

## **Disability and support for visually impaired students in South African engineering programmes**

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**ABSTRACT:** Visual impairment limits equitable access in society due to activity limitation and participation restriction. For students with disabilities in tertiary institutions, a lack of necessary support can render them academically excluded, especially if institutions are not equipped for the required assistance to these learners. This may imply that institutions have no effective framework to accommodate these learners on their campus. The purpose of this article is to review the perceptions of disability units at tertiary institutions in South Africa concerning current challenges faced by visually impaired learners in engineering programmes, thereby determining a need for such a framework. Qualitative responses were obtained through on-line questionnaires, which were distributed to 20 tertiary institutions, yielding a 25% response rate. Lack of funds, lack of resources, poor infrastructure and lack of trained lecturers were the key challenges raised by the disability units. It is recommended that tertiary institutions seek to address these challenges faced by visually impaired learners, so that they too may contribute to the socio-economic development of South Africa.

### INTRODUCTION

Knowledge is one of the most important aspects in the world and education is the process of imparting this knowledge to people. According to Taylor and Sternberg, the cost of educating a student in South Africa (SA) is very high [1]. When it comes to educating students with disabilities, then the situation gets more challenging. There are special schools to meet the special educational needs of these exceptional students in SA. But access to tertiary education is observed to be difficult for many of these students, especially for those who are visually impaired [2]. The term *visual impairment* is used to describe any kind of vision loss ranging from partial sight to blindness. Although, visually impaired learners (VILs) are being enrolled in tertiary institutions, many institutions are not equipped with the facilities to educate them [3].

It is seen that there is a low representation of VILs in engineering courses compared to other courses. According to Mayat and Amosun, this under-representation of VILs in engineering is due to the misconception among academic staff that VILs are not capable of completing an engineering degree [2]. Engineering courses are very practical and hands-on compared to other courses, such as management or education. The technicality of these courses is what makes them rather difficult and challenging for VILs. Apart from these engineering specific challenges, VILs also face many other challenges at tertiary institutions, like learning routes on campus, finding books in a library, understanding new vocabulary, recognising people, taking lecture notes and finding information on notice board, etc [4]. It may also prove challenging for VILs as they transition from special schools to higher education institutions.

Specific support to students with disabilities in tertiary institutions are coordinated by disability units (DU). The primary purpose of these units is to provide these students with the services they require, while simultaneously protecting the integrity of academic programmes and services [5]. However, many tertiary institutions across the globe have reported challenges in supporting students with disabilities. For example, Chiang reports that a lack of resources and funding affected the provision of education to students with disabilities at the University of North Carolina, USA [6].

Adequate funding, disability awareness and resources are essential for improving the participation of students with disabilities in Australian universities, as noted by Butler et al [7]. According to Matshediso, SA also lacks adequate support provisions in tertiary institutions when compared to developed countries like the UK and the USA [8]. If countries such as the USA and Australia note concerns about providing effective support to students with disabilities, then developing countries, like SA, would maybe experience even challenges.

The purpose of this article is to review the perceptions of DUs at tertiary institutions in SA concerning current challenges faced by VILs in engineering programmes, thereby determining a need for a framework. This study

forms part of a larger study that aimed at developing a framework for the adoption and effective use of ICTs for VILs in engineering. The actual framework is not discussed in this article, due to space constraints. Published work that contributes to it includes a literature review of general factors affecting the provision of education to VILs in engineering education, challenges faced by engineering faculties in accommodating VILs in SA and possible ICT tools that may assist VILs in engineering [9-11]. A similar study was conducted by Mutanga, where he investigated the inclusion of students with disabilities at two universities in SA [3]. This study focuses on the challenges faced by VILs in South African engineering programmes. This article is structured as follows: the first presents the literature review on the different support services for VILs. In further sections, the authors discuss the research methodology used for this study, and the findings and discussion regarding the challenges faced by DUs in assisting VILs in tertiary institutions. The final section presents the conclusions.

## LITERATURE REVIEW

This section begins with exploring the general support services offered to people with disabilities in SA. The effectiveness and weaknesses of these services are also noted. The review then focusses on services offered by DUs at higher education institutions.

Hanass-Hancock and McKenzie did a study to analyse the relationship between poverty and disability in SA and the effectiveness of financial support services [12]. The results indicated that people with disabilities had low probability of being employed and, therefore, were low earners. The study reported that although the disability grants partially compensated for the poverty of the people with disabilities, the additional costs related to a disability, like assistive resources, transport, access to buildings, etc, continued to be a financial burden for them. According to Johannsmeier, inadequate transport facilities, inaccessible buildings, discrimination at workplace, marginalisation at educational institutions, etc, affected the effectiveness of social support services for people with disabilities in the KwaZulu Natal Province of SA [13].

Grut et al reported that despite having health support services in the rural communities of the Eastern Cape Province of SA, barriers, like lack of knowledge about medical treatment in the rural communities, background of earlier negative experiences, cultural barriers and the burden of poverty, hinder access to these services by people with disabilities [14]. These studies provide a brief overview about the general support services offered to people with disabilities in SA. However, when it comes to tertiary institutions, there are dedicated DUs in every university that take the responsibility of assisting students with disabilities.

Chiang did a study in 2019 on how a DU was established at the University of North Carolina, USA, and the challenges faced by DU staff in assisting students with disabilities [6]. The experiences shared by the DU indicated that inadequate resources, lack of awareness about disability issues and inadequate funding affected the functioning of DUs and participation of students with disabilities at the university.

A study was done in 2017 at the Australian universities to identify the challenges faced by VILs at these universities [7]. DU staff and VILs were the participants. The results indicated that there was a lack of participation of VILs in tertiary education, especially for STEM disciplines, due to a lack of support services. A lack of awareness about disabilities, a lack of resources and inadequate funds were the identified challenges faced by VILs in higher education.

Two studies were done in the KwaZulu-Natal Province of SA (in 2010 and 2013) to identify the challenges faced by VILs in their universities [15][16]. The objective of these studies was to explore the effectiveness of DUs. The results indicated that inadequate staff, a lack of ICT tools, resources and funding, and a lack of awareness regarding the social and academic needs of the disabled students were the major challenges that hindered the provision of education to VILs.

A study in 2011 offered some insights into the perceptions of academic staff towards admission of students with disabilities into an undergraduate civil engineering programme in SA [2]. It was noted that students with disabilities were still under-represented in the faculties of science and engineering because of a misconception among the academic staff that students with special needs could not complete those academic programmes. The findings further revealed that students with disabilities were accepted into engineering courses only as a result of the ongoing efforts of DUs to increase awareness about disability.

Fotim, a higher education academic consortium in SA, funded by Ford Foundation, conducted a study with the motive to guide disability service practitioners at South African universities to ensure quality services to disabled students [4]. The effectiveness of DUs in tertiary institutions, as well as the challenges they face while assisting disabled students, were investigated. Results further indicated that minimal DU autonomy, lack of physical infrastructure, lack of ICT tools, lack of funds, inadequate staff and secure staffing posts, lack of sign language interpreters and a lack of commitment from management and academic staff existed. This report was released in 2011.

Have any of these challenges been resolved in the past nine years? This question relates to the purpose of this article that is to analyse the perceptions of DU in SA concerning current challenges faced by VILs when contemplating entry into higher education.

Furthermore, many of the above-mentioned studies focused on only one university. This article aims to identify current challenges faced at a number of universities in SA, being a more significant contribution. The literature review provided insight into various support services offered to people with disabilities in SA, and then focused on past challenges that inhibit VILs of effectively engaging in higher education. The methodology is given next.

## METHODOLOGY

This study adopted a qualitative research approach. The study started with a literature review, which assisted in identifying past challenges that VILs faced in SA and other parts of the world. The literature review was conducted through the collection and review of relevant published documentation. An on-line self-administered questionnaire was then developed, which included open-ended questions. The questionnaire focused on gathering the perceptions of DUs in SA concerning current challenges faced by VILs, when contemplating entry into higher education, and especially into engineering. The questions were linked to the literature review and developed by keeping the research objectives clearly in mind. The questionnaire was benchmarked against similar studies undertaken internationally [17]. Content validity is achieved when the questions in the research tool are a representative of the literature studies and the research objective that the study seeks to achieve [18].

In order to ensure that the questionnaire was properly structured, it had to be piloted. It was evaluated by experts in the field before the actual research was done. The experts consisted of a manager of a DU at a tertiary institution, and senior lecturers from the Engineering Faculty at the Central University of Technology (CUT), Bloemfontein, South Africa. The pilot study participants took approximately 20 minutes to complete the questionnaire. The experts, to the best of their ability, confirmed that the items were accurate, relevant, clear, simple, complete and not biased by a particular subgroup of participants. The questionnaire was then distributed to the target population.

The target population for this study was the DUs of 20 tertiary institutions in SA. These institutions were chosen to be a part of the study as they had a fully-fledged engineering programme. Twenty-five percent of the institutions (5 institutions) responded to the questionnaire, which forms the sample size of the study. According to Visser et al response rates greater than 20% are acceptable for on-line questionnaires [19]. The questionnaire was electronically distributed using Google Forms to DUs. Participants were e-mailed an informed consent along with the questionnaire. Ethical clearance was obtained from the Faculty Research and Innovation Committee at the CUT. The findings were analysed with reference to the literature that was collected for this research to address the aim of the study.

## RESULTS AND DISCUSSION

The questionnaire was divided into four sections; Section A collected the background information of the participants; Section B gathered the information about the purpose of the DU and the number of VILs registered; Section C considered the current challenges VILs face in higher education and the resources available to them; and Section D covered questions that would provide better insight into the functioning of DUs in SA.

The participants were the representatives from DUs of the tertiary institutions. The demographic findings collected from Section A of the questionnaire are presented in Table 1, that highlights that the majority of the participants are male (60%) with 80% having more than six years of experience in a DU. Well experienced DU staff play an important role in improving the experience of students with disabilities at universities [4]. Therefore, the viewpoints of experienced DU staff are crucial for this study.

Table 1: Demographic information of participants.

Profile	Categories	Percentage
Gender	Male	60%
	Female	40%
Age	35-39 years	20%
	45-49 years	20%
	50 years and above	60%
Home language	English	80%
	Afrikaans	20%
Work experience with DU	2-4 years	20%
	6 years and above	80%

Section B of the questionnaire captured the purpose of the DU and the number of VILs registered. Forty percent of the participants indicated that the main function of a DU was to support (emotional and logistical) students with disabilities. Equal access to the environment, raising awareness about the needs of disabled students in the campus and assisting VILs with proper resources were the other main functions identified. Naidoo, in 2010, already stressed the importance of these factors regarding the functioning of DUs in SA [15]. Figure 1 shows the annual

average number of VILs enrolled in the participating institutions, whereas Figure 2 indicates the annual average number of VILs in engineering at these institutions.

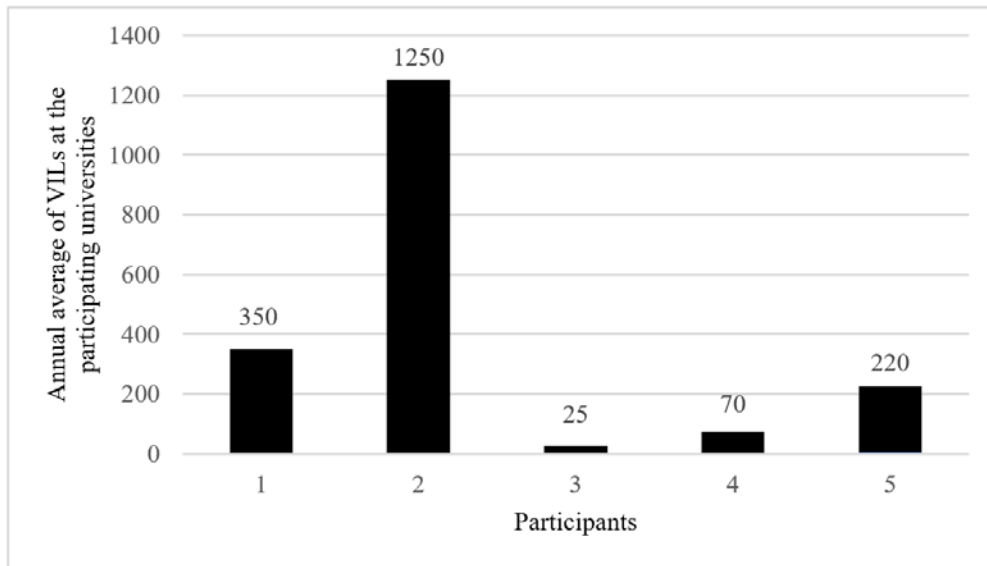


Figure 1: Annual average number of VILs at tertiary institutions that responded to the questionnaire.

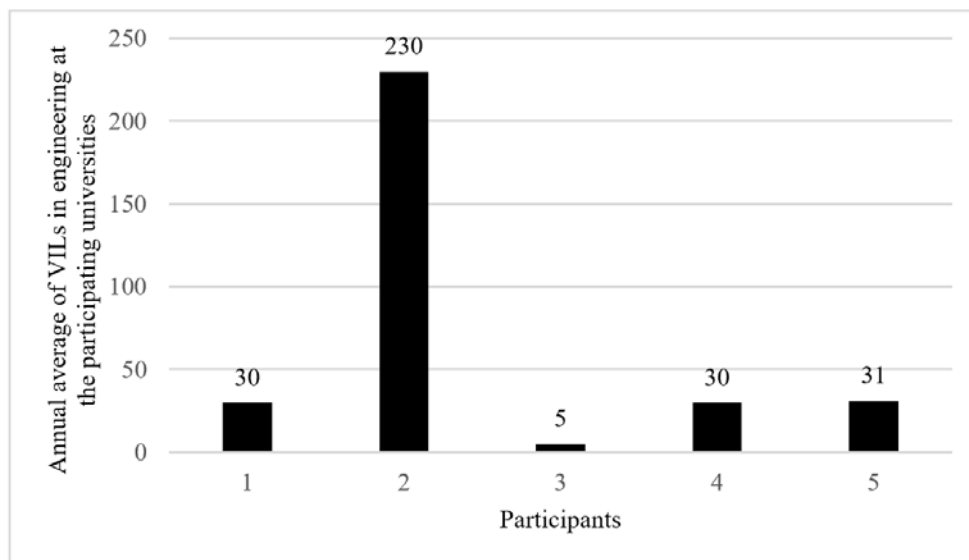


Figure 2: Annual average number of VILs in engineering at tertiary institutions that responded to the questionnaire.

A low percentage of students (on average, only 17 % of all VILs) enrolled for an engineering degree at the participating institutions. The participants also indicated that they were not aware if these VILs were even interested in pursuing engineering. As noted in the literature, in 2011, only a few VILs pursued engineering [2]. The statistics in this study indicate that this situation has not really changed in the last nine years. The response of the participants raises concerns as to what factors may lead to this low participation rate.

Section C of the questionnaire captured the participants' viewpoint on the challenges VILs faced in higher education and the resources they used for VILs. All of the participants indicated that their institution used computer software and magnifying devices to assist VILs. Scribes, braille devices, talking calculators, audio equipment and enlarged prints were some of the other tools mentioned by the participants. Some of the assistive software mentioned were WYNN, JAWS, MathType, Latech, ocr software, graphic embossers and tactile machines. However, none of the participants indicated that they used any specific resources for VILs in engineering. Forty percent of the participants indicated that they used magnifying equipment to assist VILs in engineering.

The other resources that they listed include: screen-reading software, braille devices and enlarged prints. Mayat and Amousun confirm these tools to be used for assisting VILs in engineering [2]. One of the participants mentioned that the resources used for VILs for engineering depended on the students' requirements. It must be noted that engineering subjects are technical in nature and VILs may require specialised tools depending on the nature of each engineering subject. The participants' response also indicates that they were not aware about engineering specific resources.

Participants were also asked about the choices that VILs make when choosing a course in their institution. Sixty percent of the participants indicated that VILs decide which course they want to do based on their own interest, while 20% indicated that VILs chose a particular course based on the resources available for them. The rest mentioned that they would first discuss the possible challenges with a student regarding a specific course, before the student made a choice. When the participants were asked about the courses, they recommend to VILs when they showed an interest in engineering, 20% of them recommended computer engineering. Their reason was that it would be the safest option. The Fotim report lists safety as one of the important services that should be available for all students with disabilities [4]. The rest of the participants indicated that they do not usually recommend engineering to VILs and that they also do not limit VILs to a specific course.

The participants' overall response indicated that they considered engineering to be a challenging profession for VILs. Lack of adaptive and assistive resources for VILs was raised as one of the major concerns by the participants. According to Ingber, VILs who have become successful in engineering professions are the ones who had access to proper ICT tools or assistive resources for their academic courses [20]. Other current challenges raised by the participants were safety issues and a fear of not being assisted by lecturers. One of the participants also mentioned that engineering courses contain a great amount of visual content.

Section D considered the challenges faced by DUs. A lack of funds for tutoring VILs, a lack of accessible resources for VILs, poor infrastructure and a lack of trained lecturers were identified. These were also reported by other studies published over seven years ago [8][15][16]. Most of the participants (80%) further indicated that a large number of VILs approached the DU for assistance in general. Matshediso reported that a majority of students with disabilities felt comfortable studying at tertiary institutions because of the support given by the DUs [8]. The rest of the participants (20%) indicated that a possible reason for some VILs not approaching the DU was because they did not want to be stigmatised or excluded.

Most of the participants (80%) preferred training of current lecturers in the university than recruiting special educators for VILs. This could be due to current lecturers already having a good knowledge, skill set and teaching experience as compared to newly recruited educators. Naidoo stresses the importance of training lecturers at tertiary institutions to better work with disabled students [8]. All the participants indicated that they collaborated with DUs from other institutions.

## CONCLUSIONS

The purpose of this article was to review the perceptions of DUs at tertiary institutions in SA concerning current challenges faced by VILs in engineering programmes, thereby determining a need for a framework. The challenges indicated by DUs in assisting VILs are lack of budget, lack of available resources, VILs not being trained to use ICT devices, poor infrastructure, and lack of trained lecturers, safety issues as well as logistics. These challenges may adversely affect the participation of VILs in engineering courses. Many of these challenges were noted in the literature review that were published as far back as 2010 [2][15][16]. The findings in this study indicates that the current situation is still very much the same. The question may arise, why has this situation not improved over the past nine years? It may imply that some institutions of higher learning in SA have not adopted an effective framework to guide faculty members to care for VILs in their classes. Developing such a framework for the provision of VILs in engineering may help to promote their inclusion and participation in these courses.

Based on the findings, this study puts forward a few recommendations that should be considered in the proposed framework. To promote a higher level of participation of VILs in tertiary institutions, a more inclusive educational environment could be created that would make their transition from special schools to tertiary institutions easier. This environment could include large-text sign boards to guide the VIL on campus and eliminating hazardous barriers, like uneven surfaces and holes in pavements that could cause the student to sustain physical injuries. There could be awareness programmes for students, educators and institutions about disability issues. DUs should be easily accessible to VILs and be adequately staffed. They should also be included in the strategic decision-making process of the institutions, so that they can better assist with the needs of VILs.

It is recommended that more funding and commitment be secured by the management of educational institutions to train academic staff to handle VILs, and to provide basic facilities (such as easy mobility access around the campus, good infrastructure and adequate safety measures) that could assist in accommodating VILs in engineering. Effective distribution of accessible teaching and learning material, appropriate ICT tools and proper training of students in using accessible resources are further recommendations.

Even though the researchers targeted all public universities of SA, only 25% of the institutions (five out of twenty institutions) responded to the DU questionnaire. However, these responses are more than the studies mentioned in the literature review, where only one or two universities were considered. This increases the likelihood that the confirmed challenges in this study are valid and need to be addressed. These findings will now be used in a larger study that seeks to develop a conceptual framework for the provision of VILs in engineering by using appropriate ICTs. VILs should be encouraged to attend higher education institutions and to complete their studies successfully, in whatever field they desire. An inclusive educational environment must be championed in order to promote equitable access and social justice for all, including for VILs.

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