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Teaching Life Sciences to Blind and Visually Impaired Learners: Issues to Consider For Effective Learning Mediation Practice

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ABSTRACT This study aims to determine the factors that contribute to the improvement of life science pedagogy, as viewed by both teachers (as learning mediators) and learners (as proprietors of knowledge). A qualitative research design was used in this study. Semi-structured interviews were used to obtain responses to questions. The study involved sixty-three participants: eight teachers from eight schools in five provinces and fifty five learners drawn from the eight schools represented at the 2011 winter school). Teachers and learners believed that the quality of the learning environment, knowledge specific to the teacher and the learner and effective communication are requirements for meeting the challenge of life science teaching and learning. Teachers and learners should transform into efficient learning mediators and skilful proprietors of knowledge respectively, so that both of them can optimise their capacity to achieve the greatest number of learning outcomes

INTRODUCTION

The learning of life sciences (among other subjects with a high content of abstract concepts) has always presented a challenge for blind and visually impaired learners, particularly in less resourced classrooms. The challenge is also faced by teachers who have to mediate learning for those children. This view is confirmed by Wang et al. (1989) who contend that blindness as a condition that thrusts proportionate burdens on both individuals and the agencies that seek to ameliorate its effects on learners. Thus both the teacher and the learner have active responsibilities to fulfil in the learning mediation process. This paper is based on the fact that blind and visually impaired learners cannot appropriately link the principle of perception with the principle of the so-called primary environment. Their lack of visual perception means that, unlike sighted learners, blind learners are unable to experience learning mediation as meaningful and effective because, in most instances, the examples which the special school and inclusive life science teacher presents during learning mediation do not link "… up with the learner's previous similar experiences" (Fraser et al. 1996: 68). Education's "quest", to contribute meaningfully to national development has ignited an interest in the natural sciences and other disciplines that can make a significant improvement to industry. Learners with visual impairment are not exempted from this quest.

The teacher has to be equipped with relevant skills to enable blind and visually impaired learners to learn life sciences successfully. This means that the teacher should apply strategies, techniques and mechanisms that help blind and visually impaired learners to study and master life sciences. These should enable a thorough diagnosis of learners' visual and academic needs and strengths, the establishment of a starting point in the teaching process, nurturing learners' abilities and creating an enabling learning environment. By the same token, the learner should not be treated as an ox-drawn wagon, which is led to different places but is never made consciously aware of the entire journey. Instead, the learner should be equipped with reciprocal learning strategies, techniques and mechanisms to complement the teacher's mediation efforts.

This study seeks to inform and encourage teachers to build and sustain strategies that help learners become resilient 'proprietors' of their own learning business. Sewell and Price (1999:306) lament the dire consequences of the view carried by some teachers and parents that sciences are not for the blind and visually impaired. Such views cause blind and visually impaired learners to develop the belief that a pass in science is by mere 'luck'.

Literature Review

A few years before Fraser et al. (1996) published their work, Kirk and Gallagher (1989:356) bemoaned the limitations caused by blindness: "lack of vision, then, is both a primary handicap and a condition that can hamper cognitive development because it limits the integrating experiences and the understanding of those experiences that the visual sense brings naturally to sighted children ….." However, in the few years that followed, the dark cloud that covered the realm of experiential learning in the 1980s (and even before) seemed to be clearing. In an article on blind learners' access to visual information, Wild and Hinton (1993: 99) strongly affirmed the position that "steady development in teaching strategies, practical aids, and the use of tactile diagrams has increased the ability of blind pupils to access visual information". In the opinion of these authors, visual information is already more accessible to the blind learner than was previously the case. They cautioned, though, that this gain is only a reality at secondary school level. They point out those learners in higher education still experience problems with accessing visual information because mainstream higher education has not yet embraced the expertise employed by practitioners at lower education levels.

Today, an increasing number of visually impaired learners are getting interested in the life sciences against the backdrop of a growing drive towards inclusion, even in less equipped, regular schools. There is just as much temptation to expect the school to have all the necessary equipment as there is to believe that regular class teachers are not adequately skilled to be able to teach life sciences in an inclusive class. There could be as much a need for evidence-based teaching methods as there is need for improvements in the physical and social classroom environment. The role of the teacher as a learner and an agent of educational change should be actively encouraged and perfected so that he or she can take on the new role of the regular teacher in the inclusive classroom. This is particularly true of the life science teacher, who first needs to empower the learner to accept that science is also his or her field of study.

Wild and Hinton (1996:5) claim that science education is more accessible to visually impaired students when undertaken through the Open University. They ascribe this fact to the flexibility of the distance learning model: this model is learner-based and learner-paced, and makes extensive use of "pre-recorded course texts, tutorials and summer schools". In South Africa, winter schools are the mode used, but the result is the same: learning for exam preparation.

Notwithstanding the technological redemption testified by Wild and Hinton (1993: 99); Erwin et al. (2001: 338) declare that "you don't need to be sighted to be a scientist do you? No. Absolutely not. Everything you have done today and last week is science, and you have done it, right?" This argument holds as long as the learner has grasped the fundaments of compensatory and access skills. As mapped out by Sapp and Hatlen (2010: 339): the learner can access the curriculum optimally when there is good "concept development, spatial understanding, study and organisational skills, speaking and listening skills and adaptations that are necessary to access all areas of the core curriculum". This seems to imply that the quality of the learner should improve scholastic survival in the life science education arena.

Kumagai (1995: 82) discusses the strengths of a well-oriented learner with an overview of some of the technologies which one could use to offset the disadvantages that lack of vision imposes on the learner. He poses a rhetorical question that he then answers himself: "at its heart, science is about observation: …How then does one proceed when nature's most basic and powerful tool for observing - that of sight - is missing? To be sure, the blind are not without tools of their own. Speech synthesizers interfaced to personal computers …" One question still lingers: why is life science not widely offered to blind and visually impaired learners if advances in technology and teaching methodology allow for greater investigative autonomy? Perhaps more research is needed into teaching methods.

Kumagai (1995:83-84) is of the opinion that the theoretical part of science is not much harder to master for someone who is blind or visually impaired, because these learners mostly deal with symbols that could be "… easily handled with the right computer. As for experimentation, where there may be a lot of apparatus to be manipulated, that can typically be done by working in groups". Landsberg (2005) confirms that cooperative learning has brought about drastic improvements in academic achievement and higher order thinking, and improvements in teachers' (and learners') attitudes towards learners with impairments. When discussing the importance of working in groups, Kumagai (1995: 83-84) laments the fact that "in studying and doing science … the primary hurdles that a blind person faces are the attitudes of others. Changing those attitudes will be made easier when blind students are less reliant on sighted people …" Fortunately, cooperative learning and teaching strategies allow for that independence as they necessitate the delegation of individual learning tasks to each group member, the accomplishment of which helps to reach the holistic learning goal (that is, answer the project question). There is thus a substantial hope for success if learners are taught life sciences using tested and evidence-based teaching and learning methods and this includes cooperative teaching and learning strategies.

Learning mediation is also undergoing a pro-learner revolution, with the growing popularity of dynamic assessment systems (Bouwer 2005: 54), which seek to make assessment an initial part of the teaching process. Hansen et al. (2010: 275) confirm the success of such interventions in a teaching experiment in which they use what they term 'assessment for learning (AfL) systems'. The strength of assessment-for-learning systems is based on the ability of such systems to adapt content on the basis of elaborate evidence acquired from diagnosis. In other words, the mediation system integrates learning with assessment. This system is potentially very effective for learners with and without disabilities; that said, Hansen et al. (2010) caution that diagnostic tests should be made with special consideration for their accessibility right from the beginning. They actually lament that 'assessments are often designed without taking accessibility into account ...' (Hansen et al. 2010: 275). Their mention of this point brings to the fore the importance of the eight domains of accommodations in the use of assessment, as raised by Elliot et al. (1998: 13) and cited by Bouwer (2005: 56). These eight domains are: motivation, assistance prior to the administration of the test, scheduling, setting, assessment directions, assistance during assessment, use of equipment or adaptive technology, and changes in format.

In light of the above observations, one is persuaded to support Landsberg (2005) who sees the teacher's ability to guide learners to 'success' as resident in an ability to commandeer her several managerial and diplomatic roles. The quality of the teacher is therefore a focus area in the successful mediation of life sciences for learner improvement. Teachers can improve skills in areas such as planning, establishing classroom rules, establishing classroom routines and developing sound rapport with learners (Prinsloo 2005: 457-458). One could also add that the teacher should have a sound knowledge of the subject, enabling him or her to win respect on the basis of his or her expert/referent power (Nyamuda 2002: 105). This quality enables the teacher to arouse interest and maintain a motivated audience among the class.

The overall picture obtained from this literature review is the existence of significant barriers to learning life sciences and other observation-based subjects. There are also possible solutions in the form of improved teaching methods, better classroom management techniques, improved learner qualities and the use of advanced technology in the learner-user interface.

Key Questions

This paper is a response to the following key questions:

- When mediating learning in life sciences to blind and visually impaired learners, what should be the starting point?
- What is the significance of the development of special skills in the study and mastery of life sciences?
- How can the abilities of blind and visually impaired learners be nurtured in the mediation of life sciences?
- What constitutes a conducive learning mediation environment for blind and visually impaired learners?

METHODOLOGY

Design

A qualitative research method was used in this study. Qualitative research methodology is a better way of dealing with social evidence than quantitative methodology. Smit (2001: 56) argues that qualitative research is based on a naturalistic phenomenological philosophy that is based on the assumption that realities are socially constructed by the individual and by society while quantitative methods are based on a logical positivist philosophy, which treats social evidence as a single objective reality which is separated from the feelings and beliefs of individuals. Through the use of this methodology, the authors sought to find out the opinions of blind and visually impaired learners and their teachers on the strategies, techniques and mechanisms that could be applied in the study and mastery of life sciences.

Sample

The sample comprised eight teachers and fifty-five grade twelve learners from eight schools located in five of the nine provinces of South Africa. Convenience sampling was used to draw individuals from the group of teachers and blind and visually impaired learners who came to Filadelfia Secondary School for a week-long Winter School programme in July 2011. Welman et al. (2005: 69) say that convenience sampling is used widely, but they caution that it reveals bias when results are applied as generalisations for large populations. In this study bias could be lower since visual impairment is a low prevalence condition, and the respondents came from schools in different parts of South Africa. The chance that many teachers and learners in schools for the blind under similar circumstances could share similar views could be high.

Instruments

Semi-structured interviews were used to collect data from respondents. Interviews for both teachers and learners bore the same questions. The difference was that teachers and learners answered from their sector experiential perspective, enriching the final responses to the research questions. Cohen et al. (2007: 267) define the term "interview" as "... an interchange of views between two or more people on a topic of mutual interest, [which] sees the centrality of human interaction for knowledge production and emphasizes the social situatedness for research data." This characteristic was considered most important for communication of perspectives. The overall reliability of the information was tested through checking the accuracy of our notes with the interviewees on the last day. McMillan and Schumacher (2010: 363) and Cohen et al. (2007: 288) concur that Interviews create a social environment in which group members are stimulated by the perceptions and ideas of each other.

Data Collection and Analysis

Permission to conduct the interviews with teachers and learners was sought from their parent-schools, children's parents and the Acting Principal of the host school. The eight teachers were interviewed in a single focus-group session on the first day. After the interview with teachers, one focus-group of eleven learners was held on that first day (Monday). There was one focus-group session with eleven students per day, for the next two days (Tuesday and Wednesday). On the fourth day (Thursday), two group interviews were held to cover opinions of the remaining twenty-two learners. On the fifth day, both the eight teachers and the fifty-five learners were shown transcriptions of their contributions, for final comments before interpretations would be made. This ensured the correctness of the data capturing process. Interviews with teachers lasted approximately thirty-five minutes while each focus-group session with eleven learners lasted fifty to seventy minutes. The sessions were conducted at consented times, appointed after daily revision lessons.

Interviews were transcribed in braille, after which each braille transcription was coded and responses adequately categorised. The results capture the major findings that emerged from the coding and categorisation of responses.

Ethical Issues

Before the interviews, respondents were informed on the purpose of the study. The respondents consented to the process before the interviews begun. Parents and guardians gave their consent before children came for the five-day Winter School. Responses to questions were coded according to numbers given sequentially according to respondents' seating arrangement. Respondents remained anonymous.

RESULTS

The study revealed that:

It is cardinal that a life sciences teacher gathers adequate diagnostic information for an understanding of the learner's visual and learning needs, strengths, weaknesses and potential to make meaningful and productive learning mediation.

The attainment of specialised skills is critical for students to derive maximum benefit from and participate actively in their learning encounters in life sciences.

The development and sustained use of methods that promote independent enquiry can improve the abilities of blind and visually impaired learners to think scientifically.

The combination of a well resourced classroom and effective class management is conducive to productive learning among blind and visually impaired learners.

DISCUSSION

The study revealed that both teachers and learners concurred on the primacy of accommodating the scholastic needs of learners from a well-founded understanding of the learner. Learners valued being supported by teachers who always bore in mind that they had visual impairment. Learners involved in the study agreed that failure to recognise them 'as blind and visually impaired learners' led some teachers to either making inappropriate expectations or doubting the learners' abilities. Responses from the eight teachers showed that a proper understanding of the learners' needs was paramount; and was contingent on a proper assessment of both the individual learner's degree of impairment and level of mastery of content specific to the life science syllabus. Teachers also articulated the view that a thorough knowledge of the learner and versatility in the content area empowered the teacher to make innovations to meet the ongoing needs of the learner. One teacher said, "You cannot teach what you do not know. You cannot teach a person you do not know. You would be talking to yourself." Thus, although Erwin et al. (2001) emphasise that teaching science to learners with visual impairments must be firmly grounded in a multi-sensory approach if students are to receive positive benefits; the extent to which the approach applies to the learner depends to a large extent on the characteristics of the learner. To that extent, the authors concur that proper educational intervention should be hand-tailored to dovetail with the learner's educational needs and personal attributes.

The study revealed that the acquisition of special skills was mandatory on the part of both the teacher and the learner. Teachers were of the view that the teacher had to be a connoisseur in both the art of teaching learners with visual impairment and the study of Life sciences as a school subject. One of the respondents (a teacher) said, "Science by nature is an intricate discipline, therefore it requires one to have extra-ordinary skills to impart it to the learner in a way that enables the latter to master the content." The image of a 'multi-specialist' teacher portrayed in the responses is not very surprising bearing in mind that the teachers who participated in the study were subject specialists (different subjects) who had been specially nominated to give inputs to all students at the winter school, on the basis of their outstanding pass records. Besides, they were also teachers of blind and visually impaired learners in their schools. Teachers further argued that learners had to be taught skills of enquiry (observation, exploration, explanation and experimentation) thoroughly for them to enjoy learning life sciences. Thus, blind learners should be encouraged to count, measure with assistive devices, list, compute, weigh data and objects "… during an investigative exercise" (Fraser et al. 1996: 72). Further, learners had to be groomed to engage in productive group learning and informative exploration of tactile materials. Teachers found it important to invest in changing both the quality of the learner and the structure of the content in order to reach a point at which the learner would be disciplined enough to pursue the rigour of life sciences, and the content would be in a format that would be understandable to the learner (knowing the learner's characteristics). This is unsurprising as it concurs with Woolfolk's (2010: 47) description of Vygotsky's 'Zone of Proximal Development' as, "a dynamic and changing space as student and teacher interact and understandings are exchanged." The teacher has a responsibility to develop the learner's subject-specific communication skills to a level whereby the two would be able to make meaningful knowledge transfers. Learners thought that a good knowledge of procedures enabled learners to work hard. One learner said, 'I work hard when I know how to do things and what to do next.' Thus teachers and learners concurred on the importance of skill acquisition.

The study revealed that the abilities of blind and visually impaired learners to think scientifically could be developed and sustained by teaching methods that promote independent enquiry. Teachers expressed the view that the abilities of learners in life sciences could be nurtured through the development and sustenance of a culture of setting study goals, checking on adherence to those goals and motivating one-self to continue studying the subject. This response is well confirmed by Woolfolk (2010: 223) who proposes that self-management hinges on 'goal setting', 'monitoring and evaluating progress' – and 'self-reinforcement'. Learners agreed that the way the teacher treated them, the way the teacher taught and the appeal of the topics determined their interest in the content. This response is in line with 'the model of active participation' proposed by Uys (2005: 417), whereby the learner's level of participation is a function of an optimum mix between the learner's attributes, the teacher's characteristics, the teaching strategy and the activity being done.

The study revealed that the physical and human environment in the classroom should be non-threatening and encouraging to learners. All the sixty-three respondents made a collection of characteristics of the social environment which constituted a conducive environment for learning. They cited respect, trust, care, safety and warmth as important qualities of an ideal environment for learning. This pool of characteristics is quite closely aligned to Woolfolk's (2010) list, which includes self regulation. The authors note that a combination of a good environment (portrayed in the list) with the necessary accommodations for visual impairment and effective class management could bring positive results in a life science class for the blind and visually impaired.

CONCLUSION

Based on the results discussed above, the following conclusions are drawn:

Teachers should motivate learners to be committed during life science learning mediation. Teachers should always take into account the age and experience of blind learners, because this obviously influences the nature and quality of the perceived reality of the discipline being taught. The age and experience of blind learners enable them to understand, decode, analyse, interpret, assess and evaluate the various stimuli.

Interest motivates one to be committed. The learner's curiosity has to be aroused if he or she is to develop an interest in what is being taught. Situations must be relevant if learners are to be properly motivated. If what they learn is relevant, they will never question the importance of receiving instruction in their lives. Relevant instruction boosts one's confidence level. Higher interest, motivation and confidence lead to more learning expectations and greater satisfaction.

Blind learners learn better if they are not just perceived as students, but as purpose bound owners of the content they learn. They have ambitions to go as far as they can academically. They deserve to be taught by teachers who will take the time and trouble to help them and who are willing to put their whole energy into doing just this.

Blind learners learn better in an environment which is friendly and stimulating; such as when they read or write in braille and when they have access to emerging technology. Technology is significant because it possesses the potential to expand both the intellectual and physical worlds of blind learners by giving them unrestricted access to information and knowledge.

RECOMMENDATIONS

It is recommended that teacher education should equip new teachers with special skills for establishing the learning needs of blind and visually impaired learners. Qualified teachers should undergo in-service training as well. The central role played by assessment in the teaching and learning process should be acknowledged.

It is further recommended that teachers should use methods which empower blind and visually impaired learners to be independent learners. This goes with equipping life sciences classrooms adequately and managing learning effectively.

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