

Teaching and Learning Integrated Science: An Analysis of the Challenges Teachers, and Learners with Visual Impairments Face in Chinsali District- Zambia.

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Abstract

This study is an analysis of the challenges faced by learners with visual impairments in learning integrated science in Chinsali district, Muchinga Province of Zambia. A qualitative case study design was used. The sample comprised four (4) teachers and eight (8) visually- impaired learners all purposively sampled for the study. In-depth face –to- face interviews and focus group discussions were used to collect data. Data were analysed thematically. Findings revealed learners faced challenges in learning integrated science. Challenges included lack of specialised materials for science subjects and limitations in teaching skills on the part of teachers, to convert science concepts into units that could be easily understood by learners with visual impairments. From the findings, it appears the learning of integrated science for learners with visual impairments is faced with numerous challenges that tend to obscure the prospects of learning science. Unless something is done to improve the attitudes towards teaching science and improving the supply of specialised materials to learners with visual impairments, hopes for achieving the goals of learning science remain questionable especially for learners with visual impairments.

Keywords: Challenges, Teachers, Visual impairment, Science, Learners with visual impairments.

1. BACKGROUND TO THE STUDY

If all learners with special educational needs are entitled to equal educational and quality education (Ministry of Education, MOE- Zambia, 1996), then no form of impairment or disability should deny any learner access to quality education regardless of the circumstances. 'Leave no one behind' is the current Inclusive advocacy slogan that is trying to remind educators and institutions to accommodate learners with disabilities in teaching and learning. Learners with visual impairments are in two major categories; low vision and the blind. Learners with low vision have residual sight that can be used in learning when magnifiers are used. The blind depend entirely on the sense of touch, smell and hearing to learn about their environment. Accommodations should be employed to help them access the school curriculum.

Integrated science is one of the core subjects in the Zambian school curriculum. According to the Ministry of Education, Science, Vocational Training and Early Education-MESVETEE (2013), learners learning integrated science should demonstrate understanding of the basic facts about the human body, develop investigative skills, recognise the importance of personal health,

develop knowledge, values and positive attitudes for the immediate environment, plants and animals as well as develop sensitivity towards their immediate environment. The key competences expected out of grades 8 and 9s who successfully complete junior secondary school level are the demonstration of the ability to measure mass, weight, temperature and volume, show basic skills and knowledge in determining density, real and apparent depth and demonstrating the ability to record the breathing rate as well as showing basic skills and knowledge in preparing oxygen, carbon dioxide and hydrogen (MESVETEE, 2013). The puzzle that should tickle educators and researchers' minds is to ensure that such competencies are acquired by learners with visual impairments.

All the education policy documents in Zambia, from the Reforms and Recommendations of 1977 (MOE, 1977), Focus on Learning (MOE, 1992) and Educating our Future (MOE, 1996) show science as one of the subjects learners should take in school. MOE (1996), emphasises the provision of good quality education to learners with special educational needs but what remains unknown is how the quality would be attained in the teaching and learning of integrated science for learners who cannot see. The 2013 curriculum framework includes integrated science as one of the subjects. For learners with special education needs, specifically learners with visual impairments, adaptation through technologies and the use Braille have been emphasised in the revised curriculum. What remains unclear is how teachers view the challenges they face teaching science to learners with visual impairments and how learners with visual impairments perceive their own learning of integrated science in schools. Ndhlovu (2019), reports that findings from the learning of integrated science for learners with hearing impairments as being daunting with a lot challenges. Learners with hearing impairments can at least learn through vision. Those who are blind cannot see at all while others with low vision may benefit from large print. Learning becomes problematic to learners with visual impairments due to the loss of vision, which is considered the most important sense for learning. Learners with visual impairments are not adequately accommodated in science instruction and the condition of science education for these learners appears to be discouraging. This study was conducted to establish views of learners with visual impairments in learning integrated science at a selected school in Chinsali District.

1.1. Statement of a Problem

Learners with visual impairments learn better through the sense of tactile. This is because they lack the sense of vision, which is the most important source for learning, contributing 83% ((Akpnar, Ozdas, Yildirim, and Batdi, 2013). In Zambia, Science is one of the core subjects in the school curriculum (MSVETEE, 2013). The significance of learning science in schools cannot be overemphasized. Learners need science to learn about their body hygiene and their own surrounding on one hand and to become scientists and technologists in a world of where science has become critical to national development. Several steps have been taken to promote the teaching and learning of science in schools. For instance, a fast track training of teachers in science and mathematics was introduced to equip teachers with knowledge and skills of teaching science. However, the efforts to promote the teaching and learning of science do not reflect the same on teachers for learners with visual impairments. While science education is easily accessible to fully sighted children, it is less accessible to learners with visual impairments (Maguvhe, 2015). This is because many of its concepts are presented graphically and there are many concepts that cannot be explored by touch and are put across through visual observation (Design Science 2011) in (Maguvhe, 2015). This study was therefore conducted to establish the challenges of teachers teaching science to learners

with visual impairments and those of learners learning science in Chinsali District in Muchinga province.

1.2.Objectives of the study

Two main objectives guided the study;

1. To establish teachers' experiences of teaching integrated science to learners with visual impairment.
2. To establish learners with visual impairments' experiences of learning integrated science.

We understood that through teachers' and learners narration of their experiences, challenges would also be reported.

2. LITERATURE REVIEW

A wealth of literature provides different experiences in the teaching of science subjects to learners with visual impairments. As maybe known, visual impairments are in two main categories; the blind and the partially sighted. Learners that are blind cannot perceive light signals at all while those with partial sight impairment have residual sight ability. Learners with residual sight abilities may depend on magnifiers of text in order to see while the ones that are blind have to depend on the remaining senses, mainly hearing and touch to learn about their environment.

One of the common challenges of teaching science to learners with visual impairments is the lack of experience by teachers to teach the subject to learners with visual impairments. The areas of science and mathematics have traditionally been inaccessible to students with visual impairments (Schleppenbach, 1996). However, there is research evidence that science content is actually accessible to learners with visual impairments except that teachers do not have the skills to teach such content to the learners. Stefanich and Norman (1996) discovered that most science teachers and college science educators had little or no direct experience in teaching learners with visual impairments and they do not expose the learners to instructional strategies that could best suit them for participation in class. Maguvhe, (2015), although through a one participant case study, found that mathematics and science curricula was accessible to the blind and partially sighted learners. However, Maguvhe, (2015) notes that the inaccessibility to science and mathematics curriculum can be necessitated by teachers not being well equipped to teach the subjects to learners with visual impairments.

Mwakyjeja, (2013) in Tanzania found that teachers claimed to use different methods such as oral questions, group discussions, voice projection and calling students' names, enlarging handwritings and addition of time, use of teaching resources, encouraging peer support and lecture method which were actually not used when they were observed in actual classroom teaching considered adapted methods. According to Mwakyjeja, (2013), teachers also reported lack of knowledge for adapting the teaching methods and preparation of teaching materials for learners with visual impairments. Teachers further complained that the use of participatory methods such as group discussions threatened the completion of the syllabus. English as a language of instruction was one of challenges.

Research done by Fraser and Maguvhe (2008) posit that challenges of teaching learners with visual impairments include the context in which the learning occurs; inflexible curriculum and inappropriate assessment procedures. For quality learning for learners with visual impairment to be

ensured the learning environment should have some features and conditions. These include; specialised services from specialized teachers, teaching and learning resources, assistive devices like Braille and magnifying glasses and the use of flexible teaching methods.

The challenge of lack of experience in teaching learners with visual impairments was according (Yalo, Indoshi, Agak, and Were, 2010) noted more on novice teachers who exhibited difficulties writing on straight lines when guiding visually impaired learners. The teachers who were experienced and had practice of writing on straight lines, did not experience problems. This has to do with the skills of teachers. The revelation questions teacher preparation and lack of competence, confidence and skill to demonstrate teaching of learners with visual impairments.

According to Korir (2015), crowded diagrams in science course books are a great concern for teachers who teach learners with visual impairments. The course books that are used by learners with visual impairments usually have images, figures and diagrams that are not clear and explanation is also not adequately provided. When the explanation is not lucid and coherent in textbooks, then the teachers themselves experience challenges in acquiring understanding of the concepts. It is obvious that if the teachers themselves, are not able to understand the concepts better, they will not be able to make the learners understand. Therefore, it is imperative that course books and textbooks for the visually impaired learners as well as for the teachers working with them are coherent and information is comprehensible.

In Zambia, the Ministry of Education (2014) appreciates the challenges of lack of Braille skills among teachers teaching learners with visual impairments, a finding that Penda, Ndhlovu and Kasonde (2015) also established. This may be more serious to teachers of science subjects who may not be trained to teach learners with visual impairments but end teaching them. Penda, Ndhlovu and Kasonde (2015) further reported that teachers used traditional methods hence found it difficult to teach learners with visual impairments using such methods like demonstrations, question and answer, discussion and expository methods which were traditionally used on learners without visual impairments. They also explain that learners with visual impairment faced challenges during demonstration lesson especially in subjects such as Agriculture science and other sciences where chemicals were used.

3. METHODOLOGY

This study was qualitative. This application of this approach gave the researchers impetus to provide description of the participants' views about teaching and learning science respectively. Kombo & Tromp (2006), point out that descriptive studies are more than just a collection of data. In qualitative study, data is interpreted with complete meaning from participants' expression of their feelings and experiences. In this case, both teachers and learners described their experiences of teaching and learning science. Data was collected through interviews with teachers and focus group discussions with learners.

An extreme case purposive sampling design was used because critical cases with the desired information were identified prior to the study. Thus, the teachers who teach learners with visual impairments and learners taught by these teachers were believed to have the information needed for the study. All learners with visual impairments participated in the focus group discussions.

3.1. *Interviews with Teachers*

The following questions were asked during interviews with teachers:

1. How do you describe your experiences of teaching integrated science to learners with visual impairments?
2. What challenges do you find teaching science to learners with visual impairments?
3. What challenges do learners with visual impairments find when learning integrated science?

3.2. *Focus groups with Learners*

There were two focus group discussions for learners with visual impairments. Each group had 4 participants. All the learners were male. These were the learners enrolled at the time in the school. The following questions were used during focus group discussions:

1. What are your experiences of learning integrated science?
2. How interesting is learning integrated science?
2. Explain the significance of learning integrated science
3. What challenges do you face when learning integrated science?

Data was analysed in themes guided by the objectives. Thus, similar data from both teachers and learners was grouped together for insightful analysis and interpretation. Verbatim were selected and used to highlight participants' experiences of teaching and learning science. For ethical reasons, participants' identities pseudonyms were used.

4. FINDINGS AND DISCUSSION

The findings of this study have been presented and discussed according to the experiences of the teachers and the learners. A summary of the findings is obtained from the two categories of participants.

4.1. *Experiences and Challenges of Teachers in Teaching Learners with Visual Impairments*

Findings of this study revealed varied experiences in learning science for learners with visual impairments. One of the common challenges is that of lack of materials. One of the teachers had this to say:

The materials are not available for teachers to handle learners with visual Impairments in science effectively. I always improvise when I am teaching science. This makes it difficult in teaching science to learners with Visual impairments (Teacher B).

Teacher C said the following:

Making teaching aids for learners with visual impairment is very difficult. I take a lot of time to make and sometimes it doesn't make sense when I make. Sometimes it is impossible to make teaching aids which can be used to teach science to the V.I. (Teacher C)

Teacher D further explains;

The school has limited materials and tools for teaching science. There are no science text books in Braille for both the teachers and the learners (Teacher D).

The study revealed that schools lacked materials in Braille. For learners with visual impairments, learning is by touch. They need to feel and get used to the textual of an object they are learning about. Teaching and learning materials need to be available at all times for them to manipulate. Accessibility to school can be in vein if learners with visual impairments do not benefit from

classroom learning. Sahin & Yorek (2009) that since science instruction is heavily dependent on visual instruction, learners with visual impairments mostly benefit from tactual and more hands on methods to learn science.

One of the teachers lamented that the education of learners with visual impairments seems to be more amplified on paper than in practice, explaining the reality in the school as pathetic. He explained that the lack of specialised teaching materials that can help teachers adapt learning for learners with visual impairments were not available. The teacher said;

You know my brother, when you talk about teaching the blind; there is need for specialized materials to help us adapt certain topics to their level. But we don't have even Perkins brailler, the one we had is no longer in use, and we have no computers, no Braille calculators, how can a learner with vision problem calculate in some topics?

(Teacher A)

Lacking specialised tools limits teacher creativity to facilitate learning. Tools such as the talking calculator and Braille computers are essential materials in the teacher's tool kit. The lack of such tools lowers teacher creativity in trying to adapt learning for learners with visual problems. What is coming out from the teachers is that while they struggle to improvise teaching and learning materials for learners without disabilities, it is even more difficult to do so for learners with visual impairments because materials are difficult to improvise or find.

How can you improvise materials for learners with visual impairments? The actual materials, if its objects or other concrete materials, they must just be there. You can't improvise. Learners with vision problems just need real objects when teaching them not improvising. (Teacher B).

From the findings therefore, all teachers agreed that making teaching aids like tactile teaching aids was very challenging. This was due to lack of material used in making tactile aids. This finding is similar to what Penda, et al (2015) found. But learners with visual impairments should use tactile equipment to learn science. They need tactile graphics, thermoformed tactile graphics to learn the human body anatomy, tactile demonstration thermometer to independently set and read the temperature, liquid indicators with auditory feedback to read that a beaker is getting full, talking digital scales for measurement of any kind and other technologically accommodative science equipments (Willings, n.d). The lack of such equipment denies learners with visual impairments opportunities to actively and effectively learn science.

The study further revealed that teachers were not well equipped with practical knowledge to teach science to learners with visual impairments. The necessary innovation for teaching of science especially for this category of learners was limited. For instance, teacher A explained that handling experiments was very difficult when teaching learners with visual impairments. He said,

Conducting experiments is a very interesting situation because not all experiments can be conducted without any help. All the experiments are done with the assistance from a sighted person. For example; when testing for starch in leaves, it is very difficult for learners with visual impairments to identify colours unless there is a sighted person and in most cases we only explain. (Teacher A)

The sentiments of teacher 'A' were echoed by the other three teachers saying that it was difficult to teach science to learners with visual impairments. It appears, negative attitudes towards teaching science to learners with visual impairments were crippling in the descriptions of their experiences. According to teacher 'D', every learner can learn science when teachers have positive attitudes towards the learners. Teacher D said:

Bad attitude by teachers themselves contribute to failure to teach learners with visual impairments. We are only two teachers who teach learners with visual impairments and other teachers refuse to teach the learners (Teacher D).

Some views from some participants indicated that teachers had negative attitudes towards the science subject and teachers did not put in a lot of effort to learn from their colleagues how to teach or make teaching aids.

The challenge of negative attitude can also be explained from a perspective where one of the participants explained that the teaching of science to learners with visual impairments delayed progress and syllabus coverage.

Teacher 'A' had this to say:

I repeat the topics in science for most of the times because concepts in science are very difficult to teach to learners with visual impairment. Sometimes learners themselves fail to grasp the concepts because they cannot see the real objects. In this case I only explain in the abstract.

Another teacher said:

I only transcribe the textbooks from ink print to Braille which consume time and makes me not to cover the syllabus in good time (Teacher C).

Teacher 'A' further said;

I fear teaching science because of the danger of exposing learners to experiments due to lack of sight and also when handling chemicals". He also said: "I fear teaching science because learners with visual impairments are mostly lagging behind compared to others and some scientific concepts are very difficult for them to grasp (Teacher A).

These fears communicate a lot about teacher competence and confidence to teach science to learners with visual impairments. Since science instruction heavily depends on visual instruction, learners with visual impairments may have difficulty in constructing abstract concepts because of the lack of visual input. They need mostly tactile and more hands on experiences to learn science. To have an understanding of an object, learners with visual impairments need to touch and feel the objects for longer times to internalize the concept by sense of touch.

Non-availability of science tools has also affected the teaching of science to learners with visual impairments. Through teachers' interviews, it was established that there was scarcity of science equipment for teaching. Teacher 'C' said:

Some tools that are supposed to be used with the current curriculum in science cannot be used by learners with visual impairments. As a school we are lacking a lot of science tools like test tubes, beakers, Perkin, embossers, Braille paper.

One of the teachers who reported that despite several attempts to ask for specialised materials, the school administration told him that there was no money especially that most specialized materials can only be purchased from outside the country.

Braille, stylus and Perkin are very expensive and not locally available. Efforts by the school management to buy these equipment are made but finances are not available unless an NGO Volunteers to buy enough equipment for our learners.(Teacher D)

Findings also revealed that the curriculum was not adapted to suit the learning needs of learners with visual impairments. Some curriculum barriers which affected the education of learners with visual impairments such as lack of adapted science symbols and scientific calculators to calculate science tasks were noted. One of the teachers, had this to say,

I have observed that learners with visual impairment have limited choice in doing well in science. Some of the learners have the potential to do well in sciences, now the

curriculum is not adapted and the school lacks teaching /learning resources to facilitate them in all the science subjects, then it becomes a challenge to them (Teacher 'C').

The aspect of curriculum adaptation may be a critical impediment to the learning of science by learners with visual impairments. Similarly, Muzata, Mahlo and Mabunda (2019), note that special education teachers' lack of involvement in curriculum development process created a gap in the failure to prepare them on how to adapt the curriculum.

4.2. Experiences and challenges of learning science by learners with visual impairments

Learners with visual impairments were involved in two separate focus group discussions named FGD 'A' and FGD 'B'. Learners equally a share of complaints with the manner in which they learn integrated science. Some of the challenges are similar to those given by teachers. For instance, from FGD 'A' and 'B', the following expressions were given:

Sir here we are lack tools for Science. Even simple tools like test-tubes are very few (Learner 2, Male, Group A)

Another learner from group B echoed the same;

Teachers do not use the tools which are necessary for science either due to shortage or non-availability (Learner 1, Male, Group B).

The learners explained that science books were only borrowed from the mainstream in form of ink print which was very difficult to read unless transcribed into Braille. In that case, it took time for teachers to transcribe from ink print into Braille. They also complained over lack of teachers of Braille. This meant that if the two teachers were absent then they would not learn.

Learner 3 also said:

Teachers always tell us that science books for Braille are not there and teachers always transcribe from ink print into Braille. Another problem is that we have only two teachers who can transcribe our materials from ink print into Braille (Learner 3, Male, Group B).

The findings from the Focused Group Discussions revealed that learners with visual impairments have poor tactile skills. They faced difficulties in reading diagrams because the tactile skills were poor. Most of science concepts have diagrams and charts, therefore, learners said they did not have models for them to learn properly.

Sir, the diagrams and charts which our teachers sometimes use are difficult to recognize when they are teaching ((Learner 4, Male, Group A).

Learners with visual impairments learn differently by not depending on the sight. The concepts that involve diagrams and equations are very difficult to be understood by learners. Compounded with learners' poor tactile skills, this study revealed that learners' visual impairments found it difficult to manipulate diagrams, charts and equations. Learners attributed their poor tactile skills to poor teaching by teachers. The findings are in line with Wild and Allen (2009) who explained that teachers face numerous difficulties in translating equations, graphs and diagrams into an accessible format.

Learners with visual impairments also reported that the methods used by teachers were not appropriate. This finding is in line with what was discovered by Penda and Ndhlovu (2015), that teachers find difficulties to make learners with visual impairment understand using demonstrations

and expository methods. Learners reported that teachers did not provide them with Braille notes in order to follow the lessons. The learners with visual impairments suggested that teachers should be preparing Braille notes, be audible and clear in their explanations and use materials that are tactile e.g. maps, they would understand and follow better.

5. CONCLUSION

An analysis of the challenges that teachers and learners faced shows that the challenges were deep rooted within the system such that teacher training specifically to teach science to learners with visual impairments became the main challenge. This challenge was reported by teacher participants themselves and the learners. This was further compounded by lack of support materials to teach the learners. As such teachers face challenges in teaching integrated science to learners with visual impairments. From the findings, teachers lacked specialised materials to be able to adapt the science curriculum to suit the learning needs of learners with visual impairments. They also lacked skills for teaching science to learners with visual impairments. As a result, learners with visual impairments faced challenges learning science. If effective learning for learners with visual impairments is to be attained, their learning environment should be made highly constructive and realistic. All necessary materials labelled in the 'language' they best understand should be made available. Thus, learners with total blindness learn best through symbolic interaction. The use of Braille is symbolic, just like the presentation of all science materials through the sense of touch maximizes their learning ability.

6. RECOMMENDATIONS

The study recommends that teachers should be specifically trained to teach integrated science to learners with visual impairments. It's not enough to have training in science for learners with vision but also to be trained in the methodologies of teaching integrated science to learners with visual impairments. Since teachers already had training in teaching science to learners without disabilities, capacity building through continuous professional development can help seal the gap in the teacher skills to teach learners with visual impairments. Schools with learners with visual impairments should be supported with science equipment which are modified so that learners with visual impairments can manipulate them while learning science. For instance, measuring beakers can be clearly labelled for tactile learning. Tactile equipment such as rulers, measuring tapes, talking timers, thermometers, balances and calculators should be made available for learning science. Talking computers, installed with Job Access to Windows (JAWs) can be of enormous help to learning science if learners are introduced to computers in their early school grades. Muzata (2013); Womble and Walker (2001) recommend the use of audio recorded lessons as effective adaptations for learners with visual impairments. Consideration can also be made to omit some science topics like colors that cannot be learned by learners with congenital blindness who have never been exposed to colours. Overall, more research is needed in the pedagogy of science for learners with visual impairments to realise the benefits of learning science in their lives.

LIMITATIONS

The study was restricted by the design, confining it to one selected school for learners with Visual Impairments in Muchinga province. The findings therefore may not be transferable to other areas within and outside Muchinga although lessons can be learnt from the findings by schools with similar learner characteristics.

ACKNOWLEDGEMENTS

This paper is an extract from my Master's Thesis submitted to Kwame Nkrumah University in Kabwe- Zambia. I owe gratitude to my Thesis Supervisor, Dr Kenneth Kapalu Muzata from the University of Zambia and the entire Kwame Nkrumah University lecturing staff in the Faculty of Special Education. Further acknowledgement goes to the participants in this study. Together, we will make the special education a wonderful profession.

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