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Selecting an assistive technology for visually impaired students in higher institution

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Abstract

In higher institutions, many visually impaired students including educators are increasingly challenged with selecting the most appropriate assistive technology for learning and teaching. As a result, few visually impaired students enrol in computing and engineering courses with practical sessions. As the challenges persist, some of the enrolled students drop out of the courses or institutions, and others perform poorly in their academic pursuits. This study was undertaken to examine the factors that influence the selection of assistive technology for visually impaired students. The qualitative approach was employed, and the diffusion of innovation (DOI) theory was used to guide the analysis in examining the influencing factors. The analysis revealed governance framework, contextualisation, and methodology approach as the critical influence factors. These factors have significant implications for improving the academic performance of visually impaired students.

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Keywords: assistive technology, visually impaired, diffusion of innovation, higher institutions, technology selection.

Introduction

In South African higher institutions, many visually impaired students and educators are increasingly challenged when it comes to teaching and learning (Croft, 2020). The challenges get worse for practical classes when students are engaged or assigned practical tasks in their studies. The challenges are either a lack of access to assistive technology for teaching and learning or limited information about the technology, or both. Also, many learners are unaware of how the information can be applied in the use of assistive technology (Beingolea et.al., 2022). This is primarily because they do not have access to assistive technology, a tool that can provide visually impaired students with the ability to seek and use information that can help them participate in their practical classes, independently.

This problem persists despite policies by the South African government, to address the challenges. For example, there is a White Paper on the Rights of Persons with Disabilities (Department of Social Development, 2016). Consequently, many people with disability in higher education, are not prepared adequately to face this new environment (Lourens & Swartz, 2021). We take cognise that a disability may differ from one person to another depending on the condition of an individual. According to McKinney and Swartz (2022), South African higher institutions still lack knowledge and how to handle people with disability, which include the visually impaired within the environment. People with disability need special attention.

Visually impaired has been described as an umbrella term for loss of vision that covers from partially sighted to total blindness (Mboshi, 2019). This study focuses on people who have little to no light perception. People who are visually impaired need even more attention as compared to sighted students in their learning environment. Despite the inclusion of people who are visually impaired in higher institutions, Croft (2020) indicated that these people still experience difficulties in their educational space. In some instances, their learning environment does not provide relevant equipment to support their academic activities. Lourens and Swartz (2020) emphasised that despite the lack of support, students need social coherence to ease their path.

Higher institutions need to have special equipment to assist students in pursuing their careers of choice (Dalton, 2019). This implies those who are visually impaired can be constrained when accessing or exchanging information. Therefore, visually impaired students are challenged within classrooms and the institution environment at large. Thus, various assistive technologies are often sourced by individuals and institutions. Assistive technologies are classified into different types. Hence, the emphasis is on individuals' needs (Hu et al., 2019). Students' performance improves according to the relevant use of technology in their different levels of education. Also, educators are expected to provide support to enable students to achieve their career goals (Van Dijk et al., 2020).

The problem is that many institutions do not have guidelines for selecting assistive technology, for the users (educators and visually impaired students). As a result, few visually impaired students enrol for courses such as computer and engineering that have practical sessions. As the challenges persist, some of the students drop out of the institutions, and others perform poorly in their academic pursuits. This increases the criticality of finding solutions to the problem. This study aims to gain a deeper understanding of the factors that influence the selection and use of assistive technology, for visually impaired students and educators in higher institutions in South Africa.

This paper is organised into six main sections. It begins with an introductory section followed by a review of literature that focuses on the core aspects of this study. In the third section, the theory of diffusion of innovation that underpins the study is discussed. The methodology applied is covered in the fourth section. The analysis and discussion, which revealed the influencing factors are presented in the fifth. Finally, a conclusion is drawn.

Literature review

The section presents a review of the literature related to the study. It focuses on the core aspects of the study, which are visually impaired and assistive technology including the theories that underpin the study.

Visually impaired in teaching and learning

Visually impaired refers to people who are blind or have a significant loss of vision, even with those corrective lenses (Nanjwan et.al., 2019). Vision has an impact on day-to-day life performance, social and education. Visually impaired has been described differently as a loss of vision, which reduces the ability to see in different degrees to total blindness. The reduction of sight may be irreparable others may be corrected using glasses (Naipal & Rampersad, 2018; Matsei & Stofile, 2021). visually impaired and blindness can happen during birth or instantly or over a period because of different diseases.

The focus of higher education is to improve students' skills and knowledge base needed, through teaching and research (Chankseliani et al., 2021). Based on skills education creates employment, social mobility, economic growth, and economic development. Ndebele and Gadisi (2022) stated that the brain connects with vision and in most cases, teaching and learning are through vision. Therefore, students

with visually impaired must adjust and seek alternative means. Vision does not restrict learning however content and practical subjects need more effort and support (Manis et al., 2021). Support services sometimes have limited coordination from the broader teaching and learning initiated by the institutions.

Assistive technology

Assistive technology serves a vital role in fulfilling the information needs of visually impaired people. Assistance technology is described as a tool that is designed to normalise or improve the functionality of any disabled person (Viner et al., 2020). Assistive technology is introduced to enable visually impaired students to participate not only in their education but also within their everyday life routine. Naipal and Rampersad (2018) confirmed that visual impairment adds to the challenges in reading and writing. Thus, visually impaired students need assistive technology to undertake their educational activities within the learning space and enhance their daily lives (Senjam, 2019; Hu et al., 2019). Viner et al. (2020) indicated that visually impaired students require low and high-tech assistive technology to achieve and live a normal life.

However, visually impaired students need high-tech devices for individual needs, especially in practical subjects such as computing. Amin et al. (2021) stated the obstacles faced by visually impaired students which include facilities, the environment itself and human factors from peers to educators. Visually impaired students also have difficulty seeking and accessing information (Alotaibi et al., 2020). According to Du Preez (2019), information activities such as information seeking, searching, sharing and use are prompted by an information need. The assistive technology eases information activities. Information need differs from one person to another. Most information is easily accessed and shared through vision. Schuck (2019) mentioned that technology is needed in the lives of visually impaired students however opportunities are limited to learn how to use technology effectively. It is very seldom to find visually impaired students engaged in using electronic resource centres compared to their peers.

Despite the criticality of assistive technology, it is either not accessible or users are challenged on how to apply it, in South African higher institutions. According to Viner et al. (2020), the need of each student requires assessment, to allocate the most appropriate assistive technology, to improve effective learning methods. Darabont et.al. (2020) suggest that assistive technology can be complex, however, the technology is safe and allows visually impaired people to be self-oriented. The complexity is a persistent challenge that needs a solution. Additionally, few educators are trained to teach with technologies that favour visually impaired students. Also, the factors that influence the training are not empirically known. Selepe and Molelemane (2022) emphasised that educators are not skilled enough to facilitate a class with visually impaired students. Lintangsari and Emaliana (2020) stated that educators need to accommodate and consider visualising the teaching concept for visually impaired students to have a better understanding.

Practical subjects or classes focus more on hands-on skills that students acquire while learning. Thus, Stefik et al. (2019) stated that it is still challenging to include visually impaired students in practical subjects or classes, however, there is a possibility of accessibility through unplugged activities with relevant assistive technologies.

Diffusion of Innovation

Based on the aim, as stated in the introductory section of this paper, the study focuses on how decisions are made and spread in the selection and use of assistive technology for visually impaired students in

higher education. Thus, a socio-technical theory, diffusion of innovation (DOI) was selected to unpin the study. The theory is most appropriate and selected because of its explicit focus on the innovation-decision process, which no other theory seems to focus on (Iyamu, 2021).

The DOI theory focuses on the decision process, and structured communication in the spread of an innovation over a period (Rogers, 2003). Keitany et al. (2020) explained how the theory guides the spread of innovation within an environment. Based on an adoption, the diffusion may gradual process relative to how individuals perceive the concept or innovation. Rogers (2003) described diffusion as a process in the sense that innovation is communicated over time amongst participants. Thus, an innovative message can be transferred slowly or speedily among interested persons or groups, with similar characteristics, to achieve a common goal.

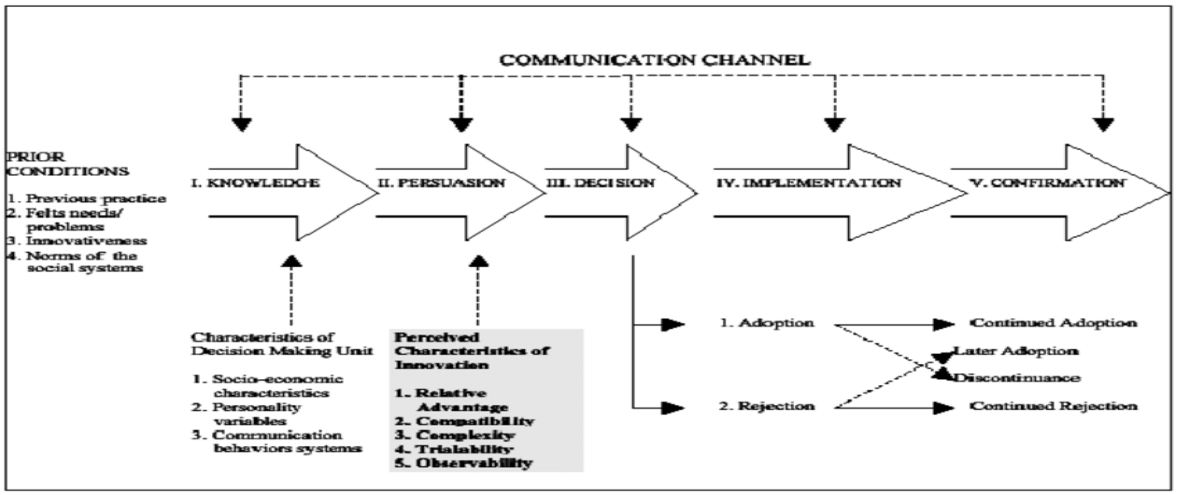

Figure 1: Communication channel (Roger, 2003)

Increasingly, innovations are explored and applied, to fortify and improve activities of teaching and learning in higher institutions. Iyamu (2021) indicated that innovation is not a single act but a process that is initiated by an idea. The idea can manifest from old to new technology. Rogers (2003) proposed four main elements that influence the spread of new ideas in DOI; which are innovation, communication channels, time, and a social system. The elements focus on how new technologies are adopted over time among participants. As shown in Figure 1, the communication channel is embedded with process-oriented components that diffusion of innovation within an environment (Rogers, 2003). These components can ease the process of transition of visually impaired students in practical sessions or classes. The components are five: knowledge, persuasion, decision, implementation, and confirmation (Rogers, 2003), which guide the spread of an innovation.

As the theory that underpins the study, DOI is applied, to gain a deeper insight into how assistive technology is selected and used by visually impaired students, for practical sessions or lecture purposes. Also, the theory helps to examine the process of how students can adapt to change relating to assistive technology.

Research methodology

The interpretive approach was employed, to gather and subjectively analyse the data. Interpretivism is a relationship between the researcher and the subject researched focusing on an understanding of meanings associated with experience, thoughts, views, and feelings of actors' reality (Junjie & Yingxin,

2022). The approach focuses on the social construction of human factors to overrule the method of natural research to come up with different meanings (Saunders et al., 2019). Interpretivism generates knowledge in understanding human experience to come up with a meaning. Omodan (2022) stated that interpretivism is based on the realistic view where the approach is subjective more than the objective perspective. The approach is selected because it is a stance that is associated with the qualitative method (Coates, 2021), which is appropriate for this study. From a subjective perspective, this study sets out to gain an understanding of the factors that influence the selection of assistive technology, for visually impaired students.

Qualitative data were collected consisting of literature, which is peer-reviewed and non-peer-reviewed (Babbie, 2021). Leedy and Ormrod (2021) emphasise that data collection includes any form of documents that can assist in answering research questions. A total of 54 materials were gathered, of which 24 were peer-reviewed and 30 were whitepapers. The whitepapers were authored by vendors, government officials, and others unknown.

The situation is examined using the diffusion of innovation (DOI). In this study, the DOI is applied for two reasons: (1) it is crucial to know the type of assistive technology that is adopted to be for examine the contingency associated with it; and (2) It is significantly valuable, to understand how and why the assistive technology was diffused before examining the strategic alternative or contingency. The DOI is used to (1) understand the decisions process in selecting and adopting the assistive technology, to enable and support visually impaired students; and (2) examine the role of visually impaired students in selecting assistive technology in their practical classes.

Factors influencing the selection of Assistive Technology for visually impaired students

The five constructs of the DOI diffusion innovation process relative advantage, compatibility, complexity, trialability, and observability were used to guide the analysis of the findings. As shown in Figure 2, three critical factors, governance framework, contextualisation, and methodology approach are revealed from the analysis tabulated in the above section. This study justifies its significance to society and the academic domains by highlighting the critical factors that influence the selection of assistive technology for visually impaired students. To the academics, the outcome of the study is intended to advance the method of teaching and learning. It provides a frame that guides educators on how to govern and manage information relating to the adoption and use of assistive technology for visually impaired students when it comes to practical sessions or classes.

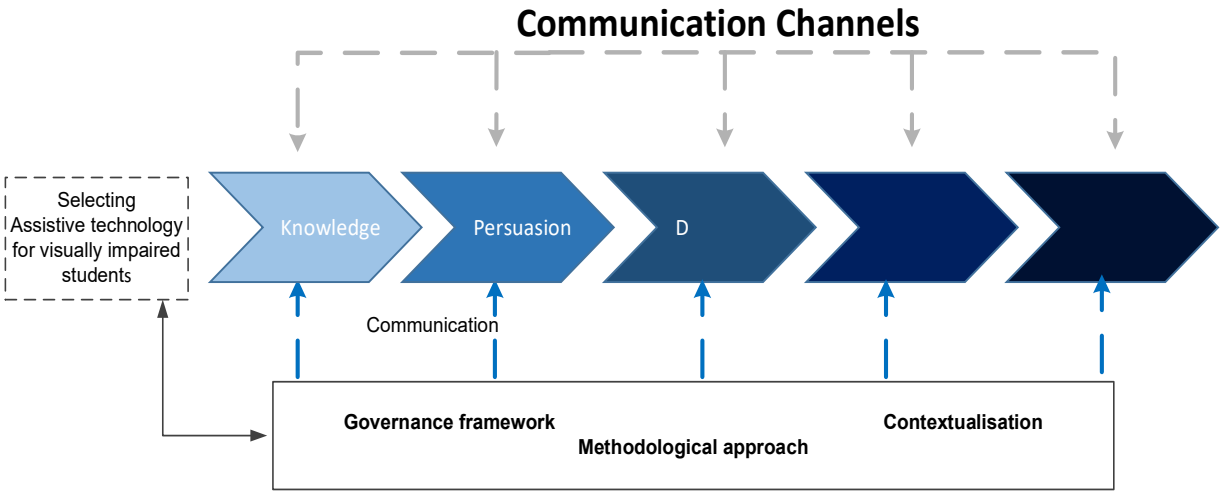

Figure 2: From analysis to findings

Governance framework

Governance framework (GF) helps to define the boundaries from both technology and users' perspectives. Explicitly, the GF outlines the requirements within the set boundaries. The GF is based on knowledge of the existing assistive technologies, including their compatibility, and complexities. Iyamu (2023) explains how governance is used to improve the selection of innovative concepts. According to Prasetyo et al. (2023), governance is an integrated structured continuous cycle based on objects and subjects. Thus, the GF deliverables of the assistive technology for visually impaired students can be developed, implemented, managed, and used.

The GF define and refines the technical and user requirements for the engineering and management of the assistive technology selection. Additionally, the GP is significant because it influences the development of policy guiding the selection of assistive technology, for visually impaired students in a higher institution. Also, the development of a framework stating the usage patterns and subsequent adaptive behaviour of visually impaired students is fundamental to defining the characterisation of the users. This requires communication and interactions between the stakeholders.

Contextualisation

The selection of the assistive technology must be based on relative advantage, contextually. According to Rogers (1995: 212), the relative advantage is "the degree to which an innovation is perceived as being better than the idea it supersedes". An assistive technology must be tested, to a high degree before it is selected for visually impaired students. In DOI, trialability is the extent to which an innovation may be experimented meaning the higher the degree of trialability, the greater the chances of diffusion (Nagra & Gopal, 2014). The experiment is practical and based on the context of both the users (visually impaired students) and the environment (institution). The trialability considers complexity and compatibility with other infrastructure within the environment.

The context provides a guide on how to select, use and manage assistive technology that can be used by both educators and visually impaired students, for practical sessions or class purposes. Relatively, the selected assistive technology must be advantageous for the visually impaired students, in the context of their environments. Relative advantage is analogous to usefulness and based on compatibility with existing infrastructure and processes within context (Nor, Pearson & Ahmad, 2010; Davis, Bagozzi & Warshaw, 1989). This includes how technology is used to source and use information relating to academic practical tasks. Practically, from the factors of influence that would be revealed, it brings a sense of collectiveness among the stakeholders, on how to support visually impaired students in applying assistive technology for learning purposes.

Methodological approach

The methodological approach examines how assistive technology can be selected to fulfil the users' needs, using a step-by-step observable process. This is to ensure that the most appropriate assistive technology is selected, to advance visually impaired students' learning during practical sessions or classes. Pashaeypoor et al. (2016) affirmed that Observability increases the rate of diffusion. Contemporarily, observability constitutes internal and external variables that must be determined by the observers in formulating the methodological approach, for assistive technology selection and use. For example, the technology must be compatible with the environment and relatively advantageous to the users.

Although Rogers (1995, 2003) affirmed that complexity is the degree to which an innovation seems difficult to understand and use, through a methodological approach, the complexity can be dismantled. The methodological approach brings about a manner of an interactive duel in the selection and use of assistive technology for teaching. This enhances confidence and provides students with the skill of being independent by reducing inequality between the sighted and the visually impaired.

Conclusion

This study highlights the critical challenges faced by visually impaired students and educators in institutions of higher learning due to the lack of assistive technology or inappropriate selection of the technology. The findings reveal three fundamental factors governance framework, contextualisation, and methodology approach that can influence the selection of the most appropriate assistive technology. The findings have the potential to address these challenges by enabling a contextualised technology solution for visually impaired students and their environments. Theoretically, the paper is a significant contribution to the existing knowledge because of the limited literature in the areas of assistive technology. From a practice perspective, the paper can form part of guiding materials used to formulate governance for selecting and using assistive technology by visually impaired students.

However, making use of the findings would require significant efforts in terms of communication and interactions between the stakeholders, which include visually impaired students, their parents or guardians, educators, institutions, and vendors. The study has important implications for enrolment of visually impaired students and institutions' policy, highlighting the need for selecting and using the most appropriate assistive technology, to improve the efficiency and effectiveness of their education. However, the study also has some limitations, such as a lack of empirical evidence. Future research should aim to validate the findings through empirical evidence or the use of the case study approach.

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