How Can the Blind and Visually Impaired Be Involved in Stem Disciplines in Nigeria

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Abstract

Blind and visually impaired students (BVI) face a lot of challenges in education especially in science and mathematics at the basic education level, technology and engineering at the post-basic education and tertiary level of education in Nigeria. Globally, BVI are also known to face similar challenges; however, some solutions have already been developed to improve their access to Science Technology, Engineering and Mathematics (STEM). This study specifically investigates how the BVI can be included in STEM disciplines from the relevant stakeholders. The result obtained from the questionnaire showed that there should be adaptations of resources for teaching and learning to BVI. The remaining students, teachers or lecturers should be accommodating. They should also believe in their abilities, encourage and allow them to perform and achieve their maximum potential in life. The results also show that many teachers are ready to include them in their classes and the technicians are ready to support the teachers/lecturers.

Introduction

Loss of vision or impaired vision put the BVI at a disadvantage in some aspects of educational pursuit. Any learning that requires the use of vision is mostly inaccessible to them especially STEM that mostly requires hands-on, interactive and visual activities. According to Sahin and Yorek (2009), students regarded science as a difficult subject because of the hard and abstract concepts and because science teaching mostly depend on visual instructions traditionally. Most teachers in inclusive classrooms were not taught how to include BVI in their classes during the teacher training and they didn't see it being practised by their lecturers. BVI in most teacher education schools is ignored even in other areas of learning (Minogue et al 2006).

Kumar, Ramasamy and Steffanich (2001) observed that BVI have the same range of cognitive abilities as their sighted peers. They established that with accommodation they can master higher order science concepts like the sighted students. In most cases, the teachers and other people generally hold stereotypical views of what they feel BVI could do or cannot do Hill and Jurmang (1996) Adelakun (2020a) and therefore a review of literature on instructional materials and resources for teaching science are in a severe shortage. Adelakun (2017) identified the communication gap as a major obstacle to the inaccessibility of science to BVI. She found out that teachers teaching sciences are mostly non-specialists (with no knowledge of special education) and the children could not see objects drawn on the board and in books. Even specialists currently in the school's resource centres weren't taught how to include BVI in STEM. According to McCarthy, 2005; Adelakun 2017 Special education teachers often lack knowledge about science curriculum, content and science pedagogy.

Blind and visually impaired students are heterogeneous in their needs. The term BVI is used differently in different societies across the world. The term legal blindness covers a range of vision problems and may not necessarily be blind. In this study, the blind student is used to refer to those who are totally blind while the visually impaired is used to represent those who have some limiting vision and cannot read print. In some instances, The term ‘low vision’ is sometimes used to represent students whose vision can only

read large print (sometimes tailored to individual students' needs). However, BVI in this study refers to students whose vision cannot read normal print, simply put they are braille readers.

Statement of the Problem

The BVI tends to access a portion of the education received by their sighted peers due to the way they are educated. Majority of the states in Nigeria opened a special primary schools for students with visual impairment. Secondary education in most cases is inclusive, A special College of Education was established in 1977 to produce teachers for students with all forms of disabilities. Very few universities run degrees in Special Education. Adelakun (1994, 2005, 2007, and 2017) observes that the schools did not make enough effort to include the BVI in STEM. Arithmetic is taught to an extent with Abacus and in some places with Cubarithm. Most schools neglected the need to involve them in any subjects/topics that have calculations or drawings. In most cases, BVI only sits in Basic Science, Technology, Agricultural Science and even parts of social studies at the primary and basic education levels. The result is seen at the senior secondary level where BVI are bonafide members of social science class, they cannot be in Commercial class and neither can they be in science class. Only a few have studied science at senior secondary school and university, despite the situation. The examination bodies either give them a bonus on questions that involve calculations, drawings or those that require interpreting figures. These pathetic situations sometimes arise when a student develops visual impairment while in the science class or disciplines in the senior secondary school or university. In most cases, they withdrew from school and became frustrated because they were asked to return to senior secondary school to start social science subjects. Cases of persons in final year Engineering, Nursing and other areas are specific examples.

This situation calls for attention especially Supalo and Kennedy (2014) state that BVI develop problem-solving skills from the onset of the visual impairment and this is especially needed in STEM disciplines. Adelakun (1994, 2007) explored, developed and evaluated resources for teaching different STEM subjects and she observed that BVI performed excellently like their sighted peers. From the findings and recommendations of her research in 2017, there is a need to ask stakeholders in STEM disciplines how BVI can be included in STEM courses. This will guide developers on provisions that are needed and also disclose the level of awareness of the Stakeholders about BVI and their abilities. This study is a follow-up to the previous research, an effort to fill the gap identified.

Research Questions

The following research questions were formulated for the study:

RQ1: What is the level of awareness of the teachers/lecturers of the capabilities and abilities of the blind and visually impaired to be included in STEM?

RQ2: What is the perception of teachers/lecturers on the inclusion of BVI in STEM?

RQ3: What are the resources and adaptations required for the inclusion of BVI in STEM

Research Methodology

This research design for this study is a descriptive survey and the population is STEM teachers and lecturers from Nigerian secondary schools, colleges of education, polytechnics and universities. Purposive sampling technique was used to select twenty-three respondents for the study. The participant A self-developed structured electronic questionnaire was used to collect data for the study. The questionnaire contained twenty-five (25) items. The five-point Likert rating scales, “Yes/No”, and open-ended questions format were adopted. Data collected were analyzed using the frequency table.The study was approved by the ethics committee of the College. It was judged to follow the required ethical principles of research involving human participants.

Presentation Of Results

Background Information

The research participants are all Nigerians, with 4.3% of them from Lagos and Cross River, 8.6% from Kwara, 21.7% from Osun and 60.86% are from Oyo State. By qualifications, 52.2% of the respondents held a Master's degree, 17.4% had a PhD, 13% were First degree holders (BSc), 8.7% had HND while 4.3% each had NCE and Senior School Certificate. Data collected also showed that the majority of the respondents were lecturers in the College of Education, 39.1% were Secondary School teachers while 4.3% of them teach at the University. All the respondents teach Science, Technology, Engineering and Mathematics (STEM) related courses and they are all sighted.

Table 1: Research Question 1: What is the level of awareness of the teachers/lecturers of the capabilities and abilities of the blind and visually impaired to be included in STEM?

SN	Item	Yes	No	May Be
1	I have seen a blind student before	91.3%	8.7%	0%
2	I have taught a blind or visually students before	36.6%	63.4%	0%
3	I have an idea of the academic performance of blind students before	65.2%	34.8%	0%
4	Do you know how the blind write	65.2%	30.4%	4.4%
5	Have you seen a slate and a stylus before	30.4%	65.2%	4.4%
6	Have you taught a blind or visually impaired student before	36.4%	63.6%	0%
7	I don’t know how to teach blind students	54.5%	31.8%	13.7%

Results from table 1 showed that 91.3% of the respondents have seen a blind before, 65.2% of them have some knowledge of the academic performance of the blind, while 34.8% of them do not have any idea of how a blind can perform academically. Also, findings from the table revealed that 65.2% of the respondents revealed that they know how blind students write and only 30.4% of them said they have seen a slate and a stylus, a very common writing tool used by the blind and the visually impaired. Furthermore, 36.4% of the respondents affirmed that they have taught blind or visually impaired students before, while 63.6% of them said they have not. Likewise, only 54.5% of the respondents admitted that they lack the required knowledge and skills to teach the blind and the visually impaired, while 31.8% said they know how to teach the blind and the visually impaired and observed that the blind take notes during lessons, through the use of slate and stylus, braille machine, typewriter, Marburg and stylus and recorders.

Table 2: Research Question 2: What is the perception of teachers/lecturers on the inclusion of BVI in STEM?

SN	Items	SA	A	N	SD	D	Decision
		5	4	3	2	1	
8	Blind and Visually Impaired can learn STEM subjects despite their disabilities	21.7%	34.8%	13%	8.7%	21.7%	Agreed
9	STEM courses are impossible for the blind and the visually Impaired Students	0%	17.4%	8.7%	30.4%	43.5%	Disagreed
10	Blind and Visually Impaired cannot be included in Practical STEM courses	17.4%	17.4%	13.02%	26.09%	26.09%	Disagreed
11	Blind and visually impaired students can do well in STEM-related courses if the right resources and adaptations are made available	38.6%	28.6%	3.4%	13.5%	15.9%	Agreed
12	It is possible to teach a blind and visually impaired student together with the sighted	50%	31.8%	13.6%	0%	4.5%	Agreed
13	Many STEM teachers/lecturers lack the needed knowledge of how to include the blind and visually impaired students in their courses	34.4%	28.6%	3.4%	12.5%	21.1%	Agreed

Table 2 showed that 56.5% of the respondents agreed that the blind and visually Impaired can learn STEM subjects despite their disabilities. Similarly, 73.9% of them disagreed that STEM courses are impossible for blind and visually Impaired Students. Findings from the table also indicated that 52.18% of the respondents disagreed that blind and visually impaired cannot be included in practical STEM courses, while 67.2% of the respondents agreed that these students can do well in STEM-related courses if the right resources and adaptations are made available. It was also observed from the table that, 81.8% of the respondents agreed that it was possible to teach a blind and visually impaired student along with the sighted, while 60% of them believe that most STEM teachers/lecturers lack the needed knowledge and skills to include the blind and visually impaired students in any STEM-related course. Finally, the majority of the respondents said they were willing to be trained on how to include the blind and visually impaired in their classes and would love to support them in accessing STEM.

Research Question 3: What are the resources and adaptations required for the inclusion of BVI in STEM

For this, responses for questions 15 and 19 are examined. So many materials were mentioned and adaptations were also proposed. Ordinary 'braille' appeared severally, Tactile materials, audio resources, modern technological equipment, universal design, Tactile diagrams, and recorders. What is listed are things within the knowledge areas of the respondents. Such responses include the followings:

"*Audio and digital laboratory equipment", "A smart classroom"*

"Technical drawing requires the use of compass, set squares and rulers. It is difficult to translate these into programming/coding. If a person had been blind since being born or a baby, they may struggle to know what some shapes look like and these are the part of the building blocks for technical drawing".

Discussion Of Findings

Findings from table one showed that STEM teachers/lecturers in schools in Nigeria are well-informed about who a blind/visually impaired, with 91.3% of the respondents affirming that they have seen a blind or a visually impaired, but only 65.2% of them are cognizant of the academic capabilities and abilities of the blind and visually impaired. This finding supports that of Kumar and Steffanich (2001), who observed that the BVI have the same range of cognitive abilities as their sighted peers. Results from table one also showed that the blind and visually impaired students are not included in STEM courses in Nigeria as 63.6% of the respondents confirmed that they have never had blind/visually impaired students in their classrooms. This is similar to the findings of Adelakun (1994), Adelakun (2020b) and Hill 1994. In addition, the study observed that a good number of STEM teachers/lecturers in the regular schools were not trained on how to include the BVI in their classes similar to the findings of Hill and Jurmang 1996; Kirzack, 2000.

Table 2 showed that STEM teachers/lecturers in schools in Nigeria are positively disposed toward the inclusion of the blind and the visually in STEM classes. Though, ways to include them remain unknown to them. Data from the table showed that 56.5% of the respondents agreed that the blind and visually

impaired can learn STEM subjects despite their disabilities and 73.9% of them disagreed that STEM courses are impossible for blind and visually impaired students. It was also observed that the respondents believe that the BVI can do well in STEM-related courses if the right resources and adaptations are made available. This means that STEM teachers'/lecturers' perceptions of inclusion are positive and this will influence their attitudes towards these students.

Conclusions And Recommendations

The blind and visually impaired can be included in STEM, respondents agreed and are ready to include them in their courses although they don't know how to do so. The resources listed are within the knowledge areas of the respondents. Therefore relevant resources should be produced and made available for the teachers to ease the inclusion. Many respondents have not seen BVI before or some haven't seen them learning in schools. Awareness of the existence, needs and abilities of the BVI should be done to increase the acceptance and readiness of their teachers /lecturers in the classroom. Regular workshops are also recommended for teachers concerned and other stakeholders to intimate them with the existing resources and also foster research on other areas of importance for the successful inclusion of BVI in STEM.

Declarations

Competing interests: The authors declare no competing interests.

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