also noted that when using the expository method was being used students did not receive relevant skills because they needed to be shown through touch of what was being talked about at an individual level.

BEST PRACTICES ESTABLISHED IN TEACHING MATHEMATICS TO THE STUDENTS WITH VISUAL IMPAIRMENT IN COLLEGES OF EDUCATION.

With regards to the best practices in teaching mathematics to students with visual impairment, data was collected from students with visual impairment, heads of department (mathematics) heads of section and lecturers handling students with visual impairment. The researchers used the interviews and focused group discussion to probe the responses on the best practices in teaching mathematics to the students with visual impairment. Furthermore, the researchers used the four themes namely; the instructional materials, the instructional approaches and the lecturers' attitudes towards learners with visual impairment to ascertain these best practices.

Instructional Materials

In order to ascertain the best practices concerning instructional materials which could be used to teach mathematics to the students with visual impairment, a question was posed to the students with visual impairment and a variety of responses was given. For example, student "A" with visual impairment from college of education [A] suggested that '*adaptive instructional materials could be of great help to me during mathematics lessons.'* Student "B" from college of education [B] said that '*the use of teaching and learning materials which involve touch could help us learn mathematics more effectively.'* Student "C" with visual impairment from college of education [A] maintained that '*instructional materials with 'touch' must be used to cover up our loss of sight in mathematics lessons.'*

Additionally, student "B" with visual impairment from college of education [A] said that "*for me to learn mathematics well there is need for the lecturers to use instructional materials which involve touch."*

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VI June 2024

Student "D" with visual impairment from college of education 'A' said that *"using the sense of touch combined with the sense of hearing can be very helpful for me to learn mathematics"*

When the heads of department, heads of section and lecturers handling students with visual impairment were asked during a focused group discussion about the best instructional materials which could allow the students with visual impairment to learn mathematics at colleges of education with less difficulties, their suggestions and responses were shown in the following statements.

Lecturer "A" from college of education [A] stated that "*there is need to make and use embossed instructional materials that can suit the students with visual impairment which we lack here."* Lecturer "B" from college of education 'A' said that "*I propose that it is important to use instructional materials which involve the use of other senses apart from sight so that these students can learn mathematics well.'* The head of section "A" from college of education [A] suggested that *'there was need for the government to provide enough adaptive instructional materials for the students with visual impairment at college level.'* Lecturer "C" from college of education [A] suggested the use of talking calculators will be of help when learning mathematics"

Lecturer "A" from college of education [B] also suggested that *"using pre-recorded lessons as instructional materials can be a beneficial thing to them."* Head of department "A" from college of education [B] suggested that *'since the instructional materials used during mathematics are not enough to make the students with visual impairment learn mathematics well it could be good for the lecturers to make more materials for the actual lesson."* Lecturer "A" from college of education [B] suggested that '*the use of Brailed instructional materials for those who are totally blind in all the mathematics lessons and using large prints for those who are partially sighted could be a possible solution."* Lecturer "B" from college of education [B] said that *'the best instructional materials for the students with blind are those which involve the use of 'touch'.*

Instructional Approaches

In order to probe from the respondents about the best practices in terms of instructional approaches which could be used to teach mathematics to the students with visual impairment, the question was posed to the students in an interview and their responses were reflected in the following statements. For instance, student "A" from college of education [A] indicated that '*the approaches to be used in mathematics lessons should involve the use of my remaining senses.' S*tudent "B" from college of education [A] suggested that ' *using demonstration approach alone in teaching mathematics is only fair to those students with sight, not to me but eclectic method such as question and answer, lecture and group method.'* Student "C" with visual impairment from college of education [A] proposed that *"lecturers should avoid using approaches which stressed the use of the sense of sight such as picture method.'* Student "D" with visual impairment from college of education [A] maintained that *'I personally cannot fail mathematics if the instructional approaches used in class are not based on the use of the sense of sight.'*

Student "A" with visual impairment from college of education [B] proposed that *'lecturers should by all means avoid using teaching methods in which they us terms such as "look at this" while they are pointing to something on the board or chart or number line."* Student "B" from college of education [B] added that " *learning mathematics become difficult if the instructional approaches being used by lecturers do not involve the use of other senses apart from the sense of touch there is need to combine sense of touch with sense of hearing ."* Student "C' with visual impairment from college of education [B] said that *'approaches which rely on lecturers' explanation are not good for students with visual impairment and there is need to use methods which involve the use of other senses.' S*tudent "C" from college [B] said that '*I don't enjoy teaching which involves putting us in groups with those who are able to see because we are disadvantaged and it is better to use individual teaching especially to us who are blind.'* Furthermore, student 'D" from

college of education [B] mentioned that *'I wouldn't like to learn from a lecturer who keeps on explaining the concepts but I would rather learn from someone who can give us time to analyze our tasks and allow us to think critically on our own after a bit of explanations.'*

On the other hand lecturers were asked during a focused group discussion about the best practices in terms instructional approaches which could be used in teaching mathematics at colleges of education. For instance, lecturer "A" from college of education [A] suggested that *"the use multisensory learning methods could be a solution that can overcome dependency on sighted learners during mathematics lessons."* Lecturer "B" from college of education [A] mentioned that, according to my experience, the lecturer based approaches such as exposition and demonstration are not helpful to the students with visual impairment. The head of section "A" from college of education [A] stated that '*using multisensory approaches in teaching mathematics to the student with visual impairment could be the only solution to effective learning of mathematics among the students with visual impairment, these students perform poorly in mathematics mainly due to their loss of sight.'*

'Lecturer "A" from college of education [B] unveiled that *'demonstration is not a good method to be used when teaching mathematics to the students with visual impairment because the students are not able to see what is being demonstrated. Instead the approaches to be used in learning of mathematics should involve the other senses other than the sense of sight and the creativity of the lecturer.'* Lecturer "B" respondent from college of education [B] suggested that *"it could be better if some of the teaching approaches are to be modified according to the needs of the students to allow them experience their own learning."* Lecturer "C" from college of education [B] said that *'these students cannot learn mathematics well when lecturer heavily depend on the methods which stress the use of the sense of sight and make them depend on the sighted peers who might not be there every time they may need such help from them.'* Lecturer "D" from college of education [B] stated that *'using multisensory teaching approaches as well as individual teaching can allow the students to learn mathematics effectively rather than relying on the methods which demand for the use of the sense of sight and help from sighted peers.'*

The Lecturers' Attitudes

In order to probe from the respondents about their experience on the attitudes the lecturers had on the students with visual impairment, the researcher used, interviews and focused group discussion.

During an interview with students at college of education [A], a question was posed about the best practices on the lecturers' attitudes towards the students with visual impairment and some of their responses were in the following statement;

Student "A" from college of education [A] confirmed that *'Lecturers need to have love for the students with visual impairment for them to perform very well in mathematics.* Student "B" from college of education [A] narrated that 'we *continue performing poorly when we are totally neglect and ignore in mathematics lessons thus we need lecturers care.*' Student "B" from college of education [A] stated that *'I have not received much love from our mathematics lecturer but other students and I with visual impairment need to be loved fully and be treated equally like our sighted peers.'*

When the students from college of education [B] were interviewed, their responses were in the following statements. For example, student "A" said that *'I need attention from our lecturers'.* Student "B" from college of education [B] said that *'I don't perform well in mathematics but the chances of improving are there if the lecturers are able to monitor my progress in classroom activities especially during the learning process with care and love.*

On the other hand, during focus group discussion when lecturers handling students with visual impairment

were asked about the best practices in terms of lecturers' attitudes towards the way students with visual impairment learn mathematics, they responded to this question with different views. For example lecturer "A" from college of education [A] suggested that *'these students need our attention and love for them to learn better.'* The head of department "A" from college of education [A] further suggested that *'lecturers should show care by going round the groups and see what the students with visual impairment are doing.*' The head of department "B" from college of education [A] confirmed that *'generally students with visual impairment perform poorly in mathematics because as lecturers we don't meet their individual needs thus the best way is to meet their needs.'*

Lecturer "A" from college of education [B] also suggested that 'the students with visual impairment can learn mathematics if we are to build self-esteem, independence and autonomous in them.' In addition, lecturer "B" from college of education [B] suggested that *"there is need for us to have positive attitude through the provision of independent learning skills to students with visual impairment as opposed to letting them depend on us and their sighted peers.'* The head of department "A" from college of education [B] added that *these students can learn mathematics very well if we are to encourage and motivate them in and outside the classrooms.* Lecturer "C" from college of education [B] indicated that '*these students can perform well if we develop positive attitude towards them, encourage and motivate them fully*.'

DISCUSSION

This section discusses the findings of the study according to different categories of themes which were in line with the objectives which were set in this study. The discussion ends with a conclusion and recommendations.

This study discovered that all the students with visual impairment performed poorly in mathematics during classroom activities as well during public examinations. For instance *S*tudent "C" from College of education [A] stated that *'I perform poorly in mathematics during both class exercises and tests or national examinations.*' The findings of this study was in agreement with Megan (2012) who carried out a research in Michigan in the United States of America on "students with visual impairment and math: 'impact of practice on achievement and attitude". The researcher reveals that the achievement in mathematics among blind and severely visually impaired persons is, and always has been extraordinarily low" compared to students with sight.

In line with this research finding, it is the researchers were in agreement that the students with visual impairment performed poorly in mathematics. If interventions were put in place, students with visual impairment would have performed better in mathematics.

Basing on the empirical evidence of the study the best practice with regard to instructional materials in teaching mathematics to students with visual impairment at colleges of education were established such as the need for the lecturers to use adaptive instruction materials, teaching and learning materials which involve the sense of touch combined with the remaining senses other than sight which can help them perform well academically. For example, student "A" with visual impairment from college of education [A] suggested that '*adaptive instructional materials could be of great help to me during mathematics lessons.* The findings of the current study corresponded to the model by Alan (2008) who stated that instructional materials to be used in a classroom where there are learners with visual impairment should be adaptive in nature.

In this vein, it is the researchers' opinion that if the instructional materials are not adapted in nature, learning of mathematics by the students with visual impairment would be affected and in turn this would affect the academic performance of the students with visual impairment.

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The study established the challenges students with visual impairment were being faced with while learning mathematics which contributed to their low performance such as not understanding mathematics concepts being taught due to the teaching methods being used which were not that of multisensory approaches, of using materials which were not tactile in nature or adaptive, materials being not user friendly, of their needs not being met, negative attitude such as not having a good relationship with their lecturers and that of depending on their sighted peers.

The findings of this study is in line with that of Megan (2012) who carried out a research in Michigan in the United States of America on "students with visual impairment and math: 'impact of practice on achievement and attitude". The researcher reveals that the achievement in mathematics among blind and severely visually impaired persons is, and always has been extraordinarily low" compared to students with sight. There are many reasons why this is so, including the visual nature of math, delayed development of concepts needed to understand math and lack of necessary knowledge among teachers of students with visual impairment. However, students with visual impairment have the capacity to learn mathematics if all the necessary logistics are put in place. Similarly. Chengeti, (2015) conducted a research in Kalulushi and Kitwe, Zambia and his research was on the perception of students and teachers on learning mathematics by students with visual impairment in secondary schools. The research reveals that traditionally, the general attitude for the visually impaired people in many societies had negative connotations. In a classroom situation, the researcher disclosed that there is a social stigma on students with visual impairment an attribute which impedes their academic, social and economic welfare. The researchers were also in agreement with Brawand and Nicole (2016) who conducted a research on effective methods for delivering mathematics instruction to students with visual impairment in Kutztown Canada. The researchers disclosed that some challenges that students with visual impairment encounter when learning mathematics can be overcome when the content is taught in an appropriate manner, such as by using adaptive materials. The researchers pointed out that the use of adaptive materials such as the abacus, the Nemeth Code for braille mathematics and the tactile graphics, or "graphics intended to be read principally by touch rather than vision.

Basing on the findings of this study student at the two colleges faced the challenges which need to be addressed if they are to improve their low performance.

The findings of this study established the best practices for the instructional approaches to be used to the students with visual impairment in learning mathematics such as, multisensory approach other than the use of the sense of sight, individual teaching, modified teaching approaches according to the needs of the visually impaired students and the use of recorded lessons for helping them to perform well academically. For instance, lecturer "A" from college of education [A] suggested that *"the use multisensory learning methods could be a solution that can overcome dependency on sighted learners during mathematics lessons."* The findings of the current study correlated with the findings of Kiarie (2004) who carried out a research on education of students with visual impairment in Kenya. The findings indicated that obstacles also exist in the area of adaptations of instructional approaches for students with visual impairments and some subjects such as mathematics because approaches used stressing the use of the sense of sight and this made it extremely hard for students with visual impairments to access education.

It is the researchers' view that if the multisensory instructional approaches are used in teaching mathematics to students with visual impairment they could learn mathematics very well and their academic performance could improve.

The findings of this study established best practice in terms of the lecturers' attitude towards students with visual impairment in learning mathematics such as; showing positive attitude, attention, love and care, not neglecting learners, building students' self-esteem and motivating them through words of encouragements which can help them perform well academically. For instance lecturer "C" from college of education [B]

indicated that '*these students with visual impairment can perform well if we develop positive attitude towards them, encourage and motivate them fully*.' The findings of the current study were in line with the findings of Chengeti, (2015) who conducted a research in Kalulushi and Kitwe, Zambia and the research was on the perception of students and teachers on learning mathematics by students with visual impairment in secondary schools. The research revealed that traditionally, the general attitude for the visually impaired people in many societies had negative connotations on their performance. In a classroom situation, the researcher disclosed that there is a social stigma on students with visual impairment an attribute which impedes their academic welfare.

In similar vein, it is the researchers' view that if the lecturers' attitude towards students with visual impairment in learning mathematics shows positive attitude, attention, love and care, not neglecting learners, building students' self-esteem and motivating them through words of encouragements, the academic performance could improve.

CONCLUSION

The findings concerning the academic performance of students with visual impairment in mathematics during classroom activities indicated that the students performed poorly in class activities despite attending lessons. The study findings unveiled that the lecturer had negative attitude towards the learners with visual impairment and this affected or posed a challenge to the way students with visual impairment learnt mathematics at colleges of education as well as their academic performance in mathematics. Basing on the empirical evidence of the study on instructional materials in teaching mathematics to students with visual impairment at colleges of education, the study revealed that, lecturers did not use adaptive instruction materials, teaching and learning materials which involve the sense of touch. The lecturers also did not use multisensory approaches when teaching students with visual impairment.

The best practice with regard to instructional materials in teaching mathematics to students with visual impairment at colleges of education were established such as the need for the lecturers to use adaptive instruction materials, teaching and learning materials which involve the sense of touch combined with the remaining senses other than sight. The study established the best practices for the instructional approaches to be used to the students with visual impairment in learning mathematics such as, multisensory approach other than the use of the sense of sight, individual teaching, modified teaching approaches according to the needs of the visually impaired students and the use of recorded lessons. The established best practice in terms of the lecturers' attitude towards students with visual impairment in learning mathematics were that of showing positive attitude, attention, love and care, not neglecting learners, building students' self-esteem and motivating them through words of encouragements.

RECOMMENDATIONS

The recommendations from this study are that if students with visual impairment are to perform well academically in their mathematics course;

1. The lecturers need to use adaptive instruction materials and these are teaching and learning materials which involve the sense of touch combined with the remaining senses other than sight when teaching learners who are blind. For example raised maps which are embossed, talking calculator and computer screen and smart phone, the abacus, the Nemeth Code for braille mathematics and the tactile graphics, or "graphics. For learners who are partially sighted they need text books, class exercise and tests or national examinations with large print as adapted materials
2. The lecturers need to use the instructional approaches when teaching students with visual impairment mathematics such as, multisensory approach; the approaches that use the sense of touch, hearing, taste

and smell other than the use of the sense of sight. The approaches are for example individual teaching. The other example is modified teaching approaches according to the needs of the students with visual impairment. This means any approach such as lecture, inquiry, question and answer can be used provided it is modified towards the needs of these students. Modification implies that braille materials have to be available for those who are blind and large print for those who are partially sighted.

3. The lecturers' attitude towards students with visual impairment learning mathematics should be positive, show attention, love and care, not neglecting learners, building students' self-esteem and motivating them through words of encouragements.

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