

EXPLORING BARRIERS TO TEACHING SCIENCE TO HEARING IMPAIRED LEARNERS IN LESOTHO SECONDARY SCHOOL

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ABSTRACT

Globally, there is a strong advocacy for including all learners in the education system, irrespective of their disabilities. This initiative, known as Education for All (EFA), is articulated in policy documents across different countries. Lesotho has actively embraced this international protocol by welcoming learners with diverse needs into its educational fold. This inclusivity extends to hearing-impaired learners (HIL), who now have the opportunity to study all subjects, including Science. Science is considered pivotal in cultivating critical skills essential for addressing societal and economic challenges, making it a mandatory subject at the secondary level in most countries among which is Lesotho. However, teaching Science to HIL presents unique challenges.

Notably, HILs often face language deficiencies, and Science, being an abstract subject, relies on verbal communication for effective learning. This linguistic barrier contributes to suboptimal performance not only among HIL but also among learners without disabilities in various schools. To explore teachers' views on the barriers they experience when teaching science to hearing-impaired learners in Lesotho secondary schools. Semi-structured interviews were conducted with four Science teachers. The collected data underwent content analysis, employing both the opportunities to learn and a capabilities framework to understand teachers' difficulties encountered. The study revealed that language is a primary obstacle to the effective teaching of Science to HIL. In response, teachers employ diverse teaching approaches to facilitate learning for HIL, although these strategies often prove time-consuming. In light of these findings, the study recommends comprehensive in-service training for teachers to enhance their preparation for teaching HIL effectively. Additionally, teachers should be

equipped with the skills to integrate Information and Communication Technology (ICT) into their teaching methods, allowing HIL to learn at their own pace. Furthermore, encouraging regular teachers to learn sign language can aid in detecting and addressing misconceptions among HIL. It also appeared that sign language interpreters should receive training in science subjects. In conclusion, addressing the language barrier is crucial for creating an accommodative learning environment for HIL in Science.

Keywords: *science teaching, opportunities to learn, education for all, hearing impairment, inclusive education, hearing-impaired learners, language barrier, teaching strategies, sign language, information and communication technology (ICT).*

INTRODUCTION

Salamanca's declaration endorsed by a majority of developed and developing nations asserts the importance of access to quality education for all learners irrespective of their disabilities. This inclusive approach has paved the way for students with various disabilities, including those with hearing impairments (HIL), not only to participate in education but also to engage in the study of science subjects. This educational practice is grounded in the perspective of Ahmad, Bokhari, and Waqar (2020), who argue that science imparts critical skills essential for learning, enabling HIL individuals to tackle the evolving challenges of the world. This aligns with Dewi & Wardani's (2018) assertion that proficiency in science subjects empowers learners to address real-life issues, as it equips them with high-order skills such as observation, critical thinking, and analytical capabilities. Being equipped with these crucial skills not only enables individuals to be problem solvers but also allows them to be lifelong learners. It is on this basis that globally science is recognized as a tool to address numerous socio-economic challenges prevalent in the 21st century (Kaluyu & Ndiku, 2020). The advocacy for "science for all" aligns with the Education for All (EFA) initiative, emphasizing that education is a fundamental human right (Madani, 2019). This initiative encourages the enrollment of every learner, irrespective of their diverse needs, in schools. Khan et al (2019) reiterate that this international protocol enables individuals including those with diverse needs like hearing impairments to actively contribute to community development. With this approach, many learners including those with HIL, are provided with the opportunity to gain a deeper understanding of science as a subject.

However, teaching science to HIL with deficient reading and writing skills poses significant challenges for teachers. According to Atika, Ediyanto, and Kawai (2018), these challenges make it difficult for HIL to comprehend abstract concepts. Additionally, a lack of research in the field of science teaching for HIL, as noted by Kang and Martin (2018), further complicates the understanding of challenges associated with teaching and learning science for this group. Consequently, the inability of teachers to effectively address these issues contributes to poor performance in science among HIL, as

highlighted by Meghdari and Alemi (2020). Given that science is inherently abstract and requires language and critical thinking skills, the question arises: how can one teach science to HIL who lacks the basic language skills necessary for engaging in critical thinking? It is on this basis that the study aims to answer the main research question that says; what are the barriers to teaching science to hearing-impaired learners in Lesotho secondary schools?

LITERATURE REVIEW

Teaching of science

There is a global concern that science is not well performed yet it is a subject that contributes massively to economic development. This may lie in the idea that teaching as important as it is, maybe a demanding task for teachers as they need not only to find resources relevant to diverse learners' needs but are also bound to manage their time well (Hankebo, 2018). This is based on a global shift that teachers should use a learners-centered approach when teaching science (Lehesvuori, Ramnarain & Viiri, 2017). With this approach, learners' differences are considered while actively engaging them in learning. Another approach advocated for the teaching of science is the use of experiments which assists learners to engage in deep learning of concepts and acquire high-order skills (HOS) such as observation and analysis (Dewi & Wardani, 2018). With this, learners are discouraged from recalling facts and are not considered passive receivers of information. Instead, learners are assisted in constructing knowledge in their minds (Bremner, 2021). These approaches require language skills, which are however deficient in HIL and need well-thought-out time management. I found it interesting to understand the challenges teachers are confronted with when teaching Science to learners with impairments.

While HILs are permitted to learn Science regardless of their deficiency in reading and writing skills, they are however lagging behind their counterparts (Baglama, Haksiz & Uzunboylu 2018). The implication is that the learning outcomes are not attained equitably by HIL and their counterparts, and the issue of access remains questioned. Besides that, Atika, Ediyanto, and Kawai (2018) bring another argument that HIL is challenged by abstract concepts. This is evidenced by low achievement in subjects such as Science that are not easy to understand when an individual is not well grounded in linguistics. Poor performance may also be because of teachers who cannot deal with the challenges they encounter when teaching HIL (Meghdari & Alemi, 2020). This suggests that teachers can identify problems that hinder HIL from achieving the proficiency level but due to inadequate or lack of pre-service and in-service training are unable to address such challenges in their classroom setting. Another contributory factor to HIL's poor performance could be a dearth of research in science teaching of HIL. This aspect, according to Kang and Martin (2018) makes it difficult for teachers to establish barriers hindering the effective teaching and learning of science to HIL. With this mentioned, one would have a reason to

understand that it is c to be in light of barriers that hinder the effective teaching of Science to HIL.

There is a global concern that Science is often poorly performed, and yet it is a subject that contributes massively to economic development. This may lie with the idea that teaching, as important as it is, maybe a demanding task for teachers, as they need not only to find the resources relevant to diverse learners' needs but are also bound to manage their time well (Hankebo, 2018). This is based on the global shift for teachers to use a learner-centered approach when teaching Science (Lehesvuori, Ramnarain & Viiri, 2017). With this approach learners' differences are considered while actively engaging them in learning.

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Teaching science to learners with impairments

As previously stated, Salamanca's statement declares that all learners should be at school regardless of their disabilities since education is regarded as a human right (UNESCO, 1994). This initiative has enabled learners with impairments to study alongside their counterparts. Concerning HIL's progress in school, Kang and Martin (2018) indicate that when given an enabling environment, they can do well in science like their counterparts. In the same study, the authors found that teachers realized that learners with impairments have different abilities and are unique. This relates to the study that learners with hearing impairments are not cognitively challenged but can learn and achieve like their counterparts. Teachers' role is to know their learners' capabilities and ensure that the teaching and learning environment is conducive for every learner. The implication of this is that how best HILs need to be taught is dependent on teachers' decisions and abilities to address barriers they are faced with which goes along with how best they have been prepared to teach learners with impairments.

Even when teachers have understood and embraced Education for All, there can be challenges with their teaching when their in-service training has not adequately prepared them to teach learners with impairments (Aas, 2020). This shows that a positive attitude alone is not enough when teaching learners with impairments, and teachers' competence is an important attribute to consider. According to Zhang, Admiraal, and Saab (2021), quality teaching increases learning opportunities. Both pre-service and in-service training are essential in shaping a teacher to provide not only quality Education for All

but also make education accessible to all learners. The implication is that teachers should not only be competent with the subject matter, but they also need to know how to teach and address the learning needs of learners with impairments.

TEACHING SCIENCE TO HIL.

As previously stated, Science is a subject that equips learners with 21st-century skills (Sabry, Darwis & Fathallah, 2020). It is globally essential to be studied by every learner, including HIL, so that they can contribute positively towards economic development. According to Ross, Yerrick, and Pagano (2020), HILs give equitable access to quality education and denote that HILs' disabilities do not limit them to quality education.

It is worth mentioning that even though HILs are often deprived of language skills and tend to lag behind their counterparts, they can do well in the sciences when appropriate methods are used (Atika et al., 2018). It should be highlighted that there are challenges experienced when teaching HIL but that does not mean that teachers cannot accommodate them. Parveen (2017) found that inquiry-based learning is the best approach when teaching HIL, especially when compared to a lecturing method. The HIL learns better through doing or when actively engaged in learning without using a sense of hearing. It is further supported by Liu (2020) and Rodrigues et al. (2022) that since HIL depends on the senses of sight and touch, teaching approaches should be inclined towards visual methods and the use of tangible objects.

Rusyani et al. (2021) find that mind maps are not only effective when teaching Science to HIL, but they also motivate them to learn it. The learners' eagerness to learn is an important aspect that needs to be considered since it increases their opportunities to learn. Another approach hailed as being effective when teaching HIL is the use of experiments that enable learners to acquire scientific skills (Dewi & Wardani, 2018), which are essential for solving the ever-changing problems of this world.

It further explains that the environment stimulates an individual's learning (Kumatongo and Muzata, 2021). The acquisition of knowledge within a convenient learning environment initiates the formulation of ideas and understanding of concepts. Based on this, the Science laboratory is considered an appropriate space for teaching Science, since it allows concepts to be more easily understood (Sahin-Kalyon, 2021). At Science laboratories, learners are exposed to experiential learning, where they engage several senses in the gathering of information essential for their learning.

Additionally, the use of ICT further improves accommodation strategies for HIL (Zafar et al., 2021). ICT is an educational tool effective for resolving challenges revolving around the teaching of HIL, thus increasing opportunities to learn. For instance, when teaching HIL there is a need to have an interpreter to assist the regular teacher when executing the lesson. Even though this is a required

accommodative strategy, regular teachers rely on interpreters who arguably lack content knowledge (Atika, 2018). According to Zafar et al. (2021), an ICT device called Avatar can be used to address this challenge and replace the interpreter. This device enables direct communication between the teacher and the HIL, as it writes the English language in sign language.

CHALLENGES OF TEACHING SCIENCE TO HIL

Even though EFA advocates for quality education for everyone, teaching hearing-impaired learners remains a challenge for most teachers. It may lie with their language difficulties, which, according to Lucas (2018) continue to impede learning opportunities. It is also evidenced by HIL's presence in science lessons where they are unable to show an outstanding performance due to the many challenges that confront teachers. The implication is that 'education doors must be open for everyone and provide access to quality education. Hence, it is crucial to investigate and understand teachers' challenges so that they can be addressed in different educational settings.

Raven and Whitman (2019) indicate that teaching HIL can be challenging when teachers disregard the ways HIL can access information such as a need for a repetition of concepts and the use of visual aids.

RESEARCH METHODOLOGY

This study is part of the study that explored science teachers' experiences in teaching HIL in Lesotho secondary schools. The main research question for this study is: What are Science teachers' challenges when teaching learners with hearing impairment? The paradigm selected for this study is interpretivism since it enables the researcher to go deeper into the phenomenon under discussion (Alharahsheh & Pius, 2020). Additionally, this study employs qualitative study which Cleland thinks (2017) is the approach that allows the researcher to understand the phenomenon under discussion in a real-life setting. Four teachers were interviewed in their schools to understand the challenges they face when teaching Science to HIL. Data generated from this sample was analyzed and interpreted as four case studies. Creswell (2019) shows that case studies enable the researcher to dig deeper into the subject under discussion and were considered appropriate to be used for this study.

Semi-structured interviews and document analysis were used to generate data as Yin (2018) emphasizes that different data sources can be used to improve the credibility of the study. Interviews were used because they give participants the liberty to explain in detail areas that they feel are important or interesting (Roulston & Choi, 2018). Semi-structured interviews were therefore considered the best way of collecting data so that teachers could explain in detail what they think are their main challenges when teaching HIL. It is not a yes or no interview; it enables the researcher deeply understand the

phenomenon under discussion. Although the researcher probed the interviewee, some questions were developed to guide the conversation. The data was transcribed, coded, and categorized into themes that responded to the research questions. According to Rich et al. (2018), this is called content analysis. Both inductive and deductive approaches were used to analyze data. With the inductive approach, data was transcribed, read, and themes assigned, while the inductive approach occurred when themes were aligned with the research question, literature review, and conceptual framework. According to Cohen et al. (2018), these approaches are called an inductive-deductive approach.

DISCUSSION OF RESEARCH FINDINGS

As stated earlier, the responses of four Science teachers in secondary schools teaching learners with hearing impairments were interpreted as constituting the challenges of teaching Science to HIL. Pseudonyms were assigned to the teachers who participated in this study as an ethical consideration. The biography of the participants is as follows: Mr. Thuto has a Bachelor's degree in Science Education and majored in Physics and Mathematics. He teaches Physics across all grades and has one learner who cannot hear or talk. Mpho has a Bachelor's degree with Physics and Mathematics as her main subjects and has ten years of teaching experience. Mr. Tsolo holds a diploma in Science Education with Biology and Chemistry as major subjects. Tsolo is a young teacher with three years of teaching experience. Lastly, Mr. Nare holds a diploma in Science Education, who majored in Physics and Mathematics, and has two years of teaching experience. All these participants are Science teachers for HIL.

Mpho showed that HIL's replacement in class is a crucial factor to be considered so that they can see the interpreter. She explained:

We usually arrange them in the first two columns so that they can see the interpreter. The arrangement is also for us to stand without shading the HIL.

Placing HIL in front is stated to be more crucial even in Mr Nare's classroom which did not have interpreters. He explains, " I place the HIL in the front seat of the classroom so that he/she could hear me". According to Kumatongo and Muzata (2021), it enables HIL to utilize their residual hearing. Additionally, Mr. Thuto indicates that teaching HIL required him to use experiments that allowed them to get the ideas with ease. However, he showed that the use of experiments consumes much time:

You may find that in classes with HIL, I am a little bit behind comparatively regarding the coverage of syllabus materials. But it is impractical to help during the lesson since the given time is the same. So, you will find that the same experiment I have to do takes double the time in a class with HIL compared to what I did in the rest of the classes. So, it takes time.

The extract above indicates that even though experiments promote learning amongst HIL, they require much time to be spent on them. With this, there is a likelihood that teachers may not complete

the syllabus as expected by the Ministry of Education (MOET).

The timing issue was also raised by Mpho, who says that teaching HIL requires her to work slowly and repeat concepts, but it is time-consuming. She explains:

The best way to teach deaf learners is to be slow, repeat whatever you say several times, and have more activities for them to understand, but this takes much time. Apart from that, you will note that some learners no longer follow you since it takes them much time to understand what is being said. At the same time, you cannot pass to the next topic.

Mpho shows that not only is the aforementioned teaching strategy time-consuming, but it is also having negative effects on learners who have no difficulty hearing but are bound to listen repeatedly to concepts they have already understood. This time issue puts teachers in a dilemma, as they know that rushing through concepts can never benefit HIL, while at the same time, they are at risk of not completing the syllabus.

Mr. Tsolo also touched on the issue of time that being slow accommodates HIL, but there is a risk of being unable to finish the syllabus within the year. He explains:

It is not easy to do the whole syllabus within the year because we have to go slower for deaf learners to understand everything in the syllabus. However, the pace increases with the use of videos and charts. The other thing that we need to do is to reduce the syllabus since it is too much.

The above-mentioned extract shows that some teaching approaches must be relaxed. Tsolo insists that the syllabus is bulky and should be reduced. Nare implies that HIL, unlike their counterparts, needs two years to learn the content allocated for each grade.

Nare also thinks that even though discussions are essential for clarifying concepts, they are time-consuming when one uses them for teaching HIL because they cannot hear. The extract below explains the negative consequences of using a discussion method in a class integrating HIL:

Another challenging part of the discussion method is that it wastes time. It is because before moving to the next concept, I get back to him and ask, did you hear? And then he said "yes". And if I ask him to tell me what I said, I always find that he did not hear anything. With that, I always have to go back and start afresh.

The extract above shows that Nare is cognizant of strategies that do not work for the HILs. He presents this as a challenge because it works well for most learners but does not benefit HIL due to their impairment.

Another challenge mentioned by participants is that sign language interpreters pass misconceptions on to HIL because they are not competent with the subject. Mrs. Mpho explained:

Sometimes, you will find that the message the interpreter is conveying is not what you said. It is observable that when you ask questions, you will see that the way learners get answers incorrectly is

because of the information they got. Not that they did not understand the concept. You will see that misconceptions come right away from the interpreter.

When regular teachers are not conversant with sign language, there is a possibility that HILs can get the wrong information from the interpreters without being rectified. That is congruent with Atika's (2018) observation that teachers depend entirely on interpreters who arguably lack content knowledge, so mistranslation can happen.

Tsolo also adds that sign language interpreters do not have a deep understanding of scientific knowledge and often cannot assist HIL. He explained:

I also realized that these interpreters explain concepts even when they do not have a deeper understanding of what you are saying. However, you would find that deaf learners have understood what has been said and assist the interpreter with concepts that are not clear to them.

The extract above shows that even though the interpreters' role is to assist HIL, they fail to do so due to limited knowledge of the subject matter. This implies that there are accommodation strategies that can compromise learners' opportunities to learn even though their initial intentions were basically to assist HIL in acquiring the information communicated in class. This shows that not all opportunities to learn can bring change to HIL learning.

Another issue is that sign language lacks vocabulary and it becomes difficult for interpreters to translate information communicated by the regular teacher. Mpho clarified:

Sign language interpreters encounter problems when teaching science due to the limited sign language vocabulary. This compels interpreters and HIL to come up with their signs. The sign depends on how they understand the word and they make a picture of that like the wave. For instance, when signing the wave with the hand, always when we talk about the wave they make that picture. The only problem with this arrangement is that you will find that interpreters have not agreed on invented signs across all classes, consequently, learners sign words differently.

The extract above shows that limited vocabulary in sign language creates yet another challenge for interpreters to clearly explain the information communicated by the regular teacher. As a result, HILs often consider creating new signs for the Science terminologies, but this consequently creates yet another challenge because, in the long run, they cannot communicate with other HILs in other classes or another school.

CONCLUSION AND RECOMMENDATION

The study concludes that language is the main barrier when teaching Science to HIL. The study also reveals that teachers are doing their best to present opportunities that can increase HIL's chances of doing well in the Sciences. However, due to limited time, these accommodations appear to be ineffective.

It is recommended that in-service training should adequately prepare teachers to teach HIL. The study shows that it is important that teachers know sign language even when they cannot teach and sign at the same time, but that would enable them to see when interpreters are not communicating messages conveyed by them. All learners should be taught sign language as a subject to deepen their understanding, as suggested by the Lesotho Language Policy (LELP) (MoET, 2018). Besides this, the use of ICT is one aspect that needs to be utilized in the education system to teach HIL to encourage their best capabilities and to achieve the learning outcomes within what is stipulated.

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