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Teaching Mathematics to Students with Visual Impairments in Inclusive Primary Schools in Tanga, Tanzania

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Abstract:

Students who are visually impaired have the potential to perform well in Mathematics just like their sighted peers. This can be made possible if the students are supported by teachers through use of appropriate teaching methods as well as being given adequate learning time to complete mathematics tasks. Unfortunately, most teachers teaching Mathematics to students with Visual Impairments in inclusive schools have been documented to use traditional methods of teaching which limit acquisition of Mathematics concepts. This paper aimed at analyzing the teaching methods used by teachers, as well as finding out whether students were given adequate time to complete their Mathematics tests and assignments. The study was done in Tanga Region, Tanzania. Fifty (50) respondents were involved including forty (40) students with Visual Impairment and ten (10) teachers. The instruments for data collection included interview guides and observation schedules. Qualitative data from interview guides and observation schedules was analysed by categorising, organizing in themes and describing the way they were. The findings revealed that students with Visual impairment were not given adequate time to complete Mathematics tests and class assignments which impacted negatively on their performance in the subject. The teaching methods used by the teachers for example the use of lecture method failed to consider the learning needs of students with Visual Impairments. Based on the findings, it was recommended that the government of Tanzania through the Ministry of Education should come-up with a more flexible curriculum which would consider the learning needs of students with Visual Impairments in inclusive settings in order for them to excel in Mathematics.

Keywords: *Inclusive schools, visual impairment, class, primary school, Tanzania*

1. Background to the Study

Globally, students with Visual Impairment (VI) perform poorly in mathematics (National Center for Blind Youth in Science, 2010). Over the years, strategies have been developed to overcome the multiple challenges that students who have visual impairment face in learning mathematics. With the development of Mathematics code by Dr. Abraham Nemeth in the late 1940's, students who are blind are able to read mathematical text independently (National Centre for Blind Youth in Science, 2010). More so, software tutorials have been developed to assist both teachers and students in learning the Nemeth Braille Code for Mathematics (Kapperman & Sticken, 2003) and to assist students in solving Mathematics word problems (Beal & Shaw, 2008). Summer programs and camps have been established to provide children and youth with visual impairments with hands-on experiences and knowledge of Mathematics careers (Giesen, Brenda & McDonnall, 2012). In USA information sharing, has continued to increase with access to multiple online resources. For example, the Texas School for the Blind (2008) maintains a comprehensive website on teaching Mathematics to students with visual impairments. The website serves as a one-stop centre where educators download instructional materials and access information about a variety of topics, including teaching strategies, Mathematic tools and resources and ongoing mathematics research projects. Although anecdotal evidence suggests that students with visual impairments lag behind their sighted peers in Mathematics achievement, there has been little empirical research to verify this claim. Some findings have shown that students with VI have lower Mathematics scores than their nondisabled peers (North Carolina State Board of Education, 2009; Winford, 2003). Students with VI have special instructional needs to be able to access academic subjects, including academic supports and specialized curricula (American Foundation for the blind, 2005). Moreover, these students have the potential to achieve in Mathematics in the same way as their nondisabled peers (Kapperman & Sticken, 2003).

All educational institution in Tanzania measure success by the academic performance, or how well a student meets standards set out by local government and the institution itself (Ileta, Mhando, Ugulumu, Marwa, Njiku & Maganga, 2011). The tracking of academic performance allows students to be ranked and sorted on a scale. At the state level, all students including those with Visual Impairments are evaluated by their performance (Ileta, Mhando, Ugulumu, Marwa, Njiku and Maganga, 2011). Notably, general teachers teaching in schools with children with VI are said to have inadequate knowledge and skills of teaching Mathematics. As a result, their teaching methodologies are not conducive for students with VI (Daily News, 2012b; Gronlund, Lim & Larsson, 2010).

This in turn affects the education of students with VI, especially in Mathematics performance. In order to deal with the challenges of teaching children with VI in classrooms, general teachers need to have the necessary knowledge and skills on inclusion (Mmbaga, 2002; United Republic of Tanzania, 2008).

In Tanzania, few students with VI in primary schools advance to secondary schools due to low average grades in major subjects including mathematics. Satu Santal (2008) has indicated that there were many challenges in the education sector which eliminate students with VI from the school system. One of the reasons was poor Mathematics teaching methods used to teach students with visual impairments in inclusive classrooms. According to Satu Santala, this contributed to students performing poorly in their final examinations, and hence, could advance in their studies. This study aimed at unveiling the gaps in the teaching of Mathematics in inclusive Primary schools of Tanga Region, Tanzania.

2. Literature Review

As a result of their disability, students with visual impairment complete their academic work at a slower rate compared to their sighted peers (Mastropieri & Scruggs, 2010) Extra time allowance is extremely important for students with VI to process visual information and complete their written assignments (Salisbury, 2008). For example, students with low vision take longer time to read a text than students with normal vision. At the same time, for students who are blind, reading and writing in braille and also getting information from tactile sources consumes a lot of time. Such students require more time to integrate information coming through hearing (Best, 1992; Mastropieri & Scruggs, 2010). Generally, it is acceptable to add an extra half of the time to any academic task for students with low vision, and twice as much for students who are blind (Spungin, 2002). Many external examinations recognize this requirement and give an allowance of up to 100% additional time for students with visual impairments (Salisbury, 2008).

The National Examination Council of Tanzania has made provisions to facilitate the examination of students with special needs. Provision of 20 minutes' extra time for every examination hour in Mathematics has been made for the visually impaired students (United Republic of Tanzania, 2013). Moreover, the examinations are produced in braille for students who are blind and in large prints for students who have low vision. Although the National Examination Council of Tanzania allow extra time in national examinations, there is no available data to show that students in schools for the VI are given extra time in completing their Mathematics assignments, tests and examination.

Simon, Echeita, Sandoval & Lopez, (2010) conducted a study in Spain with the aim of analyzing the process of inclusion to students with visual impairments. The findings revealed that teachers do not have enough knowledge of inclusion and how to teach students with visual impairments in inclusive classrooms. On the other hand, Ramesh (2006) revealed that children with visual impairment can learn and perform well in Mathematics if appropriate teaching practices and necessary adaptations put in place. In this way, visual ideas can be converted into non-visual experiences to allow students with visual impairment to get the required learning experiences and to achieve positive learning outcomes

Teaching methodologies for children with VI should include multisensory approaches wherein the remaining senses are utilized optimally to compensate for the loss of vision (Ramesh, 2006). Teachers of children with VI need other skills to equip them to teach effectively (Atitebi, 2002). Tuncay & Omur, (2009) argued that, for students to accomplish learning, teachers should provide meaningful and authentic learning activities to enable students to construct their understanding and knowledge of the subject domain. In addition, the authors emphasized that instructional strategies where students actively participate in their own learning was critical for success, and it shaped the progress of students' learning and accomplishment.

A study was conducted in Uganda by ICEVI in 2005 investigating the educational inclusion of children with visual impairment. The results showed that for children with VI to be successful in mathematics, the availability of specialist teachers, learning materials such as braille, availability of tactile equipment and tools are important. The study emphasized that better teacher preparation and the availability of assistive devices were the key factors for success in Mathematics.

3. Methodology

Descriptive survey research design was used and the study was conducted in Tanga Region of Tanzania. Tanga Region is found in the North Eastern part of Tanzania. The region is divided into eight administrative districts namely Lushoto, Korogwe, Muheza, Handeni, Pangani, Kilindi, Mkinga and Tanga. Tanga Region was purposively because it was the first region in Tanzania to enrol children with VI in inclusive schools in 1962. Two Districts of Tanga Region which had schools for children with VI were purposively selected. From each sampled district, the researcher selected one inclusive primary school where children with VI were enrolled. Classes II-VI were involved in the study and from each class, 4 students were selected (two students who were blind: one boy and one girl, and two students with low vision: one boy and one girl) giving a total of 20 respondents from each school. For every school, five Mathematics teachers teaching class II – VI were also selected. The total sample for the study comprised 50 respondents (40 students and 10 teachers).

Structured interview guides were used for the students and the teachers. The instrument intended to find out the time given to students with VI to complete Mathematics examinations, tests and assignments and the Mathematics teaching methods used by teachers. The interviews were conducted in Kiswahili as Kiswahili is used as the medium of instruction in primary schools in Tanzania. The researcher preferred interviews because at times there was need to clarify questions to the respondents for better understanding

4. Results

4.1. Time Allowed for Completion of Mathematics Tests and Assignments

Majority of the teachers 7 (70%) indicated that giving extra time to students with VI to complete their classroom assignments was important. One teacher narrated that:

“Students are given extra time to complete their exams. We even set time to read questions for them before they start doing the exam.....”

Another teacher said:

“In all kinds of Mathematics examinations, students with visual impairments are given 20 minutes extra for every 1 hour. This is because a student using Perkin’s braille or slate and stylus is slower in writing than a sighted student. Also, when I give them a test, I add them extra time although not 20 minutes but 5minute or 10 minutes depending on the length of the test”

However, some teachers 3(30%) expressed different views:

“.....it becomes difficult to add time in classroom assignment because the time for one period is 30 minutes thus, if there is an assignment, I ensure that by the end of the period the assignment is over.....I do not allocate extra time for the students with VI in classroom assignments because we want to help them to work hard and not to show them that they have inability.....”

“I ensure that students with VI sit next to students without visual impairments so that they can read or clarify for them whatever I write on the chalkboard, this makes them move at the same pace” One teacher commented:

“In my class I do not allocate extra time in test. I like them to have speed in exams and thus I allocate them equal time with their fellow sighted peers”

On the other hand, students with VI 38 (90%) said that they did not have extra time in classroom assignment. One student said “.....it becomes impossible for me to complete the assignment on time although I look for my own time during break, after class or during prep time to try and complete the assignment” Another student commented “..... Am not given extra time to do my assignments but sometimes my friend who can see, and is not involved in extra -curricular activities assists me to do”

4.2. Teaching Methods used in teaching Mathematics

Findings from classroom observations and interviews indicated that teachers used different methods in teaching Mathematics to students with VI. Teachers admitted that it was difficult to use a single method of teaching because like other students, students with visual impairments learn differently, and had different learning needs. Five teachers (50%) said that it was difficult to use a single method for teaching because students learn differently and that a single method of teaching does not satisfy the needs of all. One teacher said:

“.....I use many methods. For example, if I know that they have some knowledge on a certain Mathematics topic; I use questions technique to teach. I then elaborate the answers given and continue teaching”

All teachers mentioned questions and answers as one of the major method of teaching students with VI in classrooms. One teacher said that “this method helps to keep students alert and active during the lessons. It is a preferable method because it is simple to use and easy to observe students with VI during teaching”

Nevertheless, one teacher specified that students with VI have limitations in answering questions: “there are some questions that these students do not perform, for example questions involving calculations. In that case I find an alternative question in order to measure the same skill that would be measured by calculation question”

Nine teachers 9(90%) experienced challenges especially when the assignments involved reading or writing Braille. This is because the teachers lacked Braille skills and therefore they relied on the few special education teachers who would help them to mark. Sometimes, the special education teachers could delay or fail to mark due to their other responsibilities. Through the interview with the students, 32 (80%) agreed that in most cases, teachers used questions and answers technique in the class to keep them active. One student said “I usually feel happy when I get the questions right” One blind student said “the teacher comes and explains the question until I understand and then I use abacus to answer the questions asked”

Some teachers 5(50%) considered support by fellow students as a good teaching method for students with VI. The teachers emphasized that they were encouraging fellow sighted students to clarify difficult concepts to students with visual impairments. One teacher said: “I encourage sighted students to assist students with VI in various Mathematics assignments so that they can improve their performance” The students agreed that they got help from their fellow students who are not visually impaired. A respondent retaliated that “We usually get help from our friends who have vision or those who had low vision” Classroom observation revealed that sighted students assisted those with visual impairments although the assistance was not initiated by the teacher’s. The sighted students did this out of their own will and initiative.

Another method used by the teachers to teach Mathematics was the lecture method. They said that they preferred to use this method because it saved time and was easier to use in larger classes. One Teacher said: “I use lecture method because it saves time. Large class size is the problem that forces us to use the lecture method”. However, most of the students 33 (82.5%) complained that teachers explained Mathematics concepts without giving adequate practice and then gave them calculations to do. Classroom observation showed that 6 (60%) teachers used only lecture method throughout the lesson without considering students with visual impairments.

A few teachers 2 (20%) teachers preferred using mastery teaching to ensure that the students mastered Mathematics concepts. One of the teachers said, “I teach one mathematics concept at a time because I cannot go to the next while the previous section is not understood” However, many students 37(92.5%) differed when they said that sometimes the teachers moved to the next sections even when the previous concepts were not understood. The classroom observations showed that 9(90%) of the teachers went on to

teach new concepts and did not consider whether the students with VI had problems in grasping the content. Only 1(10%) teacher in class II was able to give individual attention to students with VI and only allowed them to go to the next section after mastery.

5. Discussion of the Findings

5.1. Time Allowed for Completion of Mathematics Tests and Assignments

Teachers understood that extra time allowance to complete tests and assignments for students with visual impairment was crucial. However, the study revealed that students with VI required more extra time to be able to complete their Mathematics assignments and tests. According to Mastropieri & Scruggs (2010), students with visual impairments spend more time in many of the activities they do in the class, as compared to sighted students. For example, reading printed papers for students with low vision, as well as reading and writing in braille for students with blindness takes a lot of time as compared to the time spent by other students without visual impairments.

The Government of Tanzania through the Ministry of Education have taken the initiative to have an addition of 20 minutes for every one hour in Mathematics examination, and 10 minutes for every one hour for other examinations, for students with low vision and blindness (URT, 2007). It might be the implementation of this initiative that the teachers mentioned 20 minutes' additional time for students with visual impairment. Although this additional time considered by the Government seemed to be a good thing, it was not enough, especially for students with blindness who use braille machines to read and write. Writing and reading through braille consumes more time than writing print. Supporting this, Spungin (2002) stressed that it is generally acceptable to add half of the time for students with low vision, and twice as much for students with blindness. In recognition of the need for extra time, Salisbury (2008) has 100% additional time for students with visual impairments.

5.2. Teaching Methods used in Teaching Mathematics

Responses given by some teacher showed that, teachers were aware that in an inclusive classroom were students with diverse learning needs who which necessitated adaptations of teaching methods (NBACL, 2007). However, teaching students with visual impairments in inclusive classrooms is not easy since it is difficult to meet each student's needs (Peters, 2003). It was observed from the teachers that, teaching and meeting the needs of students with visual impairments in inclusive classroom were difficult and most of the time teachers used common teaching methods to all students. Use of common strategies to teach all students and lack of participation and involvement of students with VI could be attributed to teachers' lack of knowledge of teaching in inclusive classrooms. Studies done in Temeke and Same districts in Tanzania proved that teachers had no enough knowledge of teaching students with VI in inclusive classrooms (Lewis & Little, 2007; Miles, 2003; Mmbaga, 2002). However, lack of knowledge among teachers seemed to be a global problem, since the study done in Turkey and Spain, also showed lack of knowledge among teachers who were teaching students with VI (Kesiktaş & Akcamete, 2011).

To be able to teach students with VI effectively, a paradigm shift from the traditional teaching approaches to modern methods should involve interaction between a teacher and a student (Mmbaga, 2002). In his study, interactive approaches in teaching comprised questions and answers which were used by the teachers. Questions and answers allow the teacher to know the students' understanding of concepts and also to take measures to ensure grasping of concepts. In this study, teachers used question and answer method in an adaptive way. Some teachers used oral questions to get oral answers instead of written answers. Using oral questions and responses instead of written ones could be a good strategy of adapting questions for students with visual impairments (Spungin, 2002).

Peer assistance and support as a method in teaching is very helpful in improving academic achievements of students VI. According to UNESCO (2001), students with visual impairments in inclusive classroom should be paired with their fellow students without visual impairments who would assist them in their work, finding the correct page during learning and repeating some teacher's instructions. Classroom observation revealed that sighted students directed and assisted those with visual impairments. This is consistent with the claim that assistance from other students can help students who lag behind academically to accomplish activities which they could not have achieved on their own (Wade, 2000). This is what Vygotsky (1978) called the Zone of Proximal Development (ZPD), gap in knowledge between what a student could achieve alone and what he/she can achieve when assisted by more capable peers. However, during class the observations; teachers were not seen encouraging sighted students to assist those with visual impairment. Rather, it was students' own initiatives to do this. Nevertheless, it can be argued that students' initiatives to provide assistance to students with visual impairments could have been as a result of long term efforts and encouragements from the teachers and hence, they offered help even without the teachers' daily encouragement.

Non-participatory method of teaching such as lecturing has been a part of teaching in most developing countries, including Tanzania (Mmbaga, 2002). This is in agreement with the findings of this study which showed that teachers widely used lecture method in inclusive classrooms. Teachers said that they use lecture method because in inclusive settings, students have diverse needs making teaching more challenging. The added that they preferred using lecture method of teaching which helped them to finish the syllabus on time. Another possible reason for the choice of lecture method could be attributed to a rigid curriculum (Lewis & Little, 2007) where there is emphasis for teachers to finish the syllabus at the end of the year. Mmbaga (2002) has stated that this kind of pressure make teachers use lecture method which is inappropriate for students with VI.

Furthermore, teachers said they use lecture method very often because it was difficult to use participatory methods with large classes. They said their classes had up to 120 students. The issue of large number of students in inclusive classrooms is supported by a study done by Polat & Kisanji (2009). In this study, inclusive classrooms had large number of students with an average of 80 students per class. It was true that this situation could threaten the use of participatory methods and therefore affect the quality of teaching

mathematics. From the teachers' perspectives, teaching students with VI in inclusive schools was challenging especially because they lacked the necessary knowledge and skills. Similarly, the findings from the study conducted in Same district, showed that teachers ignored students with special needs and concentrated on the so called "*bright students*" (Mmbaga, 2002). In this study, class observations revealed that teachers concentrated mostly on the students who were active and able to answer the questions but ignored the passive ones.

For students with VI to perform in Mathematics just like the sighted peers, it was necessary to teach them in sequence for better understanding, that is, allowing them to master a concept before moving on to the next. Through the interviews and class observations, this study revealed that it was only one teacher in lower class who practiced this method of teaching. Ramesh (2006) argued that children with visual impairment could learn Mathematics if necessary adaptations were made in the curriculum and the methods of teaching to enable them acquire the required learning experiences. On the other hand, most teachers were rushing their teaching aiming at finishing the syllabus. This was a challenge to the students as sometimes they were taught many concepts at a time making it difficult for them to understand. That's why one student said "..... teacher teaches a small part butt before I understand, she starts another part....." Ramesh (2006) has postulated that mathematics teaching requires special efforts and effective application of adaptation techniques to enable children with visual impairment to achieve positive learning outcomes.

6. Conclusions

The study found that students with VI were given extra time in examinations like national examinations, terminal and annual examinations. This time was according to the ministry of education, 20 minutes per examination hour. However, the study showed that the extra time for assignments and tests was not much considered and hence students could not complete their work. The study revealed that there was no extra time set for completing tests or assignments by the ministry of education and hence, it was left to the discretion of the teachers to give or not to give extra time. Although the teachers were aware that extra time was necessary for those with visual impairments, it was challenging for them to provide the time because one period/lesson lasted for only thirty (30) minutes leaving no extra time for those with VI. As a result, the students had to find their own free time to do the assignments.

The teaching methods used by teacher have emphasized completion of syllabus. This meant that the teachers could not cater adequately for individual learning needs of students with VI. This finding implied that the curriculum was not flexible for learners with VI. This revealed the need for curriculum developers to prepare a flexible curriculum that will allow flexibility of meeting special learning needs in inclusive classrooms.

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